

THE ECONOMETRIC MODELLING OF UKRAINIAN MACROECONOMIC TENDENCIES

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Abstract. *Econometric models are widely used in economic policies of many states. They help to build a great variety of econometric systems for every country and take into account the specifics of each economy.*

In this article, the structural macroeconomic models that describe the main aspects of the economic policy were applied. The interdependence between the level of inflation, the value of investment, savings, consumption, export and import transactions, taxes on the foreign trade were defined based on the analysis of the key macroeconomic parameters of Ukraine. After investigating all economic indicators, they were transformed into stationary time series for a correct use in the model. In addition, heteroscedasticity and autocorrelation of residuals were excluded in all econometric equations.

As a result, the research shows that a large share of black economy leads to a rather high level of inflation in the state, because its value is primarily determined by expectations of the population under such circumstances. The paper indicates that the further export growth leads to a lower consumption growth and also to a lower growth of savings. Such a situation indicates an insufficient development of the domestic market. Investment growth has been found not to be directly linked to consumption increase and economic development in general. Unfortunately, the main sources of investment in Ukraine are the funds of enterprises and foreign sources. The analysis shows a need to encourage public involvement into investment processes. For example, the creation of public-private partnerships is especially useful while implementing infrastructural projects.

Key words: *macroeconomics, structured models, econometrics, economic analysis*

Introduction

Most countries strive for a significant economic influence in the world. For Ukraine, it is actually to solve the complex of theoretical and practical problems that require to ensure conditions for the development of economics and businesses in the whole country. It is important to develop effective relations among the major economic processes in order control, manage and evolve the attractiveness of the domestic economy of Ukraine.

One of the approaches to the analysis of macroeconomic processes is associated with the development of structural econometric models. The advantage of such models is the possibility of a comprehensive analysis of the economic interrelations. The expediency and efficiency of economic and mathematical tools for predicting various indicators have been confirmed by the international practice.

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In particular, studies of J. Tinbergen (1939) exerted a significant impact on econometrics. In his work “The business cycles in the United States of America, 1919–1932” he developed the first global econometric model of a cyclic development of the U.S. economy. Using the method of multiple correlations, J. Tinbergen managed to describe the cyclical economy. His model was widely used in the interests of the Netherlands.

In 1972, Lucas opened the way for a new macroeconomics based on dynamic stochastic models with given preferences, technology and rules. Such models are called DSGE (dynamic stochastic general equilibrium); in them, agents are guided by rational expectations and make a rational choice when solving the problem of dynamic programming (e.g., Diebold 1998).

In 1980, the Nobel laureate Karl Sims proposed a vector autoregression (VAR) which is a powerful tool for describing data and building multidimensional standard forecasts. In fact, VAR-models and their modifications have become the main instrument of economic policy analysis in recent years (Stock, 2001).

At the same time, macroeconomic structural models have also found wide applications. The most famous models are MEFISTO, MIMOZA (Pisani-Ferry, 1990) and BAF (France), the Klein model (the application of this model you can find in the paper of Renfro, 2009), the Klein–Goldberger model (the USA), QPM, DRI (Canada) and many others.

In this study, an adequate stable model for the Ukrainian economy was built with the help of eight macroeconomic variables in six equations. The work is divided into several sections. The first section deals with the dynamics of variables used in the models, the role of external and political factors. The second section describes the methodology of model evaluation, and the third one contains a description of each model and an analysis of dependencies. The last section includes conclusions and proposals on how to improve the economic policy in Ukraine.

Analysis of economic variables used in the models

For a correct analysis, the researcher should have some idea about the behaviour of a model’s main factors. For this purpose, the dynamics of model factors was analysed on the basis of data of the State Committee of Statistics and the Statistical Yearbook of the National Bank of Ukraine. This part of the article also examines the situation of Ukrainian economy which suffered from serious trials of the crisis effects in 2008.

The growth of export in 2002, which was estimated at 126.55 billion UAH, was the result of accretion of food, the fuel–energy complex, and metallurgy. In 2003, due to the rise of the world prices of the key goods of Ukrainian export, as well as the buildup of import volumes, the rate of foreign trade turnover increased. The export of goods and services in 2003 amounted to 147.75 billion UAH, i.e. by 16.8% more than in the

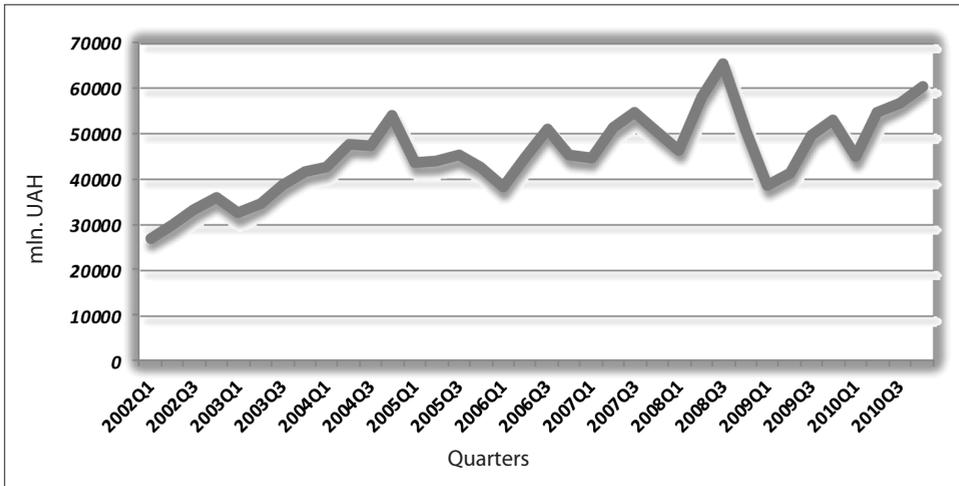


FIG. 1. Dynamics of Ukrainian export of prices in the first quarter of 2002 (2002–2010)

previous year. In 2004, the export grew by the record 30% and amounted to 191.68 billion UAH. The decreased export of machine-building goods caused a decline (about 8.4%) of export growth rate in 2005. The export growth by 2.2% in 2006 was the result of the uplift in prices of metallurgical products, machine-building and chemical goods. Export increased by 12.1% in 2007 due to preserved high prices of raw products and demand for domestic machine-building goods.

The financial crisis in Ukraine took place in the third quarter of 2008. Despite the proliferation of crisis features, the export was growing in the first three quarters and declined sharply only in the fourth quarter. As a result, the export grew by 9.7% in 2008 owing to the rising prices of the basic commodities of Ukrainian export. Consequently,

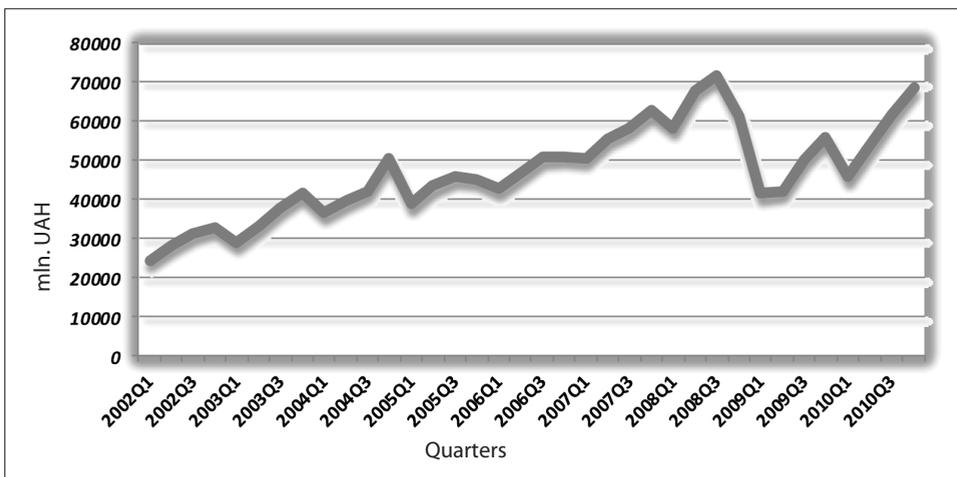


FIG. 2. Dynamics of Ukrainian import in prices of the first quarter of 2002 (2002–2010)

the deteriorating economic environment caused a fall of the export level by 17.3% in 2009. The main reason was the drop of export prices. The situation improved in 2010: the volume of export grew by 18.7%.

