

THE SIGNAL SYSTEM OF UKRAINE'S ECONOMY EXTERNAL SUSTAINABILITY: INDICATORS APPROACH

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INTRODUCTION

The main criterion of external instability is considered to be a combination of large current account deficit, real appreciation of the national currency and loss of country's competitiveness which ultimately leads to a drop of its income (Flassbeck, Panizza, 2008). If the improvement in competitiveness leads to a change in the proportions between transferable and non-transferable goods the surplus (or reduction in deficit) of the current account balance needed to repay the debt can be achieved without a decline in real income of the debtor country. In this case the loss of market share by the creditor countries and the reduction of their competitiveness may be observed.

On the other side, from the debt point of view, as the indicator of the external sustainability of the country's economy it should be considered the ratio of its external debt to GDP. This indicator measures the level of external debt in relation to business activity in the country emphasizing its solvency.

In general, the external debt should be comparable with the size of the debtor country. However, the decisive meaning for the external sustainability of the economy has the source of country's income, or rather the source of its income in foreign currency (Wyplosz, 2007).

Analysis of Recent Research and Publications

Criteria and indicators of external sustainability of the economy and methods of its evaluation are considered in papers of W. Buiters, H. Flassbek, J. Horn, S. Nikolaychuk, U. Panizza, S. Shumskaya, M. Skripnichenko, T. Tyshchuk, C. Wyplosz, Y. Zhaliloetc.

Standard indicators do not describe the situation in this field accurately enough. In this case, even the ratio of external debt to exports is not an indicator that can be uniquely used as an indicator of external sustainability. Since, in the presence of a significant export sector, the volume of accumulated funds in foreign currency may not be sufficient if the growth rate of imports exceeds the same indicator for export.

For example, International Organization of Supreme Audit Institutions proposes a number of indicators that measure debt levels or interest payments in relation to different sources of income of the country or are related to the structure of debt (short, medium- and long-term liabilities or fixed or floating liabilities interest rates)(International Organization of Supreme Audit Institutions). The main ones are the following:

- the ratio of external debt to exports that reflects the level of debt load on exports or the ability to accumulate foreign currency; It is needed to use this indicator in conjunction with an indicator reflecting the amount of debt service in relation to exports, and a ratio that compares non-productive expenditures with the volume of international reserves;
- the ratio of net international reserves to external debt that shows how many times external liabilities exceed international reserves; This indicator is used together with the ratio of external debt to the rhythm of accumulation of reserves (shows the number of years required for payment of external debt provided the persistence accumulation rhythm);
- the ratio of depreciation to payments on external debt - the level of debt depreciation;
- the proportion of payments on external debt that indicates the refinancing of debts with new issues. If the indicator is more than 100, the country will not refinance the existing debt.

According to International Monetary Fund classification, all indicators of external sustainability are divided into two groups: indicators based on the size of external debt and ones based on reserve assets (International Monetary Fund, 2000). The first group includes such indicators as the ratio of reserve assets to short-term external debt, the ratio of reserve assets to imports, the ratio of reserve assets to "broad money". The second one includes the ratio of external debt to exports, the ratio of external debt to GDP, the average interest rate on external liabilities, the average maturity of external liabilities, the share of external debt, denominated in foreign currency, to the total value of external liabilities.

Research Methods

For the analysis of the external sustainability of the Ukrainian economy we selected indicators that are divided into five groups (macroeconomic indicators, indicators characterizing the current account position, indicators characterizing the capital account position, debt indicators and indicators characterizing the influence of the external sector):

I. Macroeconomic indicators

1. Rate of GDP growth, %
2. GDP per capita, in constant dollars (2010)
3. Gross national expenditures, % to GDP
4. Expenditure on final consumption, % to GDP
5. Public expenditures on final consumption, % to GDP
6. Public deficit, % to GDP
7. GDP deflator, %

II. Indicators characterizing the current account position

1. Current account balance, % to GDP
2. Gross investment, % to GDP
3. Gross savings, % to GDP
4. Real effective exchange rate (2010 = 100)
5. Exports of goods and services, % to GDP
6. Imports of goods and services, % to GDP
7. Trade balance, % to GDP
8. Changes in terms of trade, national currency
9. Share of high-tech products in total exports, %

