Granger Causality Analysis of Foreign Trade Impact on Economic Growth: Case of Azerbaijan

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Abstract: - Main purpose of the investigation is to define existing of causality relationship between foreign trade activity of Azerbaijan and economic growth. There were used OLS method and cointegration between some macroeconomic indicators. Main conclusion is that there is not causality effect between import and GDP, but GDP growth is cause for changing import for lag=3. As well as there is causality effect between GDP growth and export. But there is not strong causality effect between foreign trade openness, foreign trade freedom and economic growth.

Key-Words: foreign trade; import; export; Granger causality; trade freedom; foreign trade openness; trade balance; GDP

1. Introduction
One of the important factors for economic development in any country is foreign trade. Both aspects of foreign trade, i.e. imports, and exports, have a certain effect on the country's gross domestic product (GDP). In the calculation of the GDP of each country by the cost method, the volume of imports is included as a negative factor and the volume of exports as a positive factor. However, the impact of foreign trade on GDP or economic growth, its quantitative assessment is not so simple. Compliance with modern econometric requirements in conducting such assessments has a significant impact on the quality of calculations. Thus, econometric calculations must meet scientifically reliable criteria. One of such reliability criteria is to check the indicators with various econometric tests before performing regression analyses.

In our study, we looked at the dependence of gross domestic product on imports, exports, trade balances, and total trade, as well as dependence on foreign trade freedom and openness. It is necessary to assess and improve government policy on foreign trade. For this purpose, we need to determine in advance how reliable the regression dependencies between these indicators are. The most common of such tests in economic theory is to check the stationarity of the indicators, e.g. by the Dickey-Fuller test, is widely used.

2. Literature review
It should be noted that the impact of foreign trade, especially exports, on economic growth in different countries leads to different results. Akanni (2007) econometrically calculates the effects of oil exports on economic growth using the least squares method, concluding that the effects of investment in the oil sector and oil rents on economic growth are positive. However, in some African countries, oil rents do not provide economic growth. An econometric analysis of the impact of Nigeria's oil export revenues on economic growth also suggests that while oil exports have had some effect on economic growth, they are not significant. Akanni analyzes the effects of Indonesian exports on economic growth with the VAR model and concludes that such effects are strong for Indonesia [1]. Gemechu uses the method of cointegration and error correction to show that there is a significant link between exports and economic growth for Abyssinia [2]. Erfani studied the effects of export activity on economic growth for Asian and Latin American countries between 1965 and 1995 and concluded that there was a positive relationship between these two indicators [3]. Studies for India, Pakistan, the Philippines, Malaysia and Thailand from 1973 to 1993 also show a positive link between exports and economic growth, as well as the liberalization of foreign trade and the increase in exports and foreign investment [4].

Balaguér compares the economic development of middle-income countries with less export-oriented countries than those with export-oriented countries and concludes that the former have faster growth [5]. These studies also show that any form of government support for exports does not have a significant impact on economic growth. Lin analyzed the state of the Chinese economy in the 1990s using a new valuation method and proved that...
a ten percent increase in China's exports leads to a
one percent increase in the economy [6].
Almost all countries have rules restricting imports.
Singapore, the world's most liberal import regime,
also has some restrictions on the import of certain
goods and services [7]. Some countries, even the
United States and European countries, which
promote globalization and trade liberalization in the
world, try to limit their imports to a certain extent.

2.1. Methodology
We will make sure that there is a correct
regression relationship between the studied
indicators by checking the periodicity of the time
sequence of these indicators. If in the initial
approach we will consider that \( y_t = \rho \cdot y_{t-1} + v_t \)
dependent, or \( y_t = \alpha + \rho \cdot y_{t-1} + v_t \)
dependent \( |\rho| < 1 \) if so, then \( y_t \) is a stationary time sequence.
This first-degree autoregression will be considered
AR (1). Here \( \mu = E(y_t) \cdot y_{t-1} \) is a mathematical
expectation of the time sequence.

In the next approximation, we will use a Dickey-
Fuller test (a stable but not trending) to increase the
accuracy of the regression relationship. That is, we
will assume that
\[
\Delta y_t = \alpha + \gamma \cdot y_{t-1} + v_t \text{ dependent}
\]
\( H_0: \rho = 1 ~ \sim H_0: \gamma = 0 \text{ if so, the } y_{t} \text{ time}
sequence is not stationary. \)
However, if \( H_1 : \rho < 1 ~ \sim H_1 : \gamma < 0 \) and \( \tau < t_e \),
then the time sequence \( y_t \) is stationary.
Here \( t_e \) are critical values for tau statistics. The
estimates proposed by R. Davidson and J.G.
MacKinnon (1993) will be taken as the critical
values of the tau statistics during the calculations.