There was a growth of import in 2002, but at a slower pace than in the previous period. The increase in import volumes by 21.1% in 2003, which numbered 141.11 billion UAH, was due to the import of machine-building goods, equipment, vehicles and agricultural commodities of foreign production. The year 2004 was characterized by an import increase by 19.3%, which amounted to 168.33 billion UAH. The strong import growth in 2005 was mainly due to the import of chemical and engineering goods. A sharp rise in energy prices, activation of investment demand, a growth of incomes and increasing consumer crediting contributed to the import increase by 33.5%. An upward trend in import took place also in 2006–2007 (10.3% and 18.9% as compared with previous periods, respectively).

The monthly import volumes declined in November–December 2008 as a result of the financial crisis, but the annual import increased by 14.2%. As a consequence, the import volume fell by 26.8% and numbered 189.23 billion UAH in 2009. The reason was the reduction of domestic demand and the rising prices of imported goods. In 2010, the import increased by 20.3%.

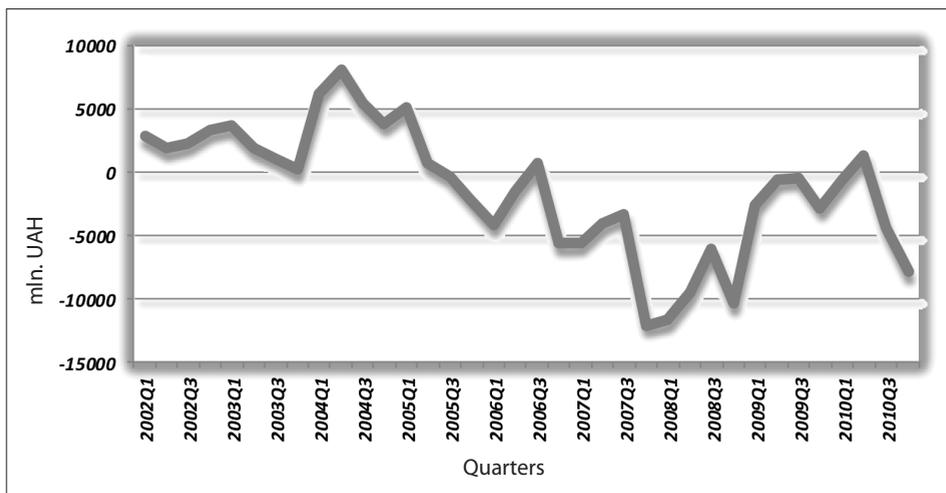


FIG. 3. Dynamics of the net export of Ukraine of prices in the first quarter of 2002 (2002–2010)

Despite the rise of prices of the key goods of Ukrainian export in foreign markets and import increase in our country, the trade surplus fell from 10 billion UAH in 2002 to 6.6 billion UAH in 2003. The positive balance increased 3.5 times in 2004 as compared with the previous period and amounted to 23.36 billion UAH. The year 2005 was characterized by a fall in the trade surplus by 86.9% owing to the reduced volumes