III. Indicators characterizing the capital account position

1. The ratio of net direct investment to GDP, %
2. The ratio of portfolio investment to GDP, %
3. Ratio of net foreign assets to GDP, %
4. Differential of interest rates, %
5. The ratio of reserve assets to imports, months of import
6. The ratio of reserve assets to the total external debt, %
7. The ratio of reserve assets to short-term external debt, %
8. The ratio of reserve assets to "broad money", %

IV. Debt Indicators

1. The ratio of gross external debt to GDP, %
2. The ratio of gross external debt to exports, %
3. The ratio of the public and publicly guaranteed external debt to the budget revenues, %
4. The share of external government debt denominated in foreign currency in the total amount of external public liabilities (except for SDRs)
5. Average maturity of external obligations
6. Average interest rate on external public liabilities
7. The ratio of payments for servicing external debt to GDP, %
8. The ratio of payments for servicing external debt to exports, %

V. Indicators characterizing the influence of the external sector

1. The growth rate of world GDP, %
2. Gross investment, % to GDP
3. Gross savings, % to GDP
4. GDP deflator, %
5. World commodity prices index (2005 = 100)
6. World metal prices index (2005 = 100)

7. Index of world prices for agrarian products (2005 = 100)
8. Index of world prices for energy products (2005 = 100).

When analyzing the external sustainability of the economy, also the threshold values of the indicators should be taken into account. The thresholds of indicators depend on many factors such as level of development of the country, the availability of capital markets, the cost of servicing external debt and others.

Instead of applying non-transparent (country policy and its institutions, developed by the World Bank (CPIA) (Wyplosz, 2007) and generalized threshold levels, it is more correct to calculate the individual threshold levels for each country, for example, based on the method described in (International Monetary Fund, Policy Development and Review Department, 2002).

In this research we calculated the threshold percentiles for the indicators of the external sustainability of the Ukrainian economy based on the method described by Karmarkar and Vani (Karmarkar, Vani, 2014) using the signal approach (Goldstein, Kaminsky, Reinhart, 2000), (Kaminsky, Lizondo, Reinhart, 1998), (Kaminsky, 1998), (Kaminsky, 1999), (Kaminsky, Reinhart, 2000).

So, thresholds for each external sustainability indicator are calculated as follows:

$$\alpha = 1 - \frac{A + B}{n} \quad (1)$$

$A + B$ - is the number of correct signals of the indicator;

n - is the number of observations.

The results of threshold percentiles calculation are given in Table 1.

In the research the signal approach also is used to calculate the probability of instability with respect to external perturbations. Due to this approach each indicator signals the emergence of instability regarding external disturbances that reflects in the growth of the current account deficit, the growth of external debt and exports to GDP ratios, a decrease in the ratio of reserve assets to imports, an increase in the ratio of exports and imports of goods and services to GDP and so on.

To identify periods of gross domestic product deviation from the long-term trend it is calculated deviations (negative) of gross domestic product from potential level using the Hodrick-Prescott filter.

Thus, based on the signal approach, to identify the correct signaling from each indicator the noise/signal ratio is calculated:

$$\frac{B}{B + D} / \frac{A}{A + C} \quad (2)$$

A - is the number of correct signals in the case of a deviation from the long-term trend;

B - is the number of correct signals in the absence of a deviation from the long-term trend;

C - is the number of false signals in the case of a deviation from the long-term trend;

D - is the number of false signals in the absence of a deviation from the long-term trend.

Results

The results of the noise-signal ratio calculations showed that 21 indicators have noise-signal ratios that are less than one, but with quite high values (Table 1). In particular, the lowest value of this ratio is observed for gross national expenditures at the level of 0.20, the most one - for world metal prices index with the value of 0.94. Analyzing data on indicator signals, there is a tendency for more accurate identification of volatility since 2008. Therefore, all proposed indicators will be used for further analysis.

