INFLUENCE OF INTERNAL AND EXTERNAL FACTORS ON THE STRUCTURAL CHANGES OF NATIONAL ECONOMY: AN EXAMPLE OF UKRAINE

Uliana NIKONENKO [1], Olena KHALINA [2], Tanina KAZYUK [3], Viktor PALIUKH [4], Serhiy SHEVCHENKO [5]

[1,2]Faculty of Media Communications and Entrepreneurship, Ukrainian Academy of Printing, Lviv, Ukraine
[3]National Academy for Public Administration under the President of Ukraine, Lviv, Ukraine
[4]National University of Civil Protection of Ukraine, Kharkiv, Ukraine
[5]Lviv Regional Institute for Public Administration, National Academy for Public Administration under the President of Ukraine, Lviv, Ukraine

Abstract. *Purpose* – the purpose of our article is to study structural changes in the national economy using a portfolio model of sectors with different returns and, on this basis, processing the methodology for identifying the current state and instrumental factors of economic policy.

Research methodology – the methodology of empirical research includes methods of grouping, abstraction, comparison, systems analysis, synthesis and generalization, graphical methods and regression analysis. To analyze the nature of the relationship between the index of structural changes and the dynamics of GDP, which determines the comparative profitability of the resource and non-resource sectors and the current position of the current structure relative to the equilibrium value, we used error-corrected models (ECMs).

Findings – using regression models with error correction, a favourable long- and short-term relationship between structural changes in favour of non-resource exports and Ukraine's GDP has been empirically confirmed. Using the index of structural changes, considering the ratio of raw materials and non-raw materials exports, the necessity of applying administrative measures is substantiated.

Research limitations – the study concerned mainly the national economy of Ukraine, but in the future, attention should be paid to the application of the results of our study in other countries of Eastern Europe. In the future, the results obtained can be adapted for other countries of the world. The research was based on the use of specific mathematical methods, and not all mathematical possibilities were used.

Practical implications – the model can be used in the practical activities of state economic structures In the future, it is possible to change key indicators and further expand the field of use of the model.

Originality/Value – the novelty of the study lies in the development of a methodology for identifying the current state and instrumental factors of economic policy that can speed up economic growth based on favourable structural shifts (in favour of the non-resource export sector).

Keywords: raw materials sector, exports, structural changes, terms of trade, exchange rate.

JEL Classification: D51, F63, E60.

*Corresponding author. E-mail: *journaltm@ukr.net*

Introduction

The aim of this work is to study the structural changes in the Ukrainian economy using a portfolio model of sectors (raw and non-raw materials) and, on this basis, processing the methodology for identifying the current state and instrumental factors of economic policy, which provides for three stages:

1) the choice of the structural equilibrium index, since certain industries combine raw materials and non-raw materials;

2) identification of the structural state of the economy;

3) an assessment of the factors of economic policy, capable of accelerating economic growth based on favorable structural changes.

The research task is to explain the structural changes in the Ukrainian economy using a sectoral model with two sectors – raw materials and non-raw materials. For this we use the index of structural equilibrium (structural change). This is important, because certain industries combine raw materials and non-raw materials. For example, this applies to metallurgy. A practical substitute for the "real" structural equilibrium index can be an index based on the structure of exports. In fact, there is no reason to believe that the "real" and export structures of the economy are significantly different. Our next step is to identify the structural state of the economy. We are talking about the nature of the relationship between the selected structural index and the dynamics of GDP, which determines the comparative profitability of the raw materials and non-resource sectors and the current position of the current structure relative to the equilibrium value. In such a context, error correction models (ECMs) provide a convenient toolkit. The final stage is the assessment of economic policy factors that can accelerate economic growth based on favorable structural shifts. First, we are talking about a standard set of tools for fiscal and monetary policy, as well as the problem of choosing the exchange rate. In a broader sense, the set of independent variables should contain variables that characterize the quality of economic policy and the scale of institutional change (error correction models – ECMs).

In this article, we investigate the structural changes of the national economy, which mean qualitative changes in the structure of domestic exports, taking into account the above factors, which will increase the level of GDP. It is advisable to stimulate structural changes in favor of the non-resource sector (non-resource exports) by strengthening the monetary unit, attracting foreign direct investment and limited government intervention, primarily to prevent the transfer of resources to the raw materials sector (infrastructure modernization, human capital development). It is interesting that the feasibility of the policy of administrative incentives for the transfer of production resources to the non-resource sector only increases in the event of structural shocks. In particular, this can be expected from a sustained deterioration in the terms of trade in world commodity markets. A powerful obstacle to such a development of events can be the inflow of foreign investment, because in this case, the incentives for internal redistribution of resources in favor of the raw materials sector are offset by the increased profitability of foreign investment in the country-raw materials exporter compared to the host country. The instrumental factor is the possibility of using the "underestimated" labour force and other advantages, which, possibly, are associated with the availability of raw materials.

1. Literature review

It is necessary to assess the export orientation of the Ukrainian economy at the present stage from the standpoint of the well-known hypothesis of the "life cycle of industry" proposed by the American economist J. Cornwell (1977). According to this theory, economic growth begins with the export of raw materials. Subsequently, income growth and technological changes in traditional industries modifiesthe structure of the economy in favor of technology sectors. The main macroeconomic indicators of such changes are growth in: 1) final domestic consumption in GDP and 2) the share of high-tech products in total exports (Wei et al., 2019). The key element of the industrial cycle hypothesis is the formation of net savings with added value created in export industries as a source of financing for economic restructuring (Ertz & Leblanc-Proulx, 2018).

Such scientists as Danylchuk et al. (2019) and Kazunobu (2017), based in their works on the existing model of three sectors, investigated the main structural changes that occur in the national economy of Ukraine, while highlighting and focusing on the importance of separating external and internal factors of influence on the main indicators of the national economy.

The increase in employment can be taken as a criterion of optimal economic policy, does not contradict the widespread perception of the Ukrainian economy which is characterized by an excess oflabour in comparison with capital. In particular, Korablin (2017), Kiselakova et al. (2018), Koziuk (2018a, 2018b), Braun and Toth (2020), Antoniuk (2017) and Sijabat (2019) argue that the share of Ukraine in the global labor force (0.65%) is 5–8 times higher than the share in the gross accumulation of global capital (0.08%) and the production of world GDP (0.12%) testifies in favor of the dominance of labor-intensive, not too technological and capital-intensive industries.

Experts Shynkaruk et al. (2015) and Ginevicius et al. (2020) also believe that the structure of employment in the Ukrainian economy is not optimal, does not meet the requirements of a post-industrial society and characterizes the processes of labour de-industrialization. The domestic service sector is primarily trade, hotel and restaurant business, although recent employment in the information and communication sector has been growing (Holian, 2016).

In general, the position of Vashkiv (2017) and Cui et al. (2019) is logical, which believes that the analysis of sectoral structural shifts significantly benefits, if not limited to the share of each of the sectors in GDP, but also to study the share of employed workers in each of them. Based on this assumption, we formalized the main relationships between the raw materials and non-resource sectors.

At the same time, despite a large number of publications indicating the feasibility of structural shifts in favor of the non-resource sector for a specific Ukrainian case, there is a lack of empirical estimates of 1) the impact of the structural change index on the dynamics of Ukraine's GDP as a country-exporter of raw materials, 2) economic policies that can accelerate economic growth based on favorable structural changes.

2. Theoretical model

To explain the structural changes in the national economy, it is appropriate to use a sectoral model with two sectors – raw materials and non-raw materials (Nikonenko, 2018). Both sectors compete for labour and investment, are characterized by free movement of resources, and can export their products without hindrance.

The main functional dependencies are as follows Equations (1)–(6):

$$Q_t^T = \alpha L_t^T + (1-\alpha)K_t^T + (1-\gamma)g_t + (1-\eta)F_t + (1-\rho)CA_t -$$
$$b_1\left[E_t L_{t+1}^T - \bar{L}_t^T\right] - a_2\left[E_t K_{t+1}^T - \bar{K}_t^T\right] + \xi_t; \tag{1}$$

$$Q_t^S = \beta L_t^S + (1-\beta)K_t^S + \gamma g_t + \eta F_t + \rho CA_t -$$
$$a_1\left[E_t L_{t+1}^S - \bar{L}_t^S\right] - a_2\left[E_t K_{t+1}^S - \bar{K}_t^S\right] + \varepsilon_t; \tag{2}$$

$$P_t Y_t = (1-\varphi)(E_t P_t^*)Q_t^S + \varphi P_t Q_t^T; \tag{3}$$

$$(1-\varphi)(E_t P_t^*)Q_t^S = \varphi P_t Q_t^T; \tag{4}$$

$$g_t\left[\gamma E_t P_t^* + (1-\gamma)P_t\right] = \tau(P_t Y_t); \tag{5}$$

$$F_t = CA_t\left(\frac{E_t P^*}{P_t}, Y, Y^*\right)_t, \tag{6}$$

where Q_t^S and Q_t^T, L_t^S and $_{\Delta OP}$, K_t^S and K_t^T – production volumes, employment and means of capital in the raw and non-raw (technological) sectors, respectively,

$E_t L_{t+1}^S$ and $E_t K_{t+1}^S$, $E_t L_{t+1}^T$ and $E_t K_{t+1}^T$ – employment expectations and investment volumes in the raw materials and non-resource (technological) sectors,

$\bar{L}_t^S$ and $\bar{K}_t^S$, $\bar{L}_t^T$ and $\bar{K}_t^T$ – equilibrium values of labour and capital in the raw materials and non-resource (technological) sectors, respectively,

g_t – budget balance,

F_t – volumes of foreign investments,

P_t^* and P_t – the level of prices for raw materials and technological goods, respectively,

E_t – nominal exchange rate (value of foreign currency in the national currency),

Y_t – income (gross domestic product),

τ – share of tax revenues in GDP.

Equations (1) and (2) describe the production function in the commodity and non-commodity sectors, respectively. Production volumes depend on labour and capital inputs, government spending, foreign investment, and overseas demand. Correction mechanisms in the labour and financial resources markets provide that in case of expectations of excess sectoral employment and reinvestment in physical capital, there will be a corrective decrease in employment and investment. It can be conditionally assumed that the share of labour force prevails in the non-resource sector $(\alpha > 1-\alpha)$, while the opposite relationship is observed in the commodity sector $(\beta < 1-\beta)$.

Government spending and foreign investment are divided between both sectors – raw materials and non-resource, and the corresponding ratio is determined by the coefficients γ and η. For simplicity, the current account balance is assumed to be symmetric in both sec-

tors – Q^T and Q^S, although in a more general case, the balance of exports-imports may be individual for each of the sectors.

Equation (3) provides an expression for income (GDP) in the prices of goods in the non-resource sector. The value of commodity products is determined by world market prices and the exchange rate. The devaluation of the monetary unit creates incentives in favour of the commodity sector. The coefficient ϕ characterises the non-price component of structural changes and may reflect the characteristics of the institutional environment. Preferences in favour of the non-resource sector (this implies an increase in values ϕ) can neutralise the impact of both the rise in prices for raw materials on world markets and the devaluation of the monetary unit. The strengthening of the monetary unit in response to the rise in prices for raw materials will have a similar impact.

Equation (4) defines the sectoral equilibrium condition when price and non-price factors do not create advantages in favour of one sector. This is logical in the absence of institutional barriers to employment and investment in both sectors.

Equation (5) defines the budget constraint. It is assumed that tax revenues $\tau(P_t Y_t)$ suffice to finance government spending in the primary and non-primary sectors.

Equation (6) defines the balance of payments with equilibrium. In a somewhat simplified way, the current account balance is balanced by the inflow of foreign capital. The functional dependencies of the current account are defined in a standard way, namely: this indicator improves in the event of a decrease in the exchange rate and an increase in the income of trading partner countries; the opposite effect is an increase in own GDP.

Taking into account the equilibrium condition (Equation (5)), from Equations (1) and (2) for the equilibrium state, we obtain that Equation (7):

$$
\begin{aligned}
L^* = \frac{1}{\phi \alpha P - (1-\phi)\beta E_t P_t^*} \Big\{ & \Big[(1-\phi)(1-\beta)E_t P_t^* - \phi(1-\alpha)P_t \Big] K^* + \\
& \Big[(1-\phi)\gamma E_t P_t^* - \phi(1-\gamma)P_t \Big] g_t + \Big[(1-\phi)\eta E_t P_t^* - \phi(1-\eta)P_t \Big] F_t + \\
& \Big[(1-\phi)\rho E_t P_t^* - \phi(1-\rho)P_t \Big] CA_t + \varepsilon_t - \xi \Big\},
\end{aligned}
\tag{7}
$$

where L^* and K^* – are the equilibrium values of the means of labour and capital.

It is not difficult to find a condition for the implementation of structural changes in favor of the non-resource sector, providing for an increase in the exchange rate Equation (8):

$$
\begin{aligned}
\frac{\partial L^*}{\partial \left(\dfrac{P}{E_t P_t^*} \right)} = \frac{1}{\left(\phi \alpha \left(\dfrac{P}{E_t P_t^*} \right) - (1-\phi)\beta \right)} \Big\{ & \Big[(1-\phi)(1-\beta) - \phi(1-\alpha) \Big] K^* + \\
& \Big[(1-\phi)\gamma - \phi(1-\gamma) \Big] g_t + \Big[(1-\phi)\eta - \phi(1-\eta) \Big] F_t + \\
& \Big[(1-\phi)\rho - \phi(1-\rho) \Big] CA_t + \varepsilon_t - \xi_t \Big\}.
\end{aligned}
\tag{8}
$$

A fairly high value $1-\beta$, combined with a low value $1-\alpha$ and low share of non-primary goods in GDP, provides investment in physical favourable capital when the share of non-primary goods increases. Low value ϕ enhances the corresponding stimulus for government spending, foreign investment and net exports.

The main ideas for econometric modeling: to investigate the nature of the relationship between the index of structural changes and the dynamics of gross domestic product; explore the impact of terms of trade and policy instruments on structural shifts in favor of the non-resource export sector.

3. Methods and data

Methodologically, identification of the current state and instrumental factors of economic policy involves three stages:

1. Choice of the index of structural equilibrium.
2. Identification of the structural state of the economy.
3. Assessment of economic polic y factors capable of accelerating economic growth based on favorable structural shifts.

Based on the Engle and Granger (1991) methodology, the presence of cointegration of two indicators containing the so-called unit root I (1) allows us to estimate the long-term relationship between them (in levels) Equation (9):

$$Y_t = \alpha + \beta X_t + \varepsilon_t, \tag{9}$$

and then use the resulting residuals to assess the short-term dynamics of the dependent variable (in the first differences) Equation (10):

$$\Delta Y_t = \delta_0 + \gamma \Delta X_t - \delta \varepsilon_{t-1} + \xi_t, \tag{10}$$

where Y_t – dependent variable, X_t – vector of independent variables, ε_t and ξ_t – stochastic factors.

In Equation (10), the lags value of the residuals from Equation (9) is added to the list of independent variables. The coefficient δ characterises the rate of return of the dependent variable to the equilibrium value based on deviations from long-term equilibrium. It should be noted that if there is over one cointegration equation between several variables, it is necessary to use the alternative VAR/VEC procedure (Alogoskoufis & Smith, 1991; Tang et al., 2015). It is also important that predictions for short-term rates may differ in principle from estimates for long-term relationships. The list of independent variables may also differ.

To assess the peculiarities of the relationship between GDP and the structural characteristics of the domestic economy, the index of structural changes based on export commodity groups was used (Figure 1).

To assess the peculiarities of the relationship between GDP and the structural characteristics of the domestic economy, the index of structural changes based on export commodity groups was used (Figure 1). Raw material exports include: agricultural products, mineral products, products of the chemical and related industries, timber and wood products, pulp made of wood or other fibrous cellulose materials, products made of stone, gypsum, cement, ceramics, glass. According to non-commodity exports, the rest of the exports are credited: finished food products, polymeric materials, plastics and rubber, leather and fur raw materials and products from them, textiles and textile products, footwear, hats, umbrellas, products from ferrous and non-ferrous metals, machines and mechanisms materials and their parts,

a) volume of commodity and non-commodity exports   b) index of structural changes
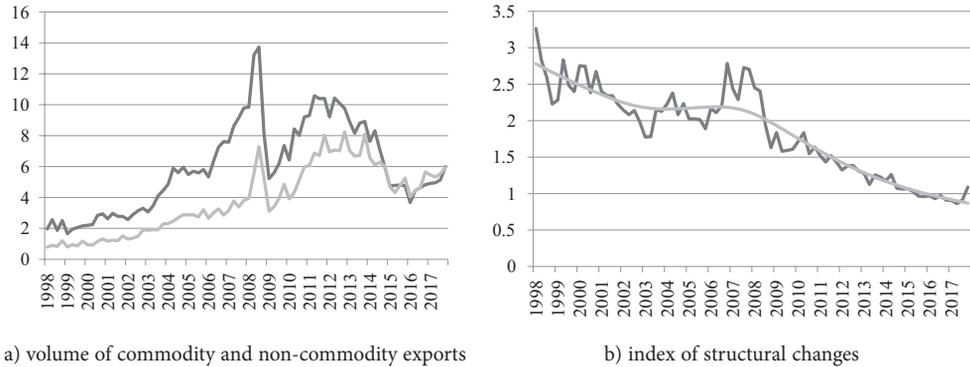
Figure 1. Ukraine export structural characteristics, 1998–2017 (source: developed by authors)

devices for recording and reproducing images and sound, vehicles and road equipment, optical instruments and apparatus, medical or surgical apparatus; clock; musical instruments, various goods and products.

Metallurgy classification issues may seem controversial, because quite often metallurgy is considered a raw materials and medium- or low-tech industry. In any case, references to the hypertrophied development of the mining and metallurgical complex as one of the reasons for the structural problems of the domestic economy are quite common. Regardless of the classification of the metallurgical industry, a constant decrease in the share of mechanical engineering can be considered a sign of an increase in the raw materials orientation of production and exports to Ukraine and an increased dependence on the situation in external raw materials markets, although some researchers believe that official statistics underestimate the export volumes of technological exports (Bitsyura, 2016).

To assess the peculiarities of the relationship between GDP and the structural characteristics of the domestic economy, the index of structural changes based on export commodity groups was used. Raw materials exports include: agricultural products, mineral products, products of the chemical and related industries, timber and wood products, wood pulp or other fibrous cellulosic materials, products made of stone, plaster, cement, ceramic, glass. According to non-commodity exports, the remaining exports are included: finished food products, polymeric materials, plastics and rubber, leather and fur raw materials and products from them, textiles and textile products, footwear , hats, umbrellas, products made of ferrous and non-ferrous metals, machines and mechanisms, electrical equipment and their parts, devices for recording and reproducing images and sound, vehicles and road equipment, optical instruments and apparatus, medical or surgical apparatus; clock; musical instruments, various goods and products (Korablin, 2017).

Metallurgy classification issues may seem controversial, because quite often metallurgy is considered a raw material and medium- or low-tech industry. References to the hypertrophied development of the mining and metallurgical complex as one reason for the structural problems of the domestic economy are quite common. Regardless of the classification of the metallurgical industry, a constant decrease in the share of mechanical engineering can be

considered a sign of an increase in the raw materials orientation of production and exports to Ukraine and an increased dependence on the situation in external raw materials markets, although some researchers believe that official statistics underestimate the volumes of non-resource (technological) exports.

The index of structural changes (structural equilibrium index, structural index) is the ratio between non-primary and primary exports.

Considering causality $STR_t \Rightarrow Y_t$ there are grounds for such a system of two Equations (11), (12):

$$Y_t = \alpha_0 + \sum_{i=1}^{n} a_i Y_{t-i} + \sum_{j=1}^{m} b_i STR_{t-j} + \alpha_1 CRISIS_t + \varepsilon_t; \qquad (11)$$

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{n} c_i \Delta Y_{t-i} + \sum_{j=1}^{m} d_i \Delta STR_{t-j} + \beta_1 CRISIS_t + \delta \varepsilon_{t-1} + \xi_t, \qquad (12)$$

where Y_t – GDP, STR_t – index of structural changes, $CRISIS_t$ – crisis-related dummy (1 for 2000Q1, 2004Q3:2004Q4, 2008Q3:2009Q4, 2013Q1:2015Q4, 0 – for the rest of the quarters). Thus, it is assumed that the situation at the beginning of 2000 had its own influence. It is associated with the inertia of the deep currency crisis of 2008–2009. A short period of financial destabilisation at the end of 2004, caused by the Orange Revolution, the events of the global financial crisis in 2008–2009 and the most recent acute crisis in 2014–2015. It is assumed that the crisis phenomena appeared in early 2013 and ended by the end of 2015, although the restoration of the pre-crisis economic dynamics continues to this day.

Since we are talking about Ukraine as a country with a raw material orientation of exports, the sample of the years 2000–2010 and 2000–2018 was made considering the volatility of prices for raw materials (in the early 2000s – a sharp increase in prices for raw materials, 2009 – a slight decrease and in 2010 – prompt resumption of growth).

By crises it is assumed that the situation at the beginning of 2000 had its own influence; a short period of financial instability at the end of 2004, caused by the Orange Revolution; events of the world financial crisis of 2008–2009, and the most recent acute crisis in 2014–2015. (it is assumed that the crisis phenomena appeared at the beginning of 2013 and ended by the end of 2015, although the restoration of the pre-crisis economic dynamics continues to this day).

The chosen division of the time sample is primarily due to considerations of checking the stability of the obtained estimates to a change in the time period. At the same time, the choice of a short sample of 2000–2010 provides for the inclusion of one of the major crisis periods (2008–2009), but in such a way that the so-called marginal effects do not occur, when the data of the last few years, estimates obtained (this explains the inclusion of 2010 data). The time sample of 2000–2013 does not differ much from the sample of 2000–2018, which does not allow us to check the stability of the estimates obtained.

The choice of a dummy variable to take into account the possible impact of crisis phenomena or, more precisely, periods with a significant decrease in GDP below the equilibrium trend is a standard procedure and does not provide for an in-depth study of the reasons for such a decline (internal or external, monetary or non-monetary, assumed or unpredictable, etc.)

In our case, the inclusion of the CRISIS variable was intended to "cleanse" the impact of the *STR* variable on GDP from crisis phenomena, regardless of the main reasons (for example, the crisis events of the second half of 2004 were not as economic as political in origin) and could affect the long-term trajectory of GDP or short-term changes this indicator. Since the periodization of crisis phenomena or periods with a significant decline in production was made, it turned out to be an important factor in the long-term trajectory of income (in levels) - the corresponding coefficient is statistically significant at the level of 5%, which means that regardless of the nature, events in these periods had an intuitively expected negative impact on the trajectory domestic GDP. At the same time, no such influence was found for short-term dynamics; it is easier to explain by the effectiveness of mechanisms for correcting deviations from the long-term trend (coefficient δ). The results obtained can be interpreted in such a way that, regardless of origin, any significant production downturns in Ukraine negatively affect the long-term growth trajectory. The mechanisms of such influence will be clarified by us in future studies. In particular, the prime candidates are investments, which recover very slowly after significant production downturns, whereas during unproblematic economic growth there is no proportional increase in investments that should compensate for the losses of the investment process during even short downward "episodes".

CRISIS is a dummy variable that takes into account only the exogenous impact of crisis phenomena.

The basic statistical model assumes that structural shifts in favour of the non-resource sector depend on the terms of trade and economic policy instruments (Nikonenko, 2018):

$$STR_t = \alpha_0 + \sum_{i=1}^{n} a_i STR_{t-1} + b_1 TOT_t^{A,B,C} + b_2 FDI_t + c_1 G_t + c_2 \ln RER_t +$$
$$c_3 \ln M2 + c_4 DEBT_t + c_5 CRISIS_t + \varepsilon_t, \tag{13}$$

where $TOT_t^{A,B,C}$ – calculated intersectoral terms of trade, FDI_t – direct foreign investments (% GDP), RER_t – real exchange rate (index, 2010 = 100), G_t – government spending (% GDP), $M2_t$ – monetary aggregate M2 (million UAH), $DEBT_t$ – external public debt (% GDP).

Data on world prices for raw materials of foreign direct investment, RER and M2 money supply are obtained from the IMF database (International Monetary Fund, n.d.). Data on the volume of external public debt was obtained from the relevant statistics of the NBU (National Bank of Ukraine, 2021).

Under the logic of the model (1)–(6), the intersectoral terms of trade are calculated as the ratio of prices for raw materials and non-primary exports. Three separate indexes are used (Nikonenko, 2018):

$$TOT_t^A = PRAW_t / METAL_t; \tag{14a}$$

$$TOT_t^B = PRAW_t / (w_1 METAL_t + w_2 PFOOD_t; \tag{14b}$$

$$TOT_t^{\tilde{N}} = PRAW_t / (w_1 METAL_t + w_2 PFOOD_t + w_3 P_t^{USPPI}), \tag{14c}$$

where P_t^{USPPI} – US Wholesale Price Index (index 2005 = 100), w_1, w_2, w_3 – weighting factors.

The first of the indices is determined by the ratio of world prices for agricultural raw materials and metal products. In a simplified way, it is assumed that the price index for agricultural products characterises raw materials, and the metal price index characterises non-raw materials. The second of the indices considers the share of metal products and food products

in export volumes. Finally, the third of the indices considers the inflation of wholesale prices in the United States – this indicator can be considered an approximate characteristic of other non-primary exports, except for metal products and food products.

4. Results and discussion

4.1. Using tests for stationarity and to identify the fact of cointegration to characterize endogenous variables

To determine the characteristics of endogenous variables, the Augmented Dickey-Fuller test or the Phillips-Perron test are used, and the Johansen cointegration test is used to identify the fact of cointegration.

Both Dickey-Fuller (ADF) and Phillips-Perron (PP) tests show the non-stationary of the Y_t and STR_t levels, while the first differences of both indicators are stationary (Table 1). This means that both indicators have a unit root I (1), and, the basis for studying their cointegration.

Table 1. Stationarity tests for GDP and structural change index (source: own calculations based on data of the National Bank of Ukraine, 2021)

Variable	Sample	ADF		PP	
		Levels	The first differences	Levels	The first differences
Y_t	2000–2010	−1,64 (0,75)	−4,31 (0.0***)	1,03 (0,92)	−4,31 (0,0***)
	2000–2018	−1,90 (0,64)	−5,71 (0.0***)	−1,61 (0,77)	−5,69 (0,0***)
STR_t	2000–2010	−2,57 (0,29)	−8,07 (0.0***)	−2,68 (0,24)	−8,09 (0,0***)
	2000–2018	−3,09 (0,11)	−4,08 (0.0***)	−3,21 (0,08*)	−10,55 (0,0***)

Johansen's test confirms the presence of one cointegration equation at a statistical significance level of at least 5% according to four out of five test assumptions (Table 2). An error-corrected model (Alogoskoufis & Smith, 1991) can apply to the GDP and structural change index.

Table 2. Johansen test for cointegration of GDP and structural change index (source: own calculations)

Model	M1	M2	M3	M4	M5
Trend	No	No	Linear	Linear	Quadratic
Test Type	Without a constant	With constant	With constant	With constant	With constant
	Without trend	Without trend	Without trend	With trend	With trend
Trace					
$r = 0$	16.34**	27.16***	28.15***	32.18***	29.41***
$r = 1$	0.05	4.94	4.43**	5.45	2.29
Max Eigen					
$r = 0$	16.28**	22.21***	21.71***	27.34***	27.11***
$r = 1$	0.05	4.94	4.43**	5.45	3.34

Note: *** means rejection of the hypothesis of no causality at the 1% statistical significance level (** at the 5% level, * at the 10% level).

Visual analysis of these indices reveals the differences are relatively insignificant (Figure 2).
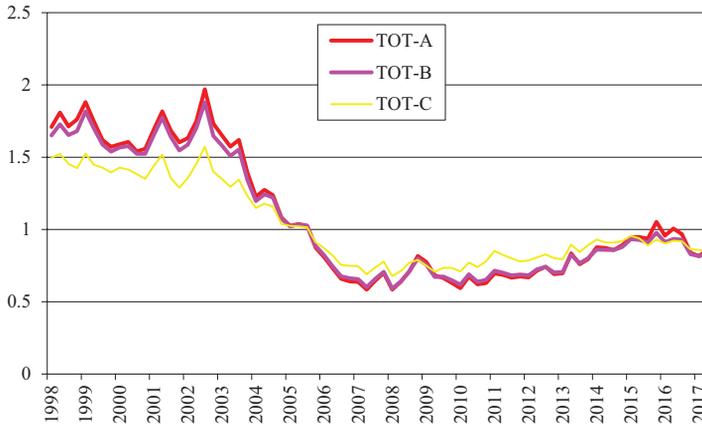

Figure 2. Ukraine: sectoral terms of trade, 1998–2017
(calculated according to the State Statistics Service of Ukraine, n.d.)