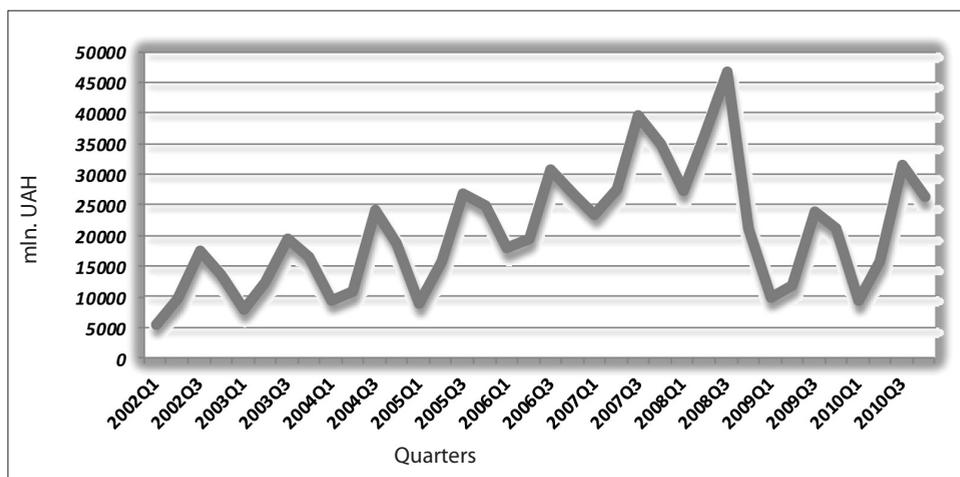


FIG. 4. Dynamics of Ukrainian investment in prices of the first quarter of 2002 (2002–2010)

of export of machine-building goods and a high growth in the import of chemical and engineering products. A negative balance of trade appeared in 2006, which amounted to 10.83 billion UAH. It also increased 2.3 times in 2007. As a result of crisis, in 2008 the Ukrainian trade deficit reached a peak and numbered 37.72 billion UAH. Funds borrowed abroad and on the domestic scene were involved in order to cover this deficit. The gap between import and export was reduced by 83% in 2009. The deficit increased again and reached 11.76 billion UAH in 2010.

In 2002, Ukraine invested 46.49 billion UAH. Investment in Ukraine increased by more than 20% and amounted to 56.3 billion UAH in 2003. 2004 was characterized by an increase in investment by 12.8% versus the previous period. After the Orange Revolution in the end of 2004, the level of investment was steadily growing by 23–33%, which was caused by the growth of the Ukrainian economy, its transparency and the accession to the WTO.

Despite the political crisis in 2007, a record inflow of foreign capital was registered: annual investment increased by 32.5% as compared with the previous period and amounted to 125.88 billion UAH. Investment in Ukraine grew up till the third quarter of 2008, but the annual growth was only 4.9% as compared with the previous period. The liquidity problems of the global financial system led to a significant outflow of investment. For example, the fall of investment in the economy was by more than 50% in 2009. There was a revival of the situation in 2010; investment increased by 24.1%, but Ukraine did not reach the pre-crisis levels of investment.

Consumption in Ukraine was increasing during the period 2002–2008 due to rising incomes, a significant increase in consumer credit in the economy, inflating the mortgage bubble. Obviously, the significant growth of income and consumption naturally led to

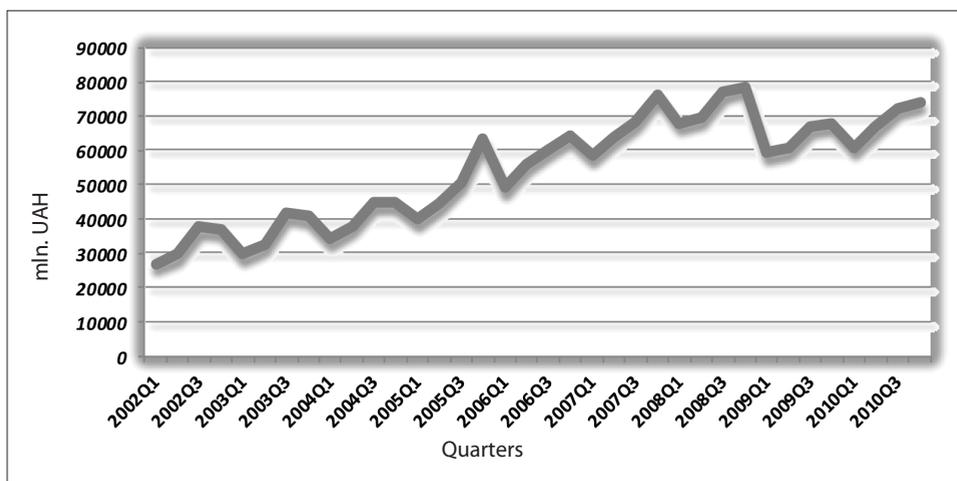


FIG. 5. Dynamics of consumption in Ukraine in prices of the first quarter of 2002 (2002–2010)

higher prices. The approaching financial crisis had a significant impact on consumer possibilities in the country: as early as in 2009 the incomes fell by 7.9% versus 2008, which was actually stopped by consumer and mortgage lending. The first shoots of improvement were observed in 2010. Due to the recovery of the market, consumption increased by 5.9%, but the lack of bank lending under such circumstances leads just to an import growth, which creates new risks for monetary stability.

The population accumulated the income of 17.41 billion UAH in 2002, but this figure dropped to 10.4% and amounted to 15.55 billion UAH in 2003.

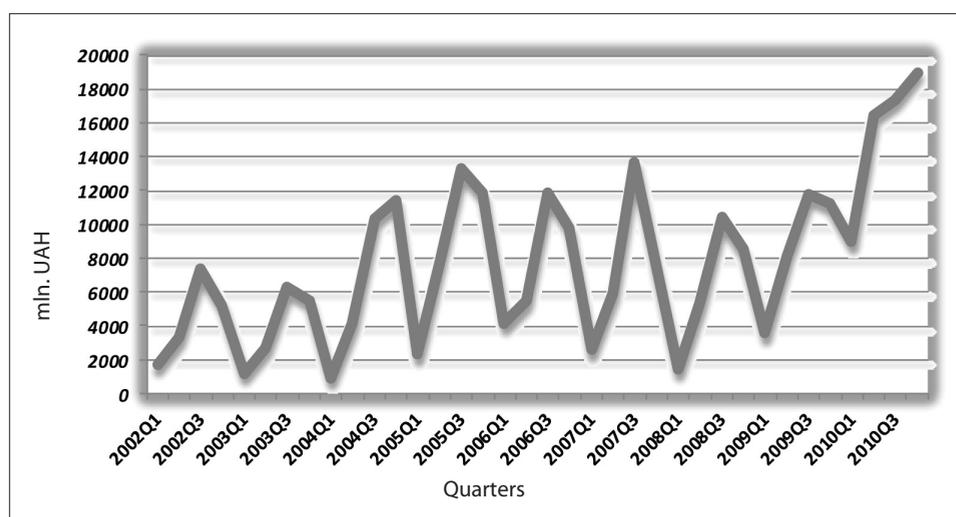


FIG. 6. Dynamics of savings in Ukraine in the prices of the first quarter of 2002 (2002–2010)

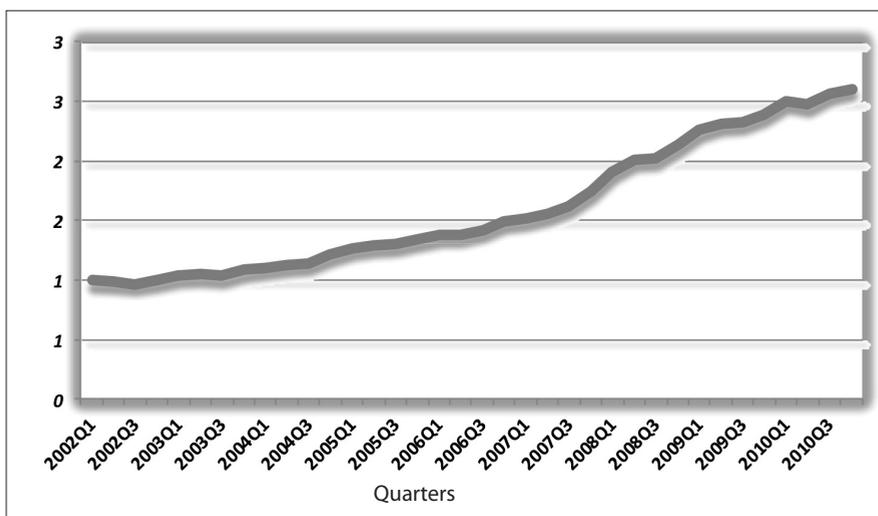


FIG. 7. The growth of the price index versus the first quarter of 2002 (2002–2010)