It is not correct to determine the extent to which
foreign trade activity affects economic growth in
terms of multiple regression alone. Because a simple
linear regression relationship between two
indicators does not indicate a cause-and-effect
relationship between these indicators. In other
words, the connection can be "fake". Therefore,
the Granger causality test is used to determine whether
the relationship with specific econometric tests is
false and whether the relationship between the
indicators is a "cause-and-effect" relationship. The
Granger causality test allows the prediction of
another time series through one-time series. It
should be noted that such a prediction is necessary,
but not sufficient, for the necessity of a cause-and-
effect relationship.

3. Results
3.1. Causality relationship between import and
GDP

The Granger test can be performed for \( \Delta MP_t \) and
\( GDP_t \). However, it should be noted that none of
these time series is stationary to degree I (0).
However, the simple linear regression dependence
between these two indicators is quite strong \( (R^2 = 0.86) \).
The F-significance level is \( 2 \cdot 10^{-10} \).
However, this does not mean that there is a cause-
and-effect relationship. Granger test shows no
causal relationship between these two indicators
(Table 2).

Table 2

<table>
<thead>
<tr>
<th>Lag=1</th>
<th>Lag=2</th>
<th>Lag=3</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta MP_t \rightarrow GDP_t )</td>
<td>F-statistics</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>P-probability</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td>hypothesis</td>
<td>( H_0 )</td>
</tr>
<tr>
<td>( GDP_t \rightarrow \Delta MP_t )</td>
<td>F-statistics</td>
<td>1.67</td>
</tr>
<tr>
<td></td>
<td>P-probability</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>hypothesis</td>
<td>( H_0 )</td>
</tr>
</tbody>
</table>

Note: Calculated by the author via the eViews
software package.

3.2. Causality relationship between import
growth and GDP growth
Calculations show that there is a moderate
correlation between \( \Delta GDP_t \) and \( \Delta MP_t \). However,
the existence of such a relationship does not yet
confirm the existence of a causal relationship
between these indicators. However, the Granger test
proves that there is no causal relationship between
these two indicators, and the hypothesis \( H_0 \) is valid
in both directions when lag = 1 and 2. When Lag = 3,
the hypothesis \( H_0 \) does not justify itself in one
direction, or rather in the direction of \( \Delta GDP_t \rightarrow \Delta MP_t \). In this case, we can say that economic
growth in Azerbaijan affects the change in imports
with a delay of 3 years. In the opposite direction,
there is no causal relationship (Table 1).

Table 1

<table>
<thead>
<tr>
<th>Lag=1</th>
<th>Lag=2</th>
<th>Lag=3</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta GDP \rightarrow \Delta MP )</td>
<td>F-statistics</td>
<td>0.44</td>
</tr>
<tr>
<td></td>
<td>P-probability</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>hypothesis</td>
<td>( H_0 )</td>
</tr>
</tbody>
</table>

Note: Calculated by the author via the eViews
software package.
3.3 Causality relationship between export and GDP

The linear regression relationship between exports and GDP over the last 23 years is quite strong ($R^2 = 0.95$). The F-significance level is $7.35 \times 10^{-15}$. However, to prove that such a strong regression relationship is indeed a cause-and-effect relationship, we must examine the existence of the Granger cause between the time series. Calculations show that for lag = 1, 2 and 3 for $\Delta EXP_t$ and $\Delta GDP_t$, the Granger test shows a causal relationship between these two indicators (Table 3). However, such a causal relationship is one-sided, or more precisely, the volume of exports is the cause of GDP.

Table 3

In the case of Lag = 1; 2 and 3, the results of the Granger test on the effects of changes in the volume of exports in Azerbaijan on changes in GDP and vice versa

<table>
<thead>
<tr>
<th>Lag=2</th>
<th>Lag=3</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistics</td>
<td>P-probability</td>
</tr>
<tr>
<td>EXP_t $\rightarrow$ GDP_t</td>
<td>0.29</td>
</tr>
<tr>
<td>GDP_t $\rightarrow$ EXP_t</td>
<td>1.17</td>
</tr>
</tbody>
</table>

Note: Calculated by the author via the eViews software package.