In turn, the probabilities of instability under the condition

of a signal from the indicator $\frac{A}{A + B}$ and without

it $\frac{A + C}{A + B + C + D}$ were calculated.

The results of calculations are given in Table 1.

For the majority of indicators, the probability of instability under the signal from the indicator is high enough and exceeds 50%. The probability of instability without signal from indicators exceeds 50% for all indicators except one (reserve assets to imports ratio with probability value of 0.45). In particular, the lowest probability of instability under the signal from the indicator for the ratio of net external assets to GDP is 0.14, the largest - for gross national expenditures as a percentage of GDP - 0.90.

In addition, for each of the five groups of indicators, the average probabilities of instability with the signal from the indicator and without it are determined (Table 1). In turn, the general probabilities of instability under a signal from the indicator and without it are 0.633 and 0.634, respectively.

Conclusions

Based on the signal approach, the threshold percentiles that are inherited to national economy, probabilities of instability due to external disturbances and the noise-signal ratio for each indicator of external sustainability for the Ukrainian economy are calculated.

The noise-signal ratio for 21 indicators are quite high. Nevertheless, identification of the volatility since 2008 demonstrates good accuracy.

For the majority of indicators the probabilities of instability due to the signal from the external sustainability indicator and without it exceed 50%.

The average probabilities of instability under the condition of a signal from indicators and without it for each of the five groups of indicators and the indicators' system in a whole are quite high and exceed 0,6.

Table 1. Results of calculations of threshold percentiles, noise-signal ratios and probabilities of the occurrence of unsustainable external perturbation for indicators of the external sustainability of Ukrainian economy

| № n/n | Indicator | Threshold percentile | Noise- signal ratio | Probability of instability given the signal from indicator | Probability of instability (unc- onditional) |
|------------------------------------|----------------------------------------------------|-------------------------|---------------------------|---------------------------------------------------------------------|----------------------------------------------------|
| 1 | 2 | 3 | 4 | 5 | 6 |
| I. Macroeconomic indicators | | | | | |
| 1 | Rate of GDP growth, % | 65,21 | 0,76 | 0,75 | 0,70 |
| 2 | GDP per capita, in constant dollars (2010) | 60 | 0,76 | 0,70 | 0,64 |
| 3 | Gross national expenditures, % to GDP | 60 | 0,20 | 0,90 | 0,64 |
| 4 | Expenditure on final consumption, % to GDP | 52 | 0,36 | 0,83 | 0,64 |
| 5 | Public expenditures on final consumption, % to GDP | 48 | 1,52 | 0,54 | 0,64 |
| 6 | Public deficit, % to GDP | 61,90 | 0,67 | 0,75 | 0,67 |
| 7 | GDP deflator, % | 100 | 1 | 0,67 | 0,67 |
| | Average probability of instability | | | 0,73 | 0,66 |

| II. Indicators characterizing the current account position | | | | | |
|--------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-------|------|-------------|-------------|
| 1 | Current account balance, % to GDP | 42,85 | 1 | 0,67 | 0,67 |
| 2 | Gross investment, % to GDP | 52 | 0,59 | 0,75 | 0,64 |
| 3 | Gross savings, % to GDP | 48 | 0,36 | 0,83 | 0,64 |
| 4 | Real effective exchange rate (2010 = 100) | 47,82 | 1,56 | 0,50 | 0,61 |
| 5 | Exports of goods and services, % to GDP | 56 | 1,48 | 0,50 | 0,64 |
| 6 | Imports of goods and services, % to GDP | 52 | 1,27 | 0,58 | 0,64 |
| 7 | Trade balance, % to GDP | 40 | 2,03 | 0,47 | 0,64 |
| 8 | Changes in terms of trade, national currency | 52 | 1,27 | 0,58 | 0,64 |
| 9 | Share of high-tech products in total exports, % | 57,89 | 1,03 | 0,63 | 0,63 |
| | Average probability of instability | | | 0,62 | 0,64 |
| III. Indicators characterizing the capital account position | | | | | |
| 1 | Ratio of net direct investment to GDP, % | 35 | 1,16 | 0,62 | 0,65 |
| 2 | Ratio of portfolio investment to GDP, % | 30 | 1,03 | 0,64 | 0,65 |
| 3 | Ratio of net foreign assets to GDP, % | 50 | 8 | 0,14 | 0,57 |
| 4 | Differential of interest rates, % | 39,13 | 0,91 | 0,71 | 0,70 |
| 5 | Ratio of reserve assets to imports, months of import | 65,21 | 0,21 | 0,80 | 0,45 |
| 6 | Ratio of reserve assets to the total external debt, % | 62,5 | 0,61 | 0,73 | 0,63 |
| 7 | Ratio of reserve assets to short-term external debt, % | 41,67 | 0,42 | 0,80 | 0,63 |
| 8 | Ratio of reserve assets to "broad money", % | 50 | 4 | 0,33 | 0,67 |
| | Average probability of instability | | | 0,60 | 0,62 |
| IV. Debt Indicators | | | | | |
| 1 | Ratio of gross external debt to GDP, % | 66,67 | 0,67 | 0,75 | 0,67 |
| 2 | Ratio of gross external debt to exports, % | 57,1 | 1,30 | 0,56 | 0,62 |
| 3 | Ratio of the public and publicly guaranteed external debt to the budget revenues, % | 62,5 | 3,75 | 0,25 | 0,56 |
| 4 | The share of external government debt denominated in foreign currency in the total amount of external public liabilities (except for SDRs) | 75 | 0,63 | 0,67 | 0,56 |
| 5 | Average maturity of external obligations | 37,5 | 0,42 | 0,80 | 0,63 |
| 6 | Average interest rate on external public liabilities | 62,5 | 3,33 | 0,33 | 0,63 |
| 7 | Ratio of payments for servicing external debt to GDP, % | 66,67 | 1,20 | 0,63 | 0,67 |
| 8 | Ratio of payments for servicing external debt to exports, % | 54,54 | 0,92 | 0,70 | 0,68 |
| | Average probability of instability | | | 0,61 | 0,62 |
| V. Indicators characterizing the influence of the external sector | | | | | |
| 1 | The growth rate of world GDP, % | 60 | 1,78 | 0,50 | 0,64 |
| 2 | Gross investment, % to GDP | 48 | 1,11 | 0,62 | 0,64 |
| 3 | Gross savings, % to GDP | 52 | 0,89 | 0,67 | 0,64 |
| 4 | GDP deflator, % | 40 | 0,89 | 0,67 | 0,64 |
| 5 | World commodity prices index (2005 = 100) | 56,52 | 1,56 | 0,50 | 0,61 |
| 6 | World metal prices index (2005 = 100) | 48 | 0,94 | 0,62 | 0,60 |
| 7 | Index of world prices for agrarian products (2005 = 100) | 56 | 0,86 | 0,64 | 0,60 |
| 8 | Index of world prices for energy products (2005 = 100) | 56,52 | 0,80 | 0,7 | 0,65 |
| | Average probability of instability | | | 0,61 | 0,63 |

Source: calculated by authors

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SUMMARY

In the paper, the signal system of Ukraine's economy external sustainability is considered. For this purpose it is presented the Ukraine's economy external sustainability indicators system that consists of 40 indicators that are divided into five groups: macroeconomic indicators; indicators, characterizing the current account position; indicators, characterizing the capital account position; debt indicators and indicators, characterizing the influence of the external sector.

Based on the signal approach, the threshold percentiles, the probabilities of instability occurrence due to external disturbances and the noise-signal ratio for each indicator of external sustainability for the Ukrainian economy are calculated.

The results of the noise-signal ratio calculations showed that their values for 21 indicators are quite high but less than one. Based on analysis of indicators' signals, there is a clear tendency of more accurate identification of the volatility since 2008.

For the overwhelming majority of indicators the probabilities of an unstable situation arising due to the signal from the indicator are high and exceed 50%. The probability of an unstable situation occurring without indicators' signals for all external sustainability indicators except one also exceeds 50%. In addition to it for each of the five groups of indicators and the indicators' system in a whole the average probabilities of unstable situation occurrence is calculated under the condition of a signal from indicators and without it.