The next year the population saved 26.69 billion UAH, which was by 71.7% more than in the previous period. The following year (2005) Ukrainians gained even more: savings increased by 31.2% and numbered 35.02 billion UAH. In 2006, we observed a decrease of savings by 13.4%. Next year, despite the economic growth and the enrichment of Ukrainians, savings fell again by 5.2% and numbered 29.42 billion UAH.

Due to a significant devaluation of national currency (50%) in 2008, savings reduced to i.e. by 25.47 billion UAH, i.e. by 13.4% lower than in the previous period. The next period (2009–2010), the population began to invest money again owing to savings' increase by 35.5% and 78.5%, respectively.

The deflation was associated with a reduction in food prices, a stable exchange rate and a strong fiscal policy in 2002. The next year, inflation kept at 108.2% due to an decrease in agricultural production, higher prices for imported grain and communal public services. The inflation remained on the level of about 12.3–16.6% during 2004–2007. In 2008, the inflation processes accelerated: 122.3% compared to 2007 (116.6%) as a result of a growth in food prices in the previous period; 37 countries around the world faced the threat of the food crisis in 2007, which emerged as a result of a rise of food and oil prices, conflicts and natural disasters (droughts, floods, climate differences). There were also an increase of social payments, a salary growth of public sector employees and raising tariffs of communal public services in the third quarter of 2007. As a result, the year 2008 was characterized by a rapid inflation.

The year 2009 was characterized by a slow growth of the CPI – 112.3% compared to 2008 (122.3%). The low aggregate demand due to the decline in population incomes and salaries, the stabilization of exchange rate in the second part of 2009 were the main

This regression shows the dependence of the price index (PI) on the value of the previous two quarters, the dependence of the PI on the trend and residuals of the previous period. It should be noted that dependence of the inflation on its previous period value indicates the inertness of this process. This means that, basically, expectations of the political situation in the country are but not the economic processes the crucial factors in inflation. The previous value of inflation affects our expectations, which in turn influence wages and prices. This confirms a former investigation (Zatonatska, Stavytskyy, 2005).

In addition, the dependence of the PI on its trend indicates a non-stationary process. This means that these time series contain a trend component which indicates the presence of long-term trends in the under study. The moving average tool was also used in the model (1) (Stavytskyy, 2006). It implies using lagged values of residuals in order to improve the forecast and makes it possible to analyse the influence of external shocks on the dependent variable. In the model (1), the coefficient 1.46 by the error correction term means that a shock in one period would be completely absorbed in the next period with an additional influence of 0.46. That would go against economic theory, but it can be explained by the increasing volatility of inflation in Ukraine. Additionally, the stability of the model was also proven by checking the coefficient values of the whole set of models for different periods.

The model (2) was created in order to define the dependenc of export on other macroeconomic factors:

$$\begin{aligned} \Delta \text{export_in_gdp}_t = & 25.107 \cdot \Delta \text{export_duty_in_gdp}_{t-1} + 0.769 \cdot \Delta \text{import_in_gdp}_t - \\ & (3,3) \qquad \qquad \qquad (8,8) \\ & - 0.199 \cdot \Delta \text{import_in_gdp}_{t-3}; R^2 = 0.75, \end{aligned} \quad (2)$$

(-2,1)

- $\Delta \text{export_in_gdp}_t$ – differences of export ratio to GDP;
- $\Delta \text{export_duty_in_gdp}_{t-1}$ – lagged variable of differences of export duty ratio to GDP;
- $\Delta \text{import_in_gdp}_t$ – differences of import ratio to GDP;
- $\Delta \text{import_in_gdp}_{t-3}$ – lagged variable of differences of import ratio to GDP.

The model (2) expresses the dependence of differences of export shares in the GDP on the differences of import shares in GDP, its previous three quarters value and previous period differences of export duty shares in the GDP. The model (2) shows that the growth of differences of export duty ratio to the GDP by 0.01% will increase the growth of differences of the export ratio to GDP by 0.25% the next quarter, and the growth of differences in the import ratio GDP by 1% causes an increase of differences in the export ratio to GDP by 0.8%, and three quarters later will cause a reduction of differences of the export ratio to GDP by 0.2 %.

Let us consider the model (3) of the import of Ukraine:

$$\begin{aligned} \Delta \text{import_in_gdp}_t = & 11.212 \cdot \Delta \text{import_duty_in_gdp}_t + 0.665 \cdot \Delta \text{export_in_gdp}_t - \\ & (5,3) \qquad \qquad \qquad (10,9) \\ & - 0.229 \cdot \Delta \text{export_in_gdp}_{t-1}; \quad R^2 = 0.85, \end{aligned} \quad (3)$$

- $\Delta \text{import_in_gdp}_t$ – differences of import ratio to GDP;
- $\Delta \text{import_duty_in_gdp}_t$ – differences of import duty ratio to GDP;
- $\Delta \text{export_in_gdp}_t$ – differences of export ratio to GDP;
- $\Delta \text{export_in_gdp}_{t-1}$ – lagged variable of differences of export ratio to GDP.

The model (3) expresses the dependence of differences of the import ratio to the GDP on the differences of the import duty ratio GDP, of the export ratio to the GDP and on its previous period value. The regression (3) shows that the growth of differences of import duty ratio to GDP by 0.01% causes the growth of differences of the import ratio to the GDP by 0.11%, and an increase of differences of the export ratio to GDP by 1% causes an increase of differences of the import ratio to the GDP by 0.7%, and an following quarter it will cause a decrease in differences the import ratio to the GDP by 0.3%.

The model investment (4) shows:

$$\begin{aligned} \Delta \text{investment_in_gdp}_t = & -0.462 \cdot \Delta \text{investment_in_gdp}_{t-1} - 0.971 \cdot \Delta \text{investment_in_gdp}_{t-1} - \\ & (-2,5) \qquad \qquad \qquad (-10,9) \\ & - 1.161 \cdot \Delta \text{consumption_in_gdp}_t - 0.501 \cdot \Delta \text{net_export_in_gdp}_{t-1} - \\ & (-12,6) \qquad \qquad \qquad (-2,7) \\ & - 0.585 \cdot \Delta \text{consumption_in_gdp}_{t-1}; \quad R^2 = 0.89, \end{aligned} \quad (4)$$

- $\Delta \text{investment_in_gdp}_t$ – differences of investment ratio to GDP;
- $\Delta \text{investment_in_gdp}_{t-1}$ – lagged variable of differences of investment ratio to GDP;
- $\Delta \text{net_export_in_gdp}_t$ – differences of net export ratio to GDP;
- $\Delta \text{net_export_in_gdp}_{t-1}$ – lagged variable of differences of net export ratio to GDP;
- $\Delta \text{consumption_in_gdp}_t$ – differences of consumption ratio to GDP;
- $\Delta \text{consumption_in_gdp}_{t-1}$ – lagged variable of differences of consumption ratio to GDP.

This model shows the dependence of differences of the investment ratio to the GDP on its previous period values, on differences of the net export ratio to the GDP, on differences of the consumption ratio to the GDP and on their lagged variables.

The inverse ratio of the growth of investment shares to its previous values is caused by the behaviour of stock market participants who follow the same strategy that leads to a significant volatility.

The inverse ratio of differences of investment shares in the GDP to differences of shares of net export in the GDP is explained by the following situation: if more

of net export causes relocation of some consumer goods from the domestic market to foreign markets. At the same time, the consumption of both the population and the state is reduced. There is also an inverse ratio between differences in consumption shares in GDP and differences in investment shares in the GDP. The economy that consumes income almost entirely invests little and is characterized by a slow economic growth. The model shows that the growth of differences in investment ratio to the GDP by 1% reduces the difference of consumption ratio to the GDP by 0.7%. The model also uses a moving average tool (Stavytskyy, 2006) which makes it possible to analyse the influence of external shocks on a dependent variable.

Conclusions

This study was devoted to the analysis of macroeconomic situation in independent Ukraine, the tendency of its development and the definition of interrelations among its major macroeconomic indicators. Six models, based on data for the period 2002–2010, were compiled. They allowed to determine new links among the macroeconomic factors of Ukraine. The dynamics of each variable, based on data of the State Committee of Statistics and the Statistical Yearbook of the National Bank of Ukraine, were also illustrated. As a result, multiple regressions were created by using the method of least squares with an additional analysis of their adequacy and stability.

On the basis of the models, the following recommendations were developed:

1. In the current conditions of Ukraine development, special attention should be given to anti-inflationary policy of the state. It is essential to develop some memes of control able to influence effectively the inflation expectations formed in society.
2. The government should encourage savings of the population in order to increase investment. It is important to restore the trust in financial institutions and to focus on reducing the economy dollarization.
3. Final consumption is one of the most important factors of the economic growth, so it is essential to stimulate processing main export goods within the state.

To solve these problems, public–private partnerships (PPP) are suggested to implement. The basic principle of PPP is a mutually beneficial cooperation between the government and the private sector. This means that, in conditions of capitalist relations, it is actual to implement PPP only with the expected income of such projects. Considering the high rate of return of investment projects in recent years, the risk of absence of investors in case of a low expected profitability should be especially emphasized. In addition, due to the instability of the whole economic system, investors may be dissatisfied with the extremely long pay-off period of the proposed projects.

PPP can be financed from the state budget, with a significant proportion of private or corporate funds. Such projects are characterized by a high debt-to-equity ratio. As a rule, the investor's equity is fluctuating from 10 to 30% of the total amount.

For this reason, the state should take responsibility for an adequate public review, management and negotiation among different partners, a correct analysis of risks. Of course, it is possible only in case of a critical reduction of corruption in decision-making processes, especially those concerning the problems of government purchases.

It is essential to require a full transparency of such a body, beginning from the announcement of projects and up to the efficiency assessment of the accomplished works.

In order to realize these tasks, it is necessary to implement the following steps:

1. To work out a clear list of required projects at national and regional levels with well-defined objectives and tasks, criteria of the assessment of results with estimation of their starting value and a full description of the distribution of property rights, revenues, responsibility in servicing, etc.
2. To identify the priority projects, including sectors' specifications. For example, to begin with the implementation of the projects related to rubbish recycling, using alternative energy sources and the modification of railways.
3. To develop a clear and unambiguous method of selecting private investors that provide the unambiguous interpretation of victory in the respective tenders.
4. To enhance the level of trust and confidence in the government, in the creation of PPP and their implementation through broad public discussions and explanatory work.
5. To increase the investment attractiveness of sectors, particularly those related to the provision of social goods and services. In conditions of underground railway profitability in Ukraine, it is possible to build new lines and to enhance ecological compatibility in Ukraine.

It should be mentioned that, while creating a list of projects, one should take into account the priority of raising the social security of people and solving their common problems. So, for PPP, first of all it is recommended to focus on the following programs:

1. Solving traffic problems through the development of urban electric transport, especially the underground railway and the Light Rail.
2. Increasing ecological compatibility in Ukrainian cities by developing systems for rubbish recycling and alternative power.
3. Solving the problem of the inefficiency of housing and utilities sectors through a temporary transfer of the cold and hot water systems to a private investor.

Nowadays Ukraine is not ready to implement PPP in some areas which were successful in other countries, particularly in the construction of schools, hospitals, prisons, toll roads, military facilities.

To conclude, it should be mentioned that the implementation of PPP in Ukraine may be one of the driving forces of national economy development, implementation

of a new level of life. On the other hand, the state should abandon a number of social benefits and significantly increase the price of social goods and services. In the long run, implementation of PPP will enhance budget incomes and budget expenditures of all levels and will improve the quality of life of the population.

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