3.4. Causality relationship between export growth and GDP growth

Calculations show that there is a high degree of correlation between $\Delta GDP_t$ and $\Delta EXP_t$ ($R^2 = 0.778252$; F-significance rate = $5.67 \times 10^{-8}$). However, the seriousness of such a relationship between these indicators does not justify its causal relationship. Calculations show that according to the Granger test between changes in exports and GDP on the basis of 1, 2 and 3-year lags, there is no causal relationship in both directions, and for Azerbaijan these two indicators are not conditioned (Table 4). It should be noted that at first glance, the steady increase in exports over the past 20 years with the increase in GDP allowed us to draw the wrong conclusion that the main reason for the increase in exports in Azerbaijan is the increase in GDP. Or, conversely, the increase in exports is due to an increase in GDP. However, the Granger test proves that there is no causal relationship between these two indicators and lag = 1; 2; In the case of 3, the hypothesis $H_0$ is valid in both directions. Unlike the one-way causality between the volume of exports and the volume of GDP, there is no causality in the relationship between changes in these indicators. In other words, changes in Azerbaijan's exports do not lead to GDP growth. Also, GDP growth does not lead to changes in exports.

Table 4

In the case of Lag = 1; 2 and 3, the results of the Granger test on the effects of changes in the volume of exports in Azerbaijan on changes in GDP and vice versa

<table>
<thead>
<tr>
<th>Lag=1</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistics</td>
</tr>
<tr>
<td>$\Delta EXP_t$ $\rightarrow$ $\Delta GDP_t$</td>
</tr>
<tr>
<td>$\Delta GDP_t$ $\rightarrow$ $\Delta EXP_t$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lag=2</th>
<th>Lag=3</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistics</td>
<td>P-probability</td>
</tr>
<tr>
<td>$\Delta GDP_t$ $\rightarrow$ $\Delta EXP_t$</td>
<td>0.64</td>
</tr>
<tr>
<td>$\Delta EXP_t$ $\rightarrow$ $\Delta GDP_t$</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Note: Calculated by the author via the eViews software package.
regression relationship is indeed a cause-and-effect relationship, we must examine the existence of the Granger cause between the time series. Calculations show that for lag = 2 and 3 for \( TB_t \) and \( GDP_t \), the Granger test shows no causal relationship between these two indicators (Table 5). The Granger test shows that in the case of lag = 1, there is a one-way, ie causal relationship from the trade balance to the volume of GDP. However, if we consider that \( TB_t \) and \( GDP_t \) are not stationary time series, then it is doubtful that such a relationship is true.

Table 5

<table>
<thead>
<tr>
<th></th>
<th>Lag=1</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>F-statistics</td>
<td>P-probability</td>
<td>hypothesis</td>
</tr>
<tr>
<td>( TB_t \rightarrow GDP_t )</td>
<td>7.27</td>
<td>0.01</td>
<td>( H_1 )</td>
</tr>
<tr>
<td>( GDP_t \rightarrow TB_t )</td>
<td>1.49</td>
<td>0.24</td>
<td>( H_0 )</td>
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</table>

Table 6

<table>
<thead>
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<th></th>
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<tbody>
<tr>
<td></td>
<td>F-statistics</td>
<td>P-probability</td>
<td>hypothesis</td>
</tr>
<tr>
<td>( TT_t \rightarrow GDP_t )</td>
<td>9.93</td>
<td>0.01</td>
<td>( H_1 )</td>
</tr>
<tr>
<td>( GDP_t \rightarrow TT_t )</td>
<td>5.07</td>
<td>0.04</td>
<td>( H_1 )</td>
</tr>
</tbody>
</table>

Note: Calculated by the author via the eViews software package

3.6. Causality relationship between trade balance growth and GDP growth

Calculations show that there is also a high degree of correlation between \( GDP \) and \( 
\Delta TB_t \) \((R^2 =0.646407; \) F-significance rate\( =6.54*10^-6\). However, the seriousness of such a relationship between these indicators does not justify its causal relationship. Calculations show that according to the Granger test between the trade balance and GDP changes on the basis of 1, 2 and 3-year lags, there is no causal relationship in both directions, and for Azerbaijan these two indicators are not conditioned. It should be noted that although one of the main components in the calculation of GDP on the basis of costs is "net foreign trade", in other words, "trade balance", the Granger test proves that there is no causal relationship between these two indicators and lag = 1; 2; In the case of 3, the hypothesis \( H_0 \) is valid in both directions.

Table 7

<table>
<thead>
<tr>
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<td>5.07</td>
<td>0.04</td>
<td>( H_1 )</td>
</tr>
</tbody>
</table>

Note: Calculated by the author via the eViews software package

3.7. Causality relationship between trade turnover and GDP

The linear regression relationship between trade turnover and GDP over the last 23 years is quite strong \((R^2 = 0.97)\). The F-significance level is \(9*10^{-18}\). However, to prove that such a strong regression relationship is indeed a cause-and-effect relationship, we must examine the existence of the Granger cause between the time series. Calculations show that for \( TT \) and \( GDP_t \) lag = 1, the Granger test shows that there is a two-way causal relationship between these two indicators (Table 7). However, in the case of lag = 2 and 3, the Granger test shows that there is no causal relationship between these two indicators in any direction.