4.3. Empirical estimates for long- and short-term coefficients of the influence of the index of structural changes on GDP

The statistical model (11) assumes that GDP depends on the index of structural changes, which, for its part, reflects the ratio between the primary and non-primary sectors. If $\sum_{j=1}^{m} b_i > 0,$ the economy is in line with the assumption of higher profitability in the non-commodity sector Q^T; otherwise, the commodity sector has a higher return on investment Q^S.

Empirical estimates for long- and short-term coefficients of the influence of the index of structural changes on GDP are given in Table 3. Quite predictably, the coefficient of determination R2 is much higher for estimates of long-term coefficients, but its value for estimates of short-term coefficients is also quite high as for the first differences. For a brief sample of 2000–2010. The included variables explain 48% of changes in GDP dynamics, and for the 2000–2018 sample This figure drops to 41%. In all cases, the ADF test detects the stationarity of the residues and allows an adequate interpretation of the results obtained

Long-term coefficients provide estimates for data in levels and concerning long-term dependencies, they turn out only over time, but short-term coefficients are estimated for data in the first differences, they are dynamic in nature and technically consider the effect of residuals for long-term equations (coefficient δ), which allows us to establish the nature of the influence of long-term factors on short-term dependencies, as well as the rate of convergence to an equilibrium state.

Estimates for long-term ratios show a direct favourable relationship between structural changes in favour of non-primary exports. The corresponding coefficient for STR_t becomes smaller for the 2000–2018 samples, which may mean approaching a certain equilibrium value of Q^T/Q^S over the past few years. However, there is no reason to deny the assumption of the highest return on non-resource sector products.

Table 3. Estimates of the dependence of GDP on structural changes in Ukrainian exports (source: own calculations)

Independent variable	Long-term coefficients		Independent variable	Short-term coefficients	
	Dependent variable Y_t			Dependent variable ΔY_t	
	2000–2010	2000–2018		2000–2010	2000–2018
Y_{t-1}	1.203 (7.93***)	1.220 (10.37***)	ΔY_{t-1}	1.394 (5.16***)	1.311 (5.08***)
Y_{t-2}	−0.226 (−1.50)	−0.230 (−1.95*)	ΔY_{t-1}	−0.487 (−2.86***)	−0.359 (−2.49**)
STR_t	0.415 (2.26**)	0.263 (2.20**)	ΔSTR_{t-1}	1.112 (2.90***)	1.348 (3.74***)
$CRISIS_t$	−0.625 (−1.95**)	−0.457 (−2.21**)	–	–	–
–	–	–	δ	−1.110 (−3.64***)	−1.045 (−3.72***)
R^2	0.97	0.97	R^2	0.48	0.41
ADF	−4.10***	−8.30***	ADF	−6.34***	−8.42***

Ukrainian GDP exaggeratedly reacts to changes in the previous period, because the coefficients at Y_{t-1} exceed 1. The correction occurs with a lag of two quarters, despite that, based on the sum of two quarters, domestic GDP looks very inertial. As might have been expected, the crisis phenomena were reflected in a decrease in GDP.

Estimates for short-term coefficients confirm the favourable nature of structural shifts in favour of non-primary goods (with a lag per quarter), and the corresponding coefficient at ΔSTR_{t-1} becomes larger for the 2000–2018 sample. The nature of the autoregressive dependence is also confirmed, when the increase in the dynamics of GDP growth with a lag of one quarter is further corrected with a lag of two quarters. Since no confirmation has been found for the destructive impact of crisis phenomena in the short term, this leads to the assumption of their long-term nature.

Finally, the correction factor δ exhibits a very prompt correction of long-term dependencies with some "overshoot". This structural feature corresponds to a situation where higher profitability of activities in the commodity sector leads to the opposite reaction.

The obtained functional dependencies can be considered quite stable, because the estimates of the regression coefficients for the periods 2000–2010 and 2000–2018 practically do not differ.

4.3. Estimates of the factors of structural changes in Ukrainian exports

As provided by the theoretical model (1)–(6), an increase in profitability in the commodity sector should be expected from an improvement in the sectoral terms of trade, should reduce the index of structural changes, but at the same time the equilibrium value of Q^T/Q^S rises, which objectively strengthens long-term incentives for investment in non-commodity

sector. However, the weakness of this trend in the context of significant foreign investment, motivated by the logic of "pushing out" and targeted policy of government stimulation of the non-resource sector, gives reason to hope for a standard dependence, when the rise in prices for raw materials is accompanied by a deterioration in the Q^T/Q^S ($(b_1 < 0)$.

Since in Ukraine foreign investors do not have wide access to the raw material sector, including agriculture, and assembly plants and the service sector have received increased attention, it can be expected that the structural proportions in the economy will improve $(b_2 > 0)$.

If government spending is concentrated primarily in the primary sector which can be explained by both profitability considerations and lobbying activities, this will lead to a deterioration in structural ratios, but it is possible that targeted support for the non-primary sector will have the exact opposite effect $(c_1 <> 0)$.

At first glance, the impact of RER does not differ from the effects of changing trading conditions, but at least three features need to be considered. First, the RER considers changes in domestic prices and the exchange rate, which do not always correlate with changes in world market prices. Secondly, it should be borne in mind that the price level P for non-commodities is only conditionally correlated with the level of domestic prices, because non-commodities can also be exported or serve as substitutes for imports. Perhaps EP * commodity prices correlate much more closely with world market prices than non-commodity prices. Third, the exchange rate policy creates its own influence, which may be aimed at inflation targeting or the exchange rate itself. Combined with the above arguments for the terms of trade, this significantly weakens the intuitive argument that lowering the RER should stimulate the expansion of the commodities sector. In general, the impact of RER on the structural proportions between the raw and non-raw sectors is not unambiguous $(c_2 <> 0)$.

In conditions of a fixed exchange rate, an increase in the money supply should be accompanied by an increase in the price level P, which should contribute to the expansion of the non-resource sector, but in an economy with strong devaluation expectations, it is more realistic to hope for an imminent devaluation of the monetary unit. There are incentives to expand the commodity sector. For a floating exchange rate, the consequences of an increase in the price level P are potentially offset by the devaluation of the monetary unit, so one can hope for the neutrality of the money supply regarding the price ratios between the commodity and non-commodity sectors. More precisely, in price inertia in the non-resource sector, a short-term "flight" of the exchange rate downward should be accompanied by a temporary decrease in RER, which is likely to contribute to an increase in the share of the commodity sector. Arguments for worsening structural relationships look more convincing $(c_3 < 0)$.

The accumulation of public external debt is likely to contributing to the raw material specialisation of the economy, as obtained in many studies, but this possibility is not uncontested. If the accumulation of public debt creates a "gap" between domestic consumption i production (Agénor, 2016) or reflects overly optimistic expectations about the terms of trade (Senhadji, 1997), it is more likely to hope for increased demand for non-primary goods more complementary to domestic demand. However, this does not apply to agricultural products, it is predominantly of a raw material nature and can not only be exported but also consumed in the domestic market. In this case, it is rather difficult to determine the direction of the resulting structural changes. The situation becomes more transparent if external borrowing

of the public sector is carried out for reasons of reducing the cost of excessive public debt and/or insufficient domestic savings. The devaluation of the monetary unit usually creates a negative balance effect, and this requires a prompt restoration of the balance of payments equilibrium, it is easier to implement by increasing the volume of exports of raw materials. According to the accumulation of external public debt, it becomes a factor of structural changes in favour of the raw materials sector ($c_4 < 0$). Similarly, crisis phenomena require an immediate improvement in the balance of export-import of goods and services, objectively strengthens the position of the raw materials sector ($c_5 < 0$).

Since there is one cointegration equation between the studied indicators, the estimates of the 2SLS statistical model with error correction were used. The use of three indices of sectoral terms of trade yielded similar results, primarily for assessing long-term coefficients, but from the point of view of the statistical significance of the obtained short-term coefficients, the specification with the index TOT_t^B (Table 4).

Table 4. Estimates of factors of structural changes in Ukrainian exports, taking into account government spending

Independent variable	Long-term coefficients		Independent variable	Short-term coefficients	
	Dependent variable STR_t			Dependent variable ΔSTR_t	
	2000–2010	2000–2018		2000–2010	2000–2018
STR_{t-1}	0.433 (3.08***)	0.502 (4.62***)	ΔSTR_{t-1}	0.380 (2.26**)	0.408 (2.61***)
STR_{t-2}	0.216 (1.57)	0.206 (2.02**)	–	–	–
TOT_{t-1}^B	−0.505 (−2.22**)	−0.360 (−2.33**)	ΔTOT_{t-1}^B	−0.318 (−1.12)	−0.258 (−1.11)
FDI_{t-1}	0.033 (1.88*)	0.019 (1.95*)	ΔFDI_{t-1}	0.025 (2.01**)	0.014 (1.88*)
G_t	0.008 (0.43)	0.020 (2.32**)	ΔG_t	0.014 (0.92)	0.014 (1.64*)
RER_t	1.234 (4.13***)	0.936 (4.77***)	ΔRER_t	0.080 (0.33)	0.724 (1.82*)
$M2_t$	−0.373 (−3.48***)	−0.314 (−4.93***)	–	–	–
$DEBT_t$	−0.012 (−1.56)	−0.011 (−3.13***)	–	–	–
$CRISIS_t$	−0.211 (−2.94***)	−0.160 (−3.55***)	–	−0.081 (−1.45)	−0.158 (−1.78*)
–	–	–	δ	−1.149 (−4.61***)	−1.017 (−4.88***)
R²	0.74	0.92	R²	0.43	0.34
ADF	−7.37***	−8.41***	ADF	−6.34***	−7.11***

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively. Calculated by the authors.

The results obtained show the inertial nature of the calculated index of structural changes, which has increased somewhat over the past few years. Besides recognising the quite natural inertia of processes in the real sector, this may mean significant institutional factors that are not considered by the specification of the assessed statistical model. According to the results of two quarters, over 2/3 of long-term structural changes are determined by their own dynamics. For short-term dynamics, the inertia remains at a sufficiently high level.

It is quite predictable that an improvement in the terms of trade in favour of the commodity sector worsens the structural proportions of Q^T/Q^S in Ukrainian exports, although the corresponding influence has been weakening over the past few years, as provided by the comparison of long-term coefficients TOT_{t-1}^B for the 2000–2010 and 2000–2018 sample. (Both ratios are statistically significant at the 5% level.) No short-term impact of cross-sectoral terms of trade on structural change has been identified (the corresponding coefficient at ΔTOT_{t-1}^B is negative, but lacks statistical significance).

Foreign-invested enterprises are stimulating action on both dimensions: long- and short-term. This means that the attraction of foreign capital takes place mainly in the non-resource sector. A certain discomfort is created because the coefficients for FDI_{t-1} i ΔFDI_{t-1} become smaller for the 2000–2018 sample, because this implies a weakening of the favourable functional dependence in recent years.

The decline in RER is accompanied by an increase in the share of non-primary exports, which is mainly of a long-term nature. In the short term, the decrease in RER affects the structural proportions much weaker, and this effect is of relatively recent origin. The beneficial effect of a decrease in RER can be explained by the insignificant dependence of production in the non-primary sector on imported components, but this may be a sign of its low innovativeness.

Corrective factor δ shows a prompt correction of long-term dependencies. This means that structural changes in favour of non-resource exports, which are driven by long-term dependencies, take little time to translate into practice.

Thus, in order to improve the structural proportions in the Ukrainian economy (for example, the export sector), it is necessary to more actively attract FDI, maintain a decrease in RER, prevent an excessive increase in the money supply, refrain from increasing public external debt (the relationship with domestic public debt has not been studied) and crisis phenomena.

The resulting relationship suggests that government spending stimulates an improvement in the Q^T/Q^S ratio in Ukrainian exports, but this should occur without increasing external public debt. Government spending should be funded from tax and other budget revenues. The direct relationship between budget revenues and structural shifts in favour of the non-resource sector has empirical confirmation (Table 5).

Estimates of the statistical model (13) with the variable of budget revenues T_t (% of GDP) instead of government expenditures show that an increase in budget revenues improves structural relationships in favour of the non-resource sector in the long run, without having an adverse short-term impact. This result can be explained by the observance of the intertemporal budgetary constraint, as provided by Equation (5), but other causal mechanisms are sufficient.

Table 5. Estimates of the factors of structural changes in Ukrainian exports, taking into account budget revenues (source: calculated by authors)

Independent variable	Long-term coefficients		Independent variable	Short-term coefficients	
	Dependent variable STR_t			Dependent variable ΔSTR_t	
	2000–2010	2000–2018		2000–2010	2000–2018
STR_{t-1}	0.418 (3.44***)	0.462 (4.48***)	ΔSTR_{t-1}	0.342 (2.30**)	0.401 (2.85***)
STR_{t-2}	0.203 (1.74*)	0.204 (2.12**)	–	–	–
TOT^B_{t-1}	−0.521 (−2.61**)	−0.382 (−2.18**)	ΔTOT^B_{t-1}	−0.297 (−1.17)	−0.248 (−1.18)
FDI_{t-1}	0.033 (2.14**)	0.016 (1.67*)	ΔFDI_{t-1}	0.026 (2.30**)	0.012 (1.71*)
T_{t-1}	0.005 (0.34)	0.017 (2.11**)	ΔT_{t-1}	0.004 (0.18)	0.010 (1.10)
RER_t	1.218 (4.51***)	0.929 (5.04***)	ΔRER_t	−0.145 (−0.19)	0.553 (1.43)
$M2_t$	−0.356 (−4.21***)	−0.282 (−5.07***)	–	–	–
$DEBT_t$	−0.011 (−1.53)	−0.011 (−3.41***)	–	–	–
$CRISIS_t$	−0.206 (−3.10***)	−0.149 (−3.56***)	–	−0.080 (−1.63)	−0.061 (−2.05**)
–	–	–	ΔCA_{t-2}	0.015 (1.87*)	0.010 (1.76*)
–	–	–	δ	−1.113 (−5.01***)	−1.038 (−5.50***)
R²	0.73	0.92	R²	0.44	0.37
ADF	−7.24***	−8.48***	ADF	−6.36***	−7.32***

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Changes to the specification of the regression model did not affect changes in other functional dependencies. Almost the only difference concerns the appearance of the influence of the current account balance CA_t (% of GDP) on the short-term dynamics of structural changes (with a lag of two quarters). The corresponding positive coefficient at ΔCA_{t-2} provides for an improvement in structural proportions because of an improvement in the current account balance. The effect of the current account balance is not seen for long-term ratios. Similarly, including this variable has no statistically significant effect in the previous specification with government spending. This feature can be explained because budget revenues largely depend on customs payments.

Since changes in the structure of production (exports) can be endogenous, not only depend on internal and external factors but also influence them, functional dependencies were studied using two VAR models, considering the influence of: price ratios between non-commodity

and commodity exports, FDI, RER, money supply (monetary aggregate M2), income (GDP), and one of the fiscal variables – government spending or budget revenues.

Assuming the presence of cointegration between dependent (endogenous) variables, the following causality is used: "*TOT ⇒ FDI ⇒ G (T) ⇒ M2 ⇒ RER ⇒ STR ⇒ Y*".

The price ratios between commodity and non-commodity exports are considered to be an independent (exogenous) variable in the current period that determines the volume of FDI. In the future, this affects the level of government spending or budget revenues. Fiscal indicators determine the supply of money supply, which should affect the RER. In the current period, the structural proportions in exports and GDP are considered because of the remaining endogenous variables.

4.4. Graphic visualization of the factors of influence of individual endogenous variables on the structure of domestic exports

The results obtained confirm the powerful influence of structural changes in favour of non-resource exports as a factor in increasing GDP (Figure 3).
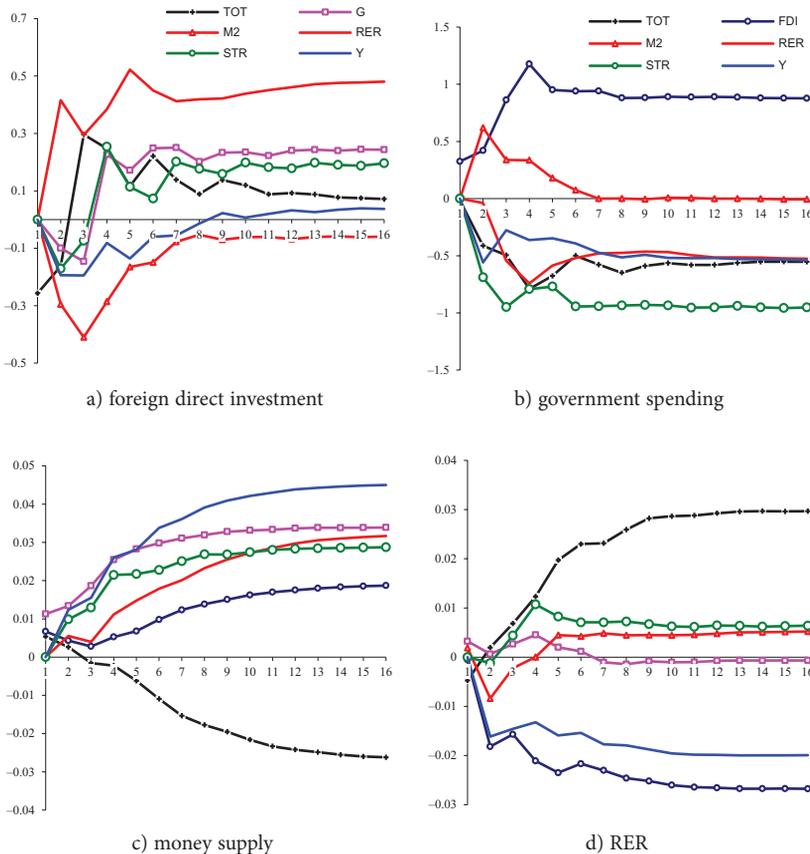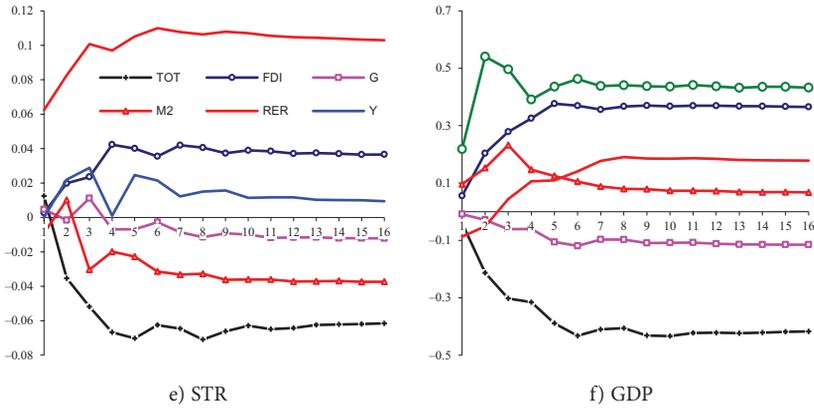

a) foreign direct investment

b) government spending

c) money supply

d) RER

Figure 3. *To be continue*

e) STR

f) GDP

Note: The effects of shocks on the endogenous variable are shown with a confidence level of ±2 standard deviations.

Figure 3. Graphic visualisation of the factors of influence of individual endogenous variables on the structure of domestic exports (built by the authors)

Decomposition of the residuals shows that changes in TOT determine up to 13% of changes in GDP, while changes in FDI account for up to 10%, and structural changes determine from 21 to 17% of changes in GDP, and the significance of this factor comes with time. Considering the structural and investment factors, the dependence of GDP on the instruments of economic policy becomes marginal (Figure 4, Table 6).
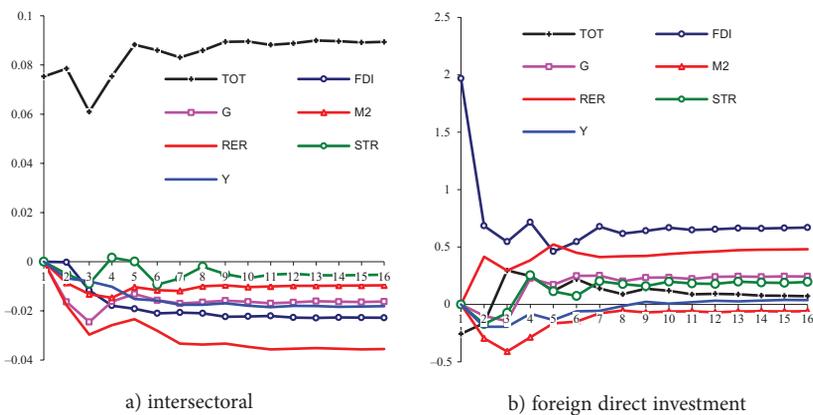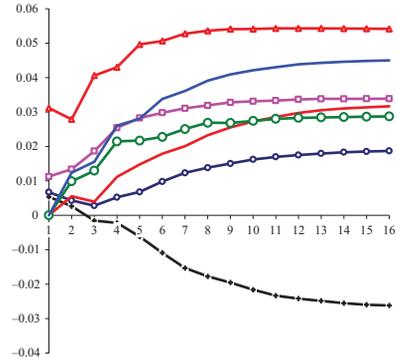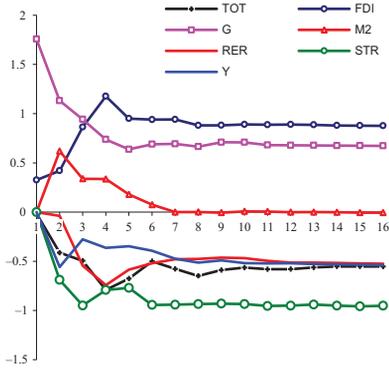

a) intersectoral
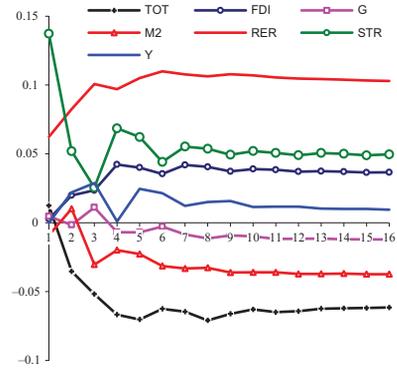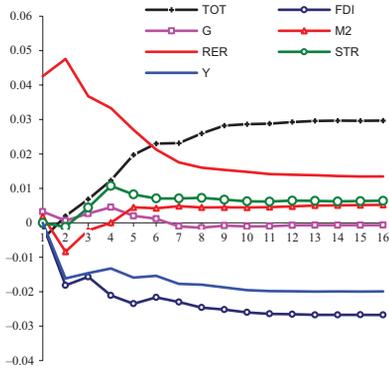
b) foreign direct investment
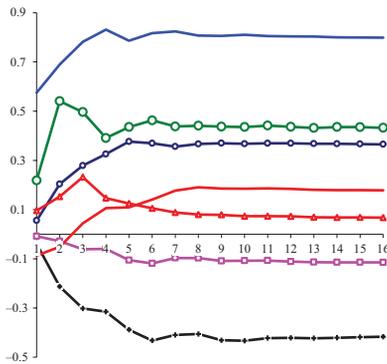
Figure 4. *To be continue*

c) government spending terms of trade (TOTCOM2)

d) money supply

e) RER

f) STR

g) GDP

Note: Consequences of shocks on the endogenous variable shown in confidence ± 2 standard deviations.

Figure 4. Graphic visualisation of the factors of influence of individual endogenous variables on the structure of domestic exports (VECM-1)

Table 6. Decomposition of VECM residuals of mutual influence of export structure and terms of trade, foreign direct investments, government spending, money supply, RER and GDP, 2000–2019 (source: calculated by the authors)

Impulse	Response to changes	Forecast horizon (quarters)				Impulse	Response to changes	Forecast horizon (quarters)			
		4	8	12	16			4	8	12	16
Sectoral terms of trade (*TOT*)	*TOT*	83	81	79	78	Real exchange rate (*RER*)	*TOT*	3	15	23	27
	FDI	2	3	4	4		*FDI*	12	20	24	26
	G	4	3	3	3		*G*	0	0	0	0
	M2	2	1	1	1		*M2*	1	1	1	1
	RER	7	8	9	10		*RER*	75	51	37	25
	STR	0	0	0	0		*STR*	2	2	2	2
	Y	1	2	3	3		*Y*	8	11	13	14
foreign direct investment (*FDI*)	*TOT*	4	4	3	3	Structural Change Index (*STR*)	*TOT*	12	18	18	18
	FDI	80	72	69	66		*FDI*	4	6	6	6
	G	1	3	4	5		*G*	0	0	0	0
	M2	5	4	3	3		*M2*	2	3	4	5
	RER	6	14	17	19		*RER*	42	48	50	51
	STR	2	2	3	3		*STR*	37	24	20	18
	Y	1	1	1	1		*Y*	2	2	1	1
Budget receipts (*T*)	*TOT*	8	10	10	10	GDP (*Y*)	*TOT*	7	11	12	13
	FDI	18	23	24	25		*FDI*	7	9	10	10
	G	44	30	26	23		*G*	0	1	1	1
	M2	5	3	2	1		*M2*	3	2	1	1
	RER	6	8	8	8		*RER*	1	1	2	2
	STR	15	21	24	25		*STR*	21	18	18	17
	Y	4	5	6	7		*Y*	61	57	56	55
Monetary aggregate M2 (*M2*)	*TOT*	0	2	4	5						
	FDI	1	2	3	3						
	G	15	15	14	14						
	M2	61	49	42	39						
	RER	2	5	7	8						
	STR	8	9	9	9						
	Y	12	18	20	21						

Similar to the 2SLS estimates, there is no objection to improved structural proportions resulting from FDI inflows and lower RERs. Similarly, the 2SLS and VAR / VEC estimates agree that the deterioration in *STR* is because of the improved terms of trade in favour of commodity exports and an increase in money supply. The RER factor determines about half of the *STR* changes, while the share of TOT gradually grows from 12 to 18%. The weight of FDI and money supply is relatively insignificant – only 6%.

The growth in the share of non-commodity exports helps to attract foreign direct investment (however, the weight of STR_t in the decomposition of FDI_t balances is not high), a decrease in government spending (the weight in the decomposition of G_t balances gradually increases to 25%), and an increase in the money supply (the weight in the decomposition of $M2_t$ balances is 8–9%). This functional influence only strengthens the argument in favour of improving the quality structure of domestic exports.

Among other functional dependencies, a decrease in RER is a significant factor in encouraging FDI (the weight in the FDI decomposition gradually increases from 6 to 19%), does not contradict the logic of attracting foreign investment to improve the structure of domestic exports. The rest of the factors are less important (the weight of each of them does not exceed 5%), although based on the analysis of the impulse function, one can expect an increase in FDI in the event of a restriction in the supply of money supply, an increase in government spending and a deterioration in TOT. There are signs of direct dependence of FDI on economic growth and do not create grounds for assumptions about the "attraction" of foreign investment by economic dynamics within Ukraine.

It is noted that FDI inflows are accompanied by an increase in government spending (the weight of the factor in the G_t decomposition reaches 25%). This may mean that FDI inflows are accompanied by an increase in government spending on projects of oligarchic structures that have a significant influence on political decision-making. In this case, there is a mutual reinforcement between FDI and government spending, but note that the decomposition of the residuals reveals the primacy of the inflow of foreign investment. It is logical to assume that FDI comes in first, and only then government spending grows. Another, more optimistic scenario assumes that FDI inflows (not related to the activities of oligarchic structures) are accompanied by an increase in government spending on infrastructure development or excessive optimism, which inclines to an increase in consumer spending.

Government spending increases with an increase in the money supply, but the influence of this factor in the decomposition of G_t balances is insignificant (only 5%). Besides structural shifts in favour of non-resource exports, lower government spending is also supported by improved TOT, lower RERs and higher income. Although the weight of each of these factors in the decomposition of the residual G_t is relatively low, in total they account for 56 to 77% of changes in government spending. In contrast to the standard "textbook" designs, government spending is quite endogenous in the system of major macroeconomic indicators.

The improvement in price ratios in favour of raw material exports is reflected in the supply's restriction of money supply. However, the weight of TOT in changes in the monetary aggregate M2 is insignificant, which does not allow overestimating the importance of the causality of "TOT⇒M2". All other endogenous factors result in an increase in the supply of money supply. If an increase in the money supply in response to an increase in income is quite natural from the point of view of meeting the higher demand for money, then such dependence on government spending means supporting fiscal policy through monetary policy. There was no reaction to the decrease in RER during the first two quarters, but in the future, an increase in the supply of money supply is observed. True, the RER weight in the decomposition of M2 residues is 8%.

An improvement in price ratios in favour of non-commodity exports leads to a significant decrease in RER, and the weight of TOT in the decomposition of the residuals of this

indicator gradually increases to 27%. Equally important is the dependence on FDI inflows, which increases the RER (the weight of FDI in the decomposition of residuals gradually increases from 12 to 26%). It is most likely that the growing demand for money becomes a factor in the increase in RER, because the consequences of an increase in GDP are similar (the weight of the factor in the decomposition of residuals is 14%). At the same time, RER does not depend on government spending and money supply.

If instead of indicator government spending we use the indicator of budget revenues, the important result practically does not change, an increase in the share of non-primary exports is reflected in GDP growth, and the main drivers of favourable structural changes are the rise in prices for non-primary exports and a decrease in RER. The optimising effect of FDI on *STR* and income remains, but the weight of this factor in the decomposition of the residuals of both variables remains low. With the change in the VECM specification, the negative impact of the money supply on *STR* is weakening. The increase in budget revenues reduces the share of non-primary goods in total exports (Figure 5, Table 7).
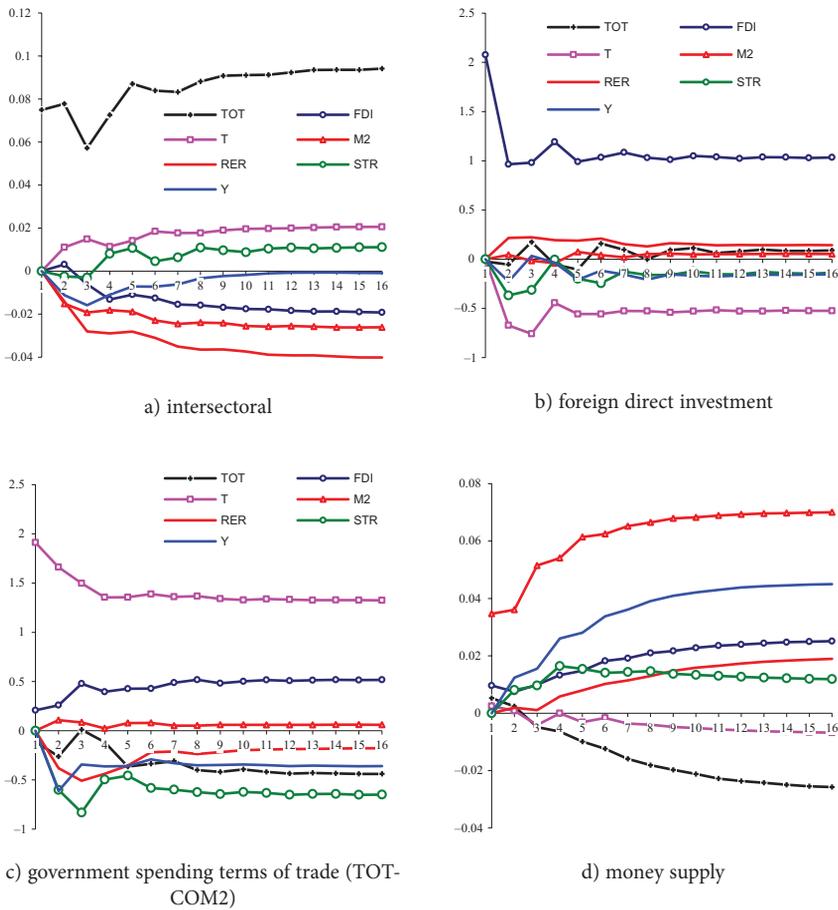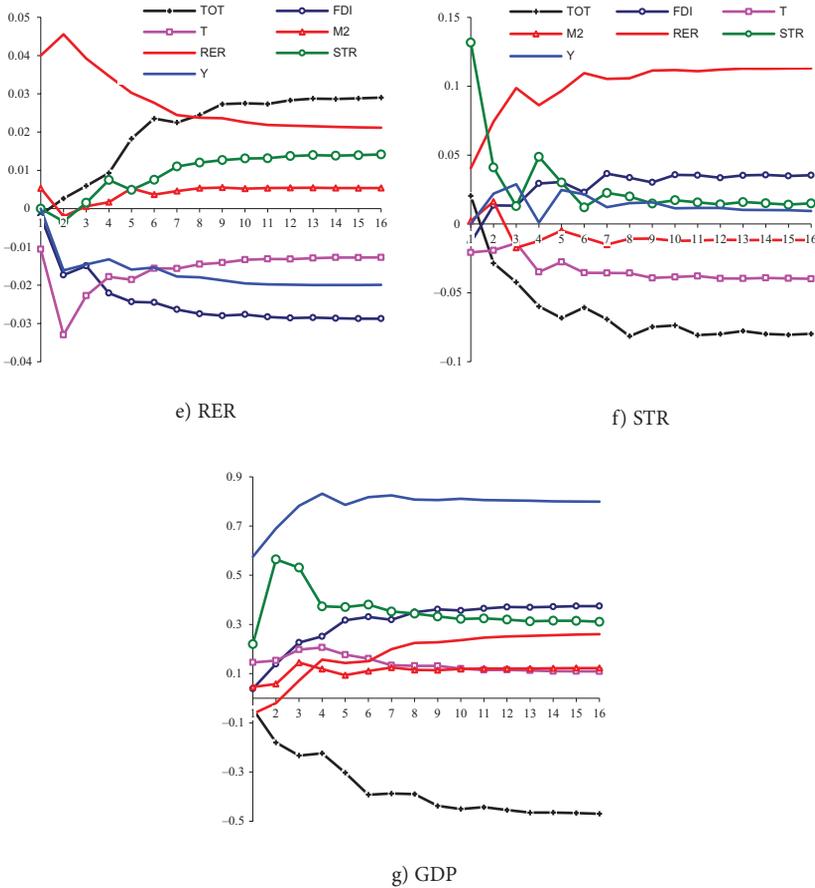

a) intersectoral

b) foreign direct investment

c) government spending terms of trade (TOT-COM2)

d) money supply

Figure 5. *To be continue*

e) RER

f) STR

g) GDP

Note: The effects of shocks on the endogenous variable are shown with a confidence level of ±2 standard deviations.

Figure 5. Graphic visualization of the factors of influence of individual endogenous variables on the structure of domestic exports (VECM-2)

Table 7. Decomposition of VECM balances of the interaction of the structure of exports and trade conditions, FDI, budget revenues, money supply, RER and GDP, 2000–2019 (source: calculated by the authors)

Impulse	Response to changes	Forecast horizon (quarters)				Impulse	Response to changes	Forecast horizon (quarters)			
		4	8	12	16			4	8	12	16
Sectoral terms of trade (*TOT*)	*TOT*	84	79	77	75	Real exchange rate (*RER*)	*TOT*	1	11	17	20
	FDI	1	2	2	2		*FDI*	10	18	22	24
	T	2	3	3	3		*T*	20	15	12	11
	M2	4	8	5	5		*M2*	1	1	1	1
	RER	8	10	11	12		*RER*	63	46	37	31
	STR	0	1	1	1		*STR*	1	2	4	5
	Y	1	1	2	2		*Y*	5	7	8	8

Impulse	Response to changes	Forecast horizon (quarters)				Impulse	Response to changes	Forecast horizon (quarters)			
		4	8	12	16			4	8	12	16
Direct foreign investments (*FDI*)	*TOT*	0	1	1	1	Structural Change Index (*STR*)	*TOT*	11	20	23	24
	FDI	82	78	77	77		*FDI*	2	4	4	5
	T	13	16	17	17		*T*	4	5	6	6
	M2	0	0	0	0		*M2*	1	1	1	1
	RER	1	2	2	2		*RER*	41	50	53	54
	STR	3	2	2	2		*STR*	36	17	11	8
	Y	1	1	1	2		*Y*	4	3	2	2
Budget receipts (*T*)	*TOT*	1	2	4	4	GDP (*Y*)	*TOT*	4	9	12	14
	FDI	4	6	7	8		*FDI*	4	7	9	9
	T	78	74	72	70		*T*	4	3	2	2
	M2	0	0	0	0		*M2*	1	1	1	1
	RER	4	4	3	3		*RER*	1	2	3	4
	STR	10	11	12	13		*STR*	23	17	14	12
	Y	4	3	3	2		*Y*	63	61	59	58
Monetary aggregate M2 (*M2*)	*TOT*	1	3	5	6						
	FDI	4	5	6	7						
	T	0	0	0	0						
	M2	82	75	71	69						
	RER	0	2	3	3						
	STR	4	4	3	3						
	Y	8	11	11	12						

The revision of the VECM specification does not change the conclusion on the increase in RER from FDI inflows and the increase in income. Similarly, the money supply decreases after commodity prices rise, while the opposite occurs with higher incomes, lower RERs, and improved export patterns. Certain differences lie because FDI does not respond to RER, and the negative feedback of M2 on the increase in FDI also disappears.

The inflow of FDI increases budget revenues, does not differ from the nature of the impact on government spending, but the weight of FDI in the decomposition of T balances is three times lower – 4–8%. A similar symmetry is characteristic of the dependence of government spending and budget revenues on *STR*, but in the second case, the weight in the decomposition of residuals T is also approximately half as much – 10–13%. Growing revenues to the budget are reflected in an increase in RER (the weight of T in the decomposition of residuals is initially 20% and eventually decreases to 11%), which differs from the neutrality of government spending on RER. Also, with an increase in budget revenues, the resulting decrease in *STR* becomes more expressive.

Structural changes (in favour of the non-resource export sector of the domestic economy) will give us the opportunity to attract foreign investment, preferably the capital of the largest industrial companies with a worldwide reputation (in Ukraine, foreign investors do not have wide access to the raw materials sector, including agriculture, and assembly plants received increased attention and service industry). To improve the structural proportions in the Ukrainian economy, it is worth: maintaining a depreciation of the exchange rate, but this does not mean the devaluation of the monetary unit is advisable, but rather the need to maintain low inflation (the beneficial effect of the depreciation of the exchange rate can be explained by the insignificant dependence of production in the non-resource sector on imported components) to limit the supply of monetary mass and accumulation of external public debt and avoid crises. Government spending should occur without increasing the external public debt, that is, they should be financed from tax and other budget revenues. Budget revenues, which largely depend on customs duties, improve the structural balance in favour of the non-resource sector in the long run, without having an adverse short-term impact. This result can be explained by the observance of the intertemporal budgetary constraint, but other causal mechanisms are sufficient. Thus, we have empirically proved that an increase in the share of non-primary exports is reflected in GDP growth, and the main drivers of favourable structural changes are the rise in prices for non-primary exports and a depreciation of the exchange rate.

Summing up, we find that for structural changes in favour of more technological (non-resource) exports, it is necessary to attract more FDI, preferably the capital of the largest industrial companies with a worldwide reputation, to limit the supply of money supply and the accumulation of external public debt, and also to avoid crisis phenomena. A decrease in RER is desirable, but this does not mean the advisability of devaluing the currency, but the need to maintain low inflation.

Conclusions

The novelty of the study lies in the development of a methodology of identifying the current state and instrumental factors of economic policy that can speed up economic growth based on favorable structural shifts (in favor of the non-resource export sector). It has been empirically proven that the structural proportions in favor of non-resource (technological) exports are improving due to: a) the rise in prices for metal products and food products compared to agricultural products, b) foreign direct investment receipts, c) a decrease in the exchange rate, d) an increase in the share of government spending in GDP, e) reduction of external public debt, f) reduction of excess money supply During crises, structural proportions deteriorate. The increase in government spending stimulates non-resource exports, but should occur without accumulating external public debt. An increase in tax and other budget revenues also improves the structural ratios in favour of the non-resource sector in the long run, without having an adverse short-term impact.

Additional verification of the obtained results for sustainability using the alternative VAR/VEC methoddoes not refute: an improvement in structural proportions because of inflows of foreign direct investment, deterioration of the terms of trade in favour of commodity exports

and a decrease in the money supply. A depreciation of the exchange rate is desirable, but this does not mean the devaluation of the monetary unit is advisable, but rather shows the need to maintain low inflation. An increase in income (GDP) does not provide an evolutionary improvement in the structure of exports.

VAR/VEC estimates confirm the powerful impact of structural changes in favour of non-resource exports as a factor in increasing GDP. Foreign direct investment has a similar beneficial effect. An increase in the money supply has a short-term positive impact, such as a monetary "surprise" that gradually diminishes. A depreciation of the exchange rate initially leads to a decrease in income, but later it becomes expansionary. Government spending and an increase in budget revenues have some adverse effects, but the most negative factor is the improvement in the terms of trade in favor of agricultural raw materials.

The growth in the share of non-resource exports helps to attract foreign direct investment, reduce government spending and increase the money supply. This functional influence only strengthens the arguments in favor of improving the quality structure of domestic exports.

Based on the analysis of the decomposition of VECM balances, it was found that: a) attracting foreign direct investment contributes to a decrease in the exchange rate, b) inflows of foreign direct investment are accompanied by an increase in government spending, c) a decrease in government spending contributes to an improvement in the terms of trade, a depreciation of the exchange rate and an increase in income (although the weight of each of these factors in the decomposition of the residuals Gt is relatively low, but in total they account for 56 to 77% of changes in government spending), d) an increase in government spending leads to an increase in the of money supply, e) the dynamics of the exchange rate depends significantly on world prices for raw materials and foreign direct investment.

At the time of this writing, the authors did not have official statistics for the end of 2019 and 2020. For this, the authors plan to receive data for the above periods from state institutions of Ukraine in the future and conduct a similar study. Also, in the future, it is planned to conduct a similar study in countries with a analogous economic situation as in Ukraine, such as Poland or Hungary.

References

Agénor, P.-R. (2016). Optimal fiscal management of commodity price shocks. *Journal of Development Economics*, *122*, 183–196. https://doi.org/10.1016/j.jdeveco.2016.05.005

Alogoskoufis, G., & Smith, R. (1991). On error correction models: Specification, interpretation, estimation. *Journal of Economic Surveys*, *1*(5), 97–128. https://doi.org/10.1111/j.1467-6419.1991.tb00128.x

Antoniuk, V. (2017). Structural shifts in the national economy as a threat to Ukraine's sustainable development. *Visnyk ekonomichnoi nauky Ukrainy*, *2*(33), 7–12.

Bitsyura, Y. (2016). Structural shifts in the economy of European countries. *Foreign trade: Economics, Finance, Law*, (3), 59–72.

Braun, A., & Toth, R. (2020). Circular economy: national and global policy – overview. *Clean Technologies and Environmental Policy*, *23*, 301–304. https://doi.org/10.1007/s10098-020-01988-8

Cornwell, J. (1977). *Explanations: Styles of explanation in science*. Oxford University Press.

Cui, L., Hou, Y., Gao, M., & Yang, Y. (2019). Exploring the influencing factors of sharing economy sustainability based on a two-mode social network analysis. In *2019 16th International Conference on Service Systems and Service Management (ICSSSM)* (pp. 1–5). IEEE. https://doi.org/10.1109/ICSSSM.2019.8887647

Danylchuk, H., Kovtun, O., & Opalenko, A. (2019). Assessment of the structural changes under transition of Ukraine towards postindustrial economy. *Cherkasy University Bulletin: Economic Sciences*, (4), 101–112. https://doi.org/10.31651/2076-5843-2019-4-101-112

Engle, R., & Granger, C. (1991). *Long-run economic relationships: Readings in cointegration. Advanced Texts in Econometrics.* Oxford University Press.

Ertz, M., & Leblanc-Proulx, S. (2018). Sustainability in the collaborative economy: A bibliometric analysis reveals emerging interest. *Journal of Cleaner Production*, *196*, 1073–1085. https://doi.org/10.1016/j.jclepro.2018.06.095

Ginevicius, R., Kliestik, T., Stasiukynas, A., & Suhajda, K. (2020). The impact of national economic development on the shadow economy. *Journal of Competitiveness*, *12*, 39–55. https://doi.org/10.7441/joc.2020.04.03

Holian, V. A. (2016). Socio-economic determinants of nature management: amber fever syndrome. *Economika ta derzhava*, *6*, 5–15.

International Monetary Fund. (n.d.). *IMF International Financial Statistics.* https://data.imf.org

Kazunobu, M. (2017). Structural change and a constant growth path in a three-sector growth model with three factors. *Macroeconomic Dynamics*, *21*(2), 406–438. https://doi.org/10.1017/S1365100515000565

Kiselakova, D., Sofrankova B., Cabinova V., & Onuferova, E. (2018). Competitiveness and sustainable growth analysis of the EU countries with the use of global indexes' methodology. *Entrepreneurship and Sustainability Issues*, *5*(3), 581–599. https://doi.org/10.9770/jesi.2018.5.3(13)

Korablin, S. (2017). *Macroeconomic dynamics of Ukraine: the trap of commodity markets.* Instytut ekonomiky i prohnozuvannia NAN Ukrainy.

Koziuk, V. (2018a, August 16). The oligarchic hydra of foreign direct investment. *Dzerkalo tyzhnia*. https://dt.ua/finances/oligarhichna-gidra-pryamih-inozemnih-investiciy-vid-makrofinansovoyi-nestabilnosti-do-tehnologichnogo-vidstavannya-285294_.html

Koziuk, V. (2018b, September 10). The hologram of expectations, or zombie ghost figures 40. *Dzerkalo tyzhnia*. https://dt.ua/finances/gologorama-ochikuvan-abo-zombi-privid-cifri-40-287790_.html

National Bank of Ukraine. (2021). *NBU Data.* https://bank.gov.ua/

Nikonenko, U. M. (2018). Structural processes of the economy of Ukraine as an exporter of raw material resources. *Naukovyi Visnyk Uzhhorodskoho Universytetu. Seriia "Ekonomika"*, *2*(52), 75–83. https://doi.org/10.24144/2409-6857.2018.2(52).75-83

Senhadji, A. (1997). *Sources of debt accumulation in a small open economy* (IMF Working Paper 97/146). https://doi.org/10.5089/9781451856606.001

Sijabat, R. (2019). Sharing economy: A study on the factors influencing users' motivation to use ride sharing platforms. *DeReMa Jurnal Manajemen*, *14*(1), 65–87. https://doi.org/10.19166/derema.v14i1.1367

Shynkaruk, L., Bevz, I., Baranovska, I., Vdovichen, A. A., & Herasimova, O. A. (2015). *Structural transformations in the Ukrainian economy: Dynamics, contradictions and impact on economic development.* Instytut ekonomiky i prohnozuvannia NAN Ukrainy.

State Statistics Service of Ukraine. (n.d.). http://www.ukrstat.gov.ua

Tang, C. F., Lai, Y. W., & Ozturk, I. (2015). How stable is the export-led growth hypothesis? Evidence from Asia's Four Little Dragons. *Economic Modelling*, *44*, 229–235. https://doi.org/10.1016/j.econmod.2014.09.022

Vashkiv, O. (2017). Sectoral structural transformations in Ukraine in the context of post-industrial economic development. *Globalni ta Natsionalni Problemu Economiky*, *16,* 127–132. http://global-national.in.ua/archive/16-2017/27.pdf

Wei, C.-L., Chang, Y.-C., Wang, W.-X., Chou, H.-M., & Chen, K.-J. (2019). Factors that influence sharing behaviors in sharing economy based on the theory of social capital and social exchange: Example of Taiwan-Based USPACE. In *2019 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)* (pp. 659–663). IEEE. https://doi.org/10.1109/IEEM44572.2019.8978908