

Estimates of Trade Dependence of Ukraine: An Indicator of Effectiveness of its Economic Structure and Foreign Economic Activities

O. Borzenko • M. Rubtsova • N. Reznikova • V. Panchenko

Abstract The approach to study the significance of trade relations between countries by analyzing economic vulnerability, economic sensitivity, symmetry and asymmetry of the established economic links is proposed in this article. This approach is adapted to analysis of the trade dependence of Ukraine. The estimated interdependence ratios for Ukraine and its largest trade partners – EU, Russian Federation, post-soviet countries, China, the U.S., and Brazil and India as emerging economies – are compared to the respective ratios of Ukraine's dependence on these countries' markets. The analyzed dynamics of the Ukrainian GDP dependence on the Ukraine's trade partners shows the growing relative weight of the countries that had not played a substantial role in the foreign trade of Ukraine. The proposed approach for estimating the quality of the established trade relations is supposed to contribute to the radical transformation of Ukraine's foreign trade.

Keywords Interdependence - Dependence - Quality Patterns - Ukraine vs. Russia
Progressive disruption but convergence with EU

JEL Classification F14 - F15 - F51 - F62 - O33

1. Introduction

Interdependence should be interpreted in view of the two critical characteristics: sensitivity and vulnerability. Sensitivity refers to direct and primary costs that can be imposed by one of the partner countries by changing interdependent relations between two partner countries. Sensitivity is associated with the severity of losses resulting from unpredictable change. Vulnerability, on the other hand, is conditional for the country's capability to recover after

O. Borzenko¹ (✉), M. Rubtsova², N. Reznikova³, V. Panchenko⁴

¹ Top Research Adviser Institute of Economy and Forecasting NAS, Kiev, Ukraine
e-mail: slozko2003@ukr.net

² PhD (econ.), Associated professor, Associated professor at International Business Department,
Institute for International Relations at Kyiv National Taras Shevchenko University, Ukraine, Kyiv

³ Chair of World Economy and International Economic Relations of the Institute of International
Relations Taras Shevchenko National University Kieve, Ukraine, Kyiv

⁴ Director of Dnipro Development Agency, Dnipro City, Ukraine

losses resulting from a change in the policy of another country. R. Cooper [1] elaborates two conceptual differences between sensitivity and vulnerability, and addresses these concepts as the two parallel definitions to separate forms of interdependence. Interdependence associated with vulnerability refers to the costs that a country has to bear (when the economic relations are disrupted), in order to do without trade transactions with its already former trade partner. These costs are classified in the public costs met by a country to the extent of its capacities, once it could adapt to the new situation.

On the other hand, interdependence associated with sensitivity acts as a tool for short-term corrections of public costs that a government has to impose on foreign policy measures in response to departures from established standards or economic practices. Therefore, while interdependence associated with sensitivity involves the costs related with maintenance of economic relations with another country, interdependence associated with vulnerability refers to the costs required for the disruption of such relations.

Yet, this theoretical modeling cannot solve the problem related to the manifestation of these costs' effects. The concept of interdependence cannot be systematized unless the causal factors behind these benefits or final costs are found out, because it would be too difficult to extract systematically the vulnerability component without understanding the factor causing these costs. In-depth analysis of the most typical variations in cross-country interactions gives reaffirming arguments of the essential modification in the meaning of the dependence phenomenon, caused by endogenous and exogenous factors. Maneuvering between economic vulnerability and sensitivity, between internal and external dependence allows us to interpret the condition of economic interdependence as the intermediate and equidistant case between the two extreme cases of full dependence and full dominance.

The concept of significance refers to the importance of trade relations relative to other trade relations. The significance of trade for one country in bilateral trade relations won't be always similar to its trade partner. For example, in the case of trade relations between Ukraine and the EU, their significance is much higher for Ukraine than for the EU. The key aspect that we are going to emphasize when interpreting the concept of interdependence is symmetry in cross-country relations. It is argued that the significance of economic relations can vary in the dyad of countries, whereas the symmetry indicates the relative equality of their economic interdependence. A potential case of the ideal symmetry is when both countries are equally dependent on each other. The ideal asymmetry occurs when one country is fully dependent on its trade partner, but this partner is almost independent on the former country. Yet, considering that each country's dependency is a function of the total exports and imports between them, and this total does not equal zero for one country in the dyad, the total won't be zero for the other country as well. Therefore, the case when one country is absolutely independent from the other country can only occur when the other country is also fully independent.

The interdependence can be estimated in the three phases. First, it establishes the relative importance of bilateral trade relations for each of the countries compared with the amounts of their total trade (in both cases imports and exports are accounted for). For two countries (Country i and Country j), $TradeShare_{ij}$ measures the ratio of economic exchange between countries i and j , and the exchange of County i with all the partners.

At the first phase, the ratio of economic exchange for a dyad of countries is estimated by the formula:

$$TradeShare_{ij} = \frac{DyadicTrade_{ij}}{TotalTrade_i} \quad (1)$$

Where $DyadicTrade_{ij}$ is the total imports and exports between Country i and Country j , $TotalTrade_i$ is the total imports and exports of Country i with all the partners.

This ratio can range between 0 and 1, with 0 indicating absence of imports or exports between Country i and Country j , and 1 showing that Country i has international trade relations only with Country j . Using the basic share of trade derived by (1), the significance of interdependence between two countries can be estimated by multiplying the share of $TradeShare_{ij}$ for both countries and taking square root from the product by the formula:

$$Salience_{ij} = \sqrt{TradeShare_{ij} \cdot TradeShare_{ji}} \quad (2)$$

The low level of dependence for one country decreases the overall significance of the relations in a dyad of countries. The overall significance for each of the two countries can be estimated by use of $TradeShare_{ij}$ for each country.

At the second phase, the symmetry of trade relations between Country i and Country j is estimated by the formula:

$$Symmetry_{ij} = 1 - |TradeShare_{ij} - TradeShare_{ji}| \quad (3)$$

When the symmetry estimate is 1, this means that countries i and j are absolutely symmetrical. When it approaches 0, it will be an indication to as explicitly asymmetrical relations between them as may be. Like the indicator of significance, the indicator of symmetry is valid for both countries. At the third phase, these two indicators of economic relations are consolidated into one, to estimate the interdependency indicator:

$$Interdependece_{ij} = Salience_{ij} \cdot Symmetry_{ij} \quad (4)$$

The low level of dependence for one of the countries decreases the overall significance of the relations in a dyad. The overall significance for a dyad can be estimated by use of $TradeShare_{ij}$ for each country.

The interdependence phenomenon results from interactions of the two indicators. The interdependence will be the highest, when both countries are fully reliant on each other in the trade, i. e. when both indicators, of the significance and of the symmetry, are close to 1. Lower estimates for the significance and for the symmetry decrease the overall level of interdependence for a dyad of countries, whereas high estimates of the two indicators are required to have the highest levels of interdependence.

The reliability of the obtained data is proposed to test by estimating the dependence of Country i on Country j on Gross Domestic Product (GDP) of Country i :

$$Depend_{ij,t} = \frac{X_{ij,t} + M_{ij,t}}{GDP_{i,t}} \quad (5)$$

where $Depend_{ij,t}$ is the estimate of dependence of Country i on Country j , $X_{ij,t}$ is the exports from Country i to Country j in the moment of time t , and $M_{ij,t}$ is the imports to Country i from Country j in the moment of time t .

The only essential difference between this indicator and the three-phase estimation of interdependence is use of GDP in denominator.

2. Estimating $TradeShare_{ij}$ for Ukraine and its selected trade partners

Estimation of $TradeShare_{ij}$ for Ukraine and its selected trade partners – EU, Russian Federation, post-soviet countries, China, the U.S., and the group of countries consisting of Brazil and India – allows for the following conclusions (see Table 1, Table 2, Figure 1):

1. Trade relations of Ukraine with the EU and the Russian Federation can be referred to as significant and indicative of the vulnerability of the Ukrainian economy to their dynamics.
2. The relative vulnerability of trade relations between Ukraine and the Russian Federation have been gradually decreasing.
3. The trade interdependence of Ukraine and post-soviet countries features high volatility and the decreasing vulnerability.
4. Regarding the interrelations of Ukraine and the EU, the period from 2000 to 2008 stands out as one demonstrating most clearly the growing share of the EU in the total exports and imports of Ukraine.
5. Ukrainian-American trade relations do not feature dynamics.
6. Joining of Ukraine to WTO has not made Ukraine's trade relations with principal partners less vulnerable.
7. The dynamics of interdependence ratios derived for the Ukraine – China dyad shows the increasing vulnerability of their trade relations.

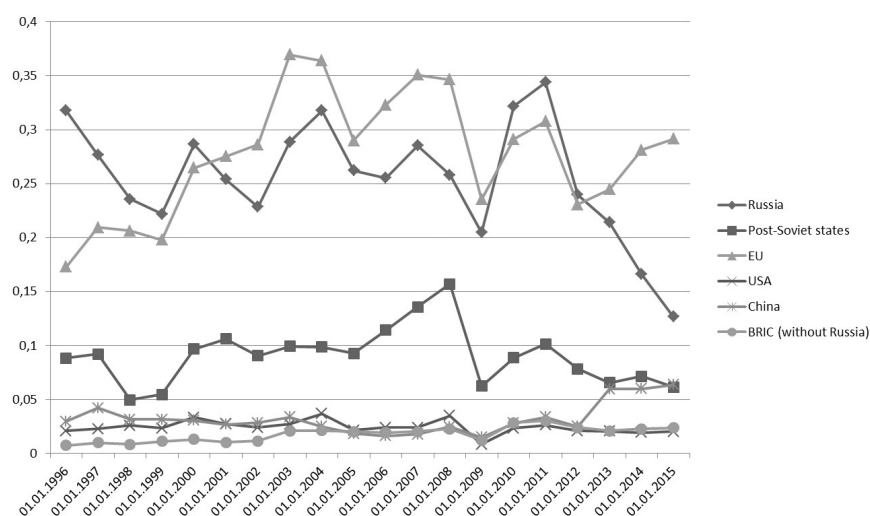
Table 1 Ratios of interdependence between Ukraine and its largest trade partners

Date	TradeShare _{ij}					
	Russian Fed.	Post-soviet countries	EU	The U.S.	China	BRIC (not incl. Russian Fed.)
01.01.1996	0.318	0.088	0.173	0.021	0.030	0.007
01.01.1997	0.277	0.092	0.209	0.023	0.042	0.010
01.01.1998	0.236	0.049	0.206	0.026	0.031	0.008
01.01.1999	0.222	0.054	0.198	0.023	0.031	0.011
01.01.2000	0.287	0.097	0.265	0.033	0.030	0.013
01.01.2001	0.254	0.106	0.275	0.027	0.027	0.010
01.01.2002	0.229	0.091	0.286	0.024	0.028	0.011
01.01.2003	0.289	0.099	0.369	0.027	0.033	0.021
01.01.2004	0.318	0.098	0.364	0.037	0.025	0.021
01.01.2005	0.262	0.093	0.290	0.021	0.018	0.020
01.01.2006	0.255	0.114	0.323	0.024	0.016	0.019
01.01.2007	0.285	0.136	0.351	0.024	0.018	0.020
01.01.2008	0.258	0.157	0.347	0.035	0.025	0.022
01.01.2009	0.205	0.062	0.235	0.008	0.015	0.012
01.01.2010	0.322	0.089	0.291	0.023	0.028	0.028
01.01.2011	0.344	0.101	0.308	0.026	0.034	0.030
01.01.2012	0.240	0.078	0.231	0.021	0.025	0.024
01.01.2013	0.214	0.065	0.245	0.020	0.059	0.021
01.01.2014	0.166	0.071	0.281	0.019	0.060	0.023
01.01.2015	0.127	0.061	0.291	0.020	0.063	0.024

Source: estimated and constructed by the author by data [2; 3; 4]

The analysis of data for 2015 shows the continually decreasing trade dependence of Ukraine on the Russian Federation due to the sanctions (0.127 in 2015; 0.214 in 2013, against 0.318 in 1996); in parallel, estimates of trade dependence for Ukraine in the posts-crisis year of 2009 marking the shrinking global demand show that markets in post-soviet countries could adapt to the consumption of Ukrainian products.

Figure 1 Dynamics of dependence of Ukrainian GDP on its trade partners



Source: estimated and constructed by the author by data [2; 3; 4]

Beginning with 2012, the dependence of Ukraine on the Russian Federation and post-soviet countries was notably decreasing, contrary to the markets of the EU and China, which, given the high volatility (turning points of growths and recessions), could retain stability. In parallel, the decreasing dependence of Ukraine on the main trade partners in 2012–2015 is an indication to the growing relative weight of the third countries, which had not a substantial role in the Ukraine's foreign trade. It is true that Egypt or Turkey, which figures of trade with Ukraine are beyond the scope of our analysis, could increase their shares in the foreign trade with Ukraine beginning with 2014.

Table 2 Estimation of correlation between indicators of economic exchange between Ukraine and other countries (TradeShareij, by use of pair correlation coefficients)

Estimates of economic exchange between Ukraine and other countries (TradeShareij)						GDP	
Russian Fed.	Post-soviet countries	EU	U.S.	China	BRIC (not incl. Russian Fed.)	thousand USD	per capita, USD.
1.000	0.447	0.550	0.615	0.374	0.406	-0.359	-0.355
0.447	1.000	0.731	0.528	-0.227	0.376	0.004	0.004
0.550	0.731	1.000	0.678	-0.135	0.610	-0.132	-0.122
0.615	0.528	0.678	1.000	0.273	0.195	-0.447	-0.441

Estimates of economic exchange between Ukraine and other countries (TradeShare _{ij})						GDP	
Russian Fed.	Post-soviet countries	EU	U.S.	China	BRIC (not incl. Russian Fed.)	thousand USD	per capita, USD.
0.406	0.376	0.610	0.195	-0.180	1.000	0.534	0.545
-0.359	0.004	-0.132	-0.447	-0.396	0.534	1.000	1.000
-0.355	0.004	-0.122	-0.441	-0.395	0.545	1.000	1.000

Source: estimated and constructed by the author by data [2; 3; 4]

3. Estimating $Depend_{ij,t}$ for Ukraine and its selected trade partners

Estimation of $Depend_{ij,t}$ for Ukraine and its selected trade partners – EU, Russian Federation, post-soviet countries, China, the U.S., and the group of countries consisting of Brazil, China and India – allows for the following conclusions (see Table 3):

- The dependence of the Ukrainian GDP growth on trade relations of the Russian Federation has decreased; interrelations between Ukraine and the Russian Federation have five explicit phases of economic activity, correlating closely with the political climate in Ukraine.
- The contribution of post-soviet countries in the Ukrainian GDP growth has rapidly decreased (dependence ratio 0.114 as of 1 January 2008, against 0.062 as of 1 January 2016).
- Although the impact of trade relations between Ukraine and EU countries on growth of the Ukrainian GDP features relative stability (dependence ratio 0.319 for 2003; 0.254 for 2006; 0.259 for 2011), in 2015 EU countries (with a dependence ratio of 0.295 recorded for the second time after 2000, the year when the significance of trade relations with this group of countries was dominant for the Ukrainian GDP dynamics) became the trade partner for Ukraine with the most essential impact on the dynamics of the Ukrainian GDP. However, given that the indicators of dependence of the Ukrainian trade on EU countries are analyzed considering the waves of EU enlargement (enlarging significantly the number of EU members), the change in Ukraine – EU relations is not explicit.
- Given that China joined the top three trade partners of Ukraine by the results of 2016, its impact on the dynamics of the Ukrainian GDP gives evidence of gradual transformations in China – Ukraine relations: its nearly zero impact on the Ukrainian GDP at early phases of the Ukraine's state building (0.019 dependence ratio as of 1 January 1996) was gradually increasing to catch up with the dependence estimates for the group of post-soviet countries, with which the significance of trade was rapidly falling (dependence ratio 0.064 for China and 0.062 for the group of post-soviet countries as of 1 January 2016, against 0.026 for China and 0.090 for the group of post-soviet countries as of 1 January 2006).

Table 3 Ratios of dependence of Ukrainian GDP growth on trade relations with Ukraine's partners

	$Depend_{ij,t}$					Anchor countries (Brazil, China, India)
	Russian Fed.	Post-soviet countries	EU	U.S.	China	
01.01.1996	0.312	0.087	0.170	0.021	0.019	0.007
01.01.1997	0.223	0.074	0.169	0.018	0.024	0.008
01.01.1998	0.230	0.048	0.201	0.025	0.020	0.008

	<i>Depend_{ij,t}</i>					
	Russian Fed.	Post-soviet countries	EU	U.S.	China	Anchor countries (Brazil, China, India)
01.01.2000	0.289	0.097	0.266	0.034	0.042	0.013
01.01.2001	0.241	0.101	0.262	0.026	0.019	0.010
01.01.2002	0.216	0.086	0.271	0.023	0.022	0.011
01.01.2003	0.249	0.086	0.319	0.023	0.029	0.018
01.01.2004	0.268	0.083	0.307	0.031	0.023	0.018
01.01.2005	0.228	0.081	0.252	0.019	0.028	0.017
01.01.2006	0.201	0.090	0.254	0.019	0.026	0.015
01.01.2007	0.198	0.094	0.244	0.017	0.025	0.014
01.01.2008	0.187	0.114	0.251	0.025	0.033	0.016
01.01.2009	0.179	0.094	0.205	0.013	0.034	0.018
01.01.2010	0.252	0.069	0.228	0.018	0.043	0.022
01.01.2011	0.289	0.085	0.259	0.022	0.050	0.025
01.01.2012	0.247	0.081	0.237	0.021	0.053	0.025
01.01.2013	0.201	0.061	0.230	0.019	0.056	0.019
01.01.2014	0.171	0.073	0.289	0.020	0.061	0.023
01.01.2015	0.128	0.062	0.295	0.020	0.064	0.024

Source: estimated and constructed by the author by data [2; 3; 4]

Given the strong impact from the U.S. on shaping the geopolitical vector of Ukraine's development, the existing trade relations between the two countries indicate the unchanged positions (dependence ratio 0.021 as of 1996 and 0.020 as of 2015).

Yet, the estimates of $TradeShare_{ij}$ $Depend_{ij,t}$ demonstrate the quality of the economic exchange between Ukraine and its partners in a more representative way, which allows for the following statements:

- the structure of Ukraine's foreign trade with the Russian Federation and, to a larger extent, with the U.S. is too ineffective;
- while the impact of Ukraine's foreign trade with the EU on the Ukrainian GDP changed from negative (-0.132 in 2012) to positive (0.204), in the case of foreign trade with the Russian Federation (-0.359) and the U.S. (-0.447) the situation is too bad.;
- the impact of Ukraine's foreign economic relations with developing countries (Brazil, India, China) on the Ukrainian GDP growth is positive (0.534);
- it should be noted that Ukraine's membership in WTO was of no effect for the trade dependence of Ukraine on its principal partners;
- high estimates of dependence show insufficient structural diversification of the Ukrainian economy, disregard to the need for the import substitution policy implementation, which would change commodity positions of the Ukrainian exports and imports.

In the case of Ukraine (given its economic dependence on EU (0.295 as of the end of 2015) and the Russian Federation (0.128 as of the end of 2015, against 0.217 as of the end of 2013)), the estimates give evidence of the skewed trade structure and orientation on the group of selected partners.

4. Analysis and discussion of results.

We have built the equation of regression for the total exports and imports by country, which looks representative.

$$Y_i = -2,758X_6 + 4,922X_9 + 2,042X_{12} + 16,524X_{15} - 35,289X_{18} + 23,273X_{21} + 54687205 \quad (6)$$

coefficient of determination $R^2 = 0,940$;

where X_6 – total imports and exports with Russian Federation;

X_9 – total imports and exports with post-soviet countries (not including Russian Federation);

X_{12} – total imports and exports with EU countries;

X_{15} – total imports and exports with China;

X_{18} – total imports and exports with the U.S.;

X_{21} – total imports and exports with Brazil, China, and India.

The results lead to the following conclusions:

- Ukraine's dependence on foreign economic relations with the Russian Federation has a negative impact on the growth rates of the Ukrainian GDP (growth in the trade relations by 1000 UAH reduces the GDP by 2758 UAH);
- Ukraine's dependence on foreign economic relations with the U.S. has an extremely negative impact on the growth rates of the Ukrainian GDP (growth in the trade relations by 1000 UAH reduces the GDP by 35289 UAH);
- Ukraine's dependence on foreign economic relations with China has a positive impact on the growth rates of the Ukrainian GDP (growth in the trade relations by 1000 UAH increases the GDP by 16524 UAH);
- Ukraine's dependence on foreign economic relations with post-soviet countries has a positive impact on the growth rates of the Ukrainian GDP (growth in the trade relations by 1000 UAH increases the GDP by 4922 UAH);
- Ukraine's dependence on foreign economic relations with EU countries has a positive impact on the growth rates of the Ukrainian GDP (growth in the trade relations by 1000 UAH increases the GDP by 2042 UAH);
- Trade leaders with positive impact on the growth rates of the Ukrainian GDP (growth worth of 23273 UAH per each 1000 UAH) are Brazil, China, and India.

5. Summary and conclusion

1. The proposed methodology of estimating the indicators of dependence, interdependence, as well as of symmetry, sensitivity and vulnerability of interrelations between partner countries can be useful in analyzing the established relations, in order to find the dynamics of change in the character of relations between the partner countries that differ from each other by indicators of economic capacity, and between the partner countries with similar economic structures. However, it should be born in mind that the import substitution policy or a policy like re-shoring that will inevitably change its economic structure and, therefore, the structure of its demand for goods proposed by the global market, when pursued by one of the partner countries, will have a substantial impact on the quality of the established relations and gradually transform them towards either the lesser asymmetry (when the import substitution policy is adopted by the country that is the outsider of relations) or more explicit asymmetries (when the re-shoring policy is adopted by the country that is the leader of relations).

2. The lesser diversified is the economic structure of a country and the more similar is the structure of its partner countries, the more stable are the relations. Accordingly, if even the trade between such partner countries shrinks, the quality of their relations will remain unchanged, with the implicit asymmetric or symmetric dependence. Furthermore, changes tend to be mutual if even asymmetric relations are preserved.
3. The decreasing interdependence of partner countries, along with establishing more diversified trade relations and/or re-orienting on production of alternative goods/services, and with the respective growth in exports, is a signal of the country's economic development.
4. A growth in interdependence of partner countries' economies can be caused by the symmetrically increased demand for goods that they offer, if even the technological gaps between these countries are preserved. For example, the growing technology imports by one of the partner countries may be accompanied by the symmetric growth in its exports of minerals to the market of its partner country. The quality of such trade relations can, therefore, hardly be determined without a detailed study of the commodity structure of exports and imports.
5. Dynamics of dependence-based cross-country relations are effected by not only endogenous factors (economic structure, demand structure, macroeconomic stability in a country), but by factors of exogenous origin (global economic growth rate, global commodity markets conjuncture, conditions of access to capital markets and intellectual property markets etc.). When GDP in one of the partner countries shows substantial growth, absence of rapid change in the indicators of its trade relations with selected countries cannot be evidence of the relations decline.
6. The Ukrainian GDP, GDP per capita in particular, is dependent on external trade, which is confirmed by the estimations (the correlation coefficient is 0.993). Ukraine, as a small open economy, demonstrates classical dependence on external markets: the correlation coefficient did not change in 1996–2012 and 1996–2015 (0.994 compared with 0.993), which does not show any structural change in the Ukrainian economy. Higher degree of diversification in the Ukrainian economy and higher capacity of the domestic market due to the increasing solvency of the population have to be the key orientations.
7. The computed estimates give clear evidence of the need for imports regulation, in order to optimize their structure and scopes.
8. Foreign trade relations of Ukraine are based on interdependence, characterized by sensibility in relations with all its trade partners, except for Russian Federations, with which Ukraine has the interdependence associated with vulnerability, because it refers to the intended disruption of the existing relations and minimization of the Russia's role as exporter and importer, being Russia more and more asymmetric with Ukraine and facing a deep economic slowdown, a part the military building-up, the same mistake done in the Sixties and Seventies as former Soviet Union. History had apparently not given any learning to Moscow on how to promote growth and competitiveness.
9. In the case of Ukraine (given its economic dependence on EU (0.295 as of the end of 2015) and Russian Federation (0.128 as of the end of 2015, against 0.217 as of the end of 2013)), the estimates give evidence of the skewed trade structure and orientation on the group of selected partners.
10. Although the impact of trade relations between Ukraine and EU countries on growth of the Ukrainian GDP features relative stability (dependence ratio 0.319 for 2003; 0.254 for 2006; 0.259 for 2011), in 2015 EU countries (with dependence ratio of 0.295 recorded for the second time after 2000, the year when the significance of trade relations with this group

of countries was dominant for the Ukrainian GDP dynamics) became the trade partner for Ukraine with the most essential impact on the dynamics of the Ukrainian GDP. However, given that the indicators of dependence of the Ukrainian trade on EU countries are analyzed considering the waves of EU enlargement (enlarging significantly the number of EU members), the change in Ukraine – EU relations is not explicit.

11. The existence of the large shadow economy sector in one of the partner countries causes serious errors in estimations.
12. Considering the already built economic capacities and the industrial structure of Ukraine, it should be noted, that Ukraine, intending to integrate in the global market that has undergone the powerful globalization processes aiming to reconcile the interests of international value added chains, faces objective challenges. We believe that Ukraine needs to diversify the foreign economic relations in five mainstream directions: technological, financial, infrastructural, structural and diplomatic.

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