Table 8

<table>
<thead>
<tr>
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<th>Lag=2</th>
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<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>F-statistics</td>
<td>P-probability</td>
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<tr>
<td>( TT_t \rightarrow GDP_t )</td>
<td>9.93</td>
<td>0.01</td>
<td>( H_1 )</td>
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<tr>
<td>( GDP_t \rightarrow TT_t )</td>
<td>5.07</td>
<td>0.04</td>
<td>( H_1 )</td>
</tr>
</tbody>
</table>

Note: Calculated by the author via the eViews software package
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3.8. Causality relationship between trade turnover growth and GDP growth

Calculations show that there is also a high degree of correlation between $\Delta GDP$ and $\Delta TT_t$ ($R^2 = 0.82$; F-significance rate $= 5.27 \times 10^{-9}$). However, the seriousness of such a relationship between these indicators does not justify its causal relationship. Calculations show that according to the Granger test, there is no causal relationship between trade turnover and GDP change on the basis of 1, 2 and 3-year lags, and for Azerbaijan these two indicators are not conditioned and the hypothesis $H_0$ is valid in both directions (Table 8).

Table 8
Results of the Granger test on the effects of changes in trade turnover in Azerbaijan on changes in GDP and vice versa

<table>
<thead>
<tr>
<th></th>
<th>Lag=1</th>
<th>Lag=2</th>
<th>Lag=3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta TT_t \rightarrow \Delta GDP_t$</td>
<td>0.79</td>
<td>0.33</td>
<td>0.53</td>
</tr>
<tr>
<td>$\Delta GDP_t \rightarrow \Delta TT_t$</td>
<td>0.31</td>
<td>0.73</td>
<td>0.38</td>
</tr>
</tbody>
</table>

Note: Calculated by the author via the eViews software package

3.9 Causality relationship between trade freedom and GDP

Calculations show that the correlation between $\Delta GDP_t$ and foreign trade vulnerability ($TO_t$) is also very weak ($R^2 = 0.135$; F-significance rate $= 0.093$). Given the stationary nature of the time series of both indicators, if we perform the Granger test on the basis of 1, 2 and 3-year lags, we see that there is no causal relationship between these two indicators and the hypothesis $H_0$ is valid in both directions (Table 9).

Table 9
Results of the Granger test on the impact of the level of trade freedom in Azerbaijan on changes in GDP and vice versa

<table>
<thead>
<tr>
<th></th>
<th>Lag=1</th>
<th>Lag=2</th>
<th>Lag=3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$TO_t \rightarrow \Delta GDP_t$</td>
<td>1.39</td>
<td>3.56</td>
<td>2.58</td>
</tr>
<tr>
<td>$\Delta GDP_t \rightarrow TO_t$</td>
<td>0.51</td>
<td>3.56</td>
<td>0.51</td>
</tr>
</tbody>
</table>

Note: Calculated by the author via the eViews software package

3.10. Causality relationship between trade openness and GDP growth

Calculations show that the correlation between $\Delta GDP_t$ and foreign trade vulnerability ($TO_t$) is also very weak ($R^2 = 0.135$; F-significance rate $= 0.093$). Given the stationary nature of the time series of both indicators, if we perform the Granger test on the basis of 1, 2 and 3-year lags, we see that there is no causal relationship between these two indicators and the hypothesis $H_0$ is valid in both directions (Table 10).

Table 10
Results of the Granger test on the impact of the level of trade openness in Azerbaijan on changes in GDP and vice versa

<table>
<thead>
<tr>
<th></th>
<th>Lag=1</th>
<th>Lag=2</th>
<th>Lag=3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$TO_t \rightarrow \Delta GDP_t$</td>
<td>1.39</td>
<td>3.56</td>
<td>2.58</td>
</tr>
<tr>
<td>$\Delta GDP_t \rightarrow TO_t$</td>
<td>0.51</td>
<td>3.56</td>
<td>0.51</td>
</tr>
</tbody>
</table>

Note: Calculated by the author via the eViews software package
4. Conclusion

Thus, the Granger test examines the cause and effect of GDP and its dependence on indicators that characterize foreign trade activity, including imports, exports, trade balance, trade turnover, trade freedom and trade openness, among these indicators in Azerbaijan. cause-and-effect relationships are very weak. The main reason for this is most likely that the bulk of the country's GDP is related to oil and gas production.

References:


