TAX BURDEN AND INNOVATION ACTIVITIES: THE INTERRELATION PROBLEM

Abstract. This article provides a study of the theoretical and applied aspects of the relationship between tax burden and innovation activities. The hypothesis of the transmission mechanism between tax burden and innovation activities might be illustrated by the following logical chain: Tax burden → Tax incidence → ... → Innovation activities. It is reasonable to interpret tax burden and tax incidence relationship in terms of the approach of “losses-benefits”. This approach creates a theoretical basis for explaining not only the reversed, but also the direct link – a situation where the increase of tax burden (up to a certain optimal amount) does not limit innovation activities. An attempt is made to evaluate the closeness of this relationship between tax burden and innovation activities in EU countries and Ukraine. For the calculation based on panel data from 27 EU countries we used the information of eight parameters, six of which are indicators of tax burden, and the last two – indicators of innovation activities. The tax burden in the EU, as defined by the percentage of all collected taxes to GDP and the share of direct taxes are closely related to two innovation activities indicators – innovation activities index and the share of expenditure on innovation activities in GDP. Our findings in the area of the relationship between indicators of tax burden and innovation activities in Ukraine give grounds to draw the following conclusions: this relationship is unlikely to exist or, if it exists, it is inverse, i.e. an increase in the tax burden, (as the share of total taxes in GDP and as the share of indirect taxes in GDP) limits the volume of innovation activities. The conclusions stress the importance of the investigation of the relationship between tax burden and innovation activities for the Government tax management decisions.

Keywords: tax burden; tax incidence; innovation activities; tax burden and innovation relationship model; state management.

JEL Classification: E10, E62, H22, H39, O31, O57

Introduction. An assumption that innovators are entities of the economy connected with innovation activities who ought to react to tax burden changes is quite simple and realistic. The problem of the relationship between tax burden and innovation activities becomes obvious and shaped if we try to answer the following additional questions: 1) if this relationship has media-

ing links; 2) in terms of direction what nature has this relation-

ship (direct or inverse); 3) if there are any differences in this rela-

tionship implementation in countries with different levels of development; 4) in what way a government can use the informa-

tion about this relationship to make management decisions. In this article we make an attempt to answer mentioned questions.

The purpose of this article is to specify theoretical grounds of tax burden and innovation activities relationship as well as to analyse this relationship in order to justify the necessity of its consideration by the government while making management decisions.

Brief Literature Review. All macroeconomic scholars who emphasise the problem of tax influence on the general eco-


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**Results.** The answer to the question about mediating links in the relationship between tax burden and innovation activities ought to be positive. At least one link exists between tax burden and innovation activities – tax incidence or excess tax burden between different indicators selected to assess tax burden and innovation activities. It can be tested by calculating the relationship between tax burden and innovation activities. It is this approach that further makes it possible to come to the issue of innovation activities. The «losses-benefits» approach creates a theoretical basis for explaining not only the reversed, but also the direct link – a situation where the increase of tax burden (up to a certain optimal amount) does not limit innovation activities. The latter is an undeniable society benefit, that is connected to the growth of wealth and prosperity. The presence of a direct link between tax burden and innovation, according to the logic of the proposed approach, can be explained by the consistently positive choice of economic entities for these activities, despite some increase in tax burden. We assume that the relationship between tax burden and innovation activities is a nonlinear function similar to the Laffer curve.

We are trying to determine how realistic the assumption is about the existence of direct and inverse relationship between tax burden and innovation activities. It can be tested by calculation. To answer the third question we estimated the relationship between different indicators selected to assess tax burden and innovation activities in EU Member States and Ukraine.

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For the calculation based on panel data from 27 EU countries we used the information [15] on the value (for two post-crisis years – 2010 and 2011) of eight parameters, six of which are indicators of tax burden, and the last two – indicators of innovation activities:

- the total tax revenue into budget (including social contributions) as % of GDP – $T_{tax}$ / Y;
- the total tax revenue (excluding social security contributions) as % of GDP – $T_{out}$ / Y;
- budget revenues from direct taxes as % of GDP – $T_{direct}$ / Y;
- budget revenues from indirect taxes as % of GDP – $T_{indirect}$ / Y;
- taxes on labour as % of GDP – $T_{l}$ / Y;
- taxes on capital as % of GDP – $T_{k}$ / Y;
- expenditure on innovation as % of GDP – IE / Y;
- composite index of innovation – $SII$.

The formula set out below, in our opinion, reflects tax burden and tax incidence relationship in terms of «losses-benefits» theory (Figure).

<table>
<thead>
<tr>
<th><strong>Losses</strong></th>
<th><strong>Benefits</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax burden</td>
<td>Tax incidence</td>
</tr>
</tbody>
</table>

The index of innovation is a composite index to determine the level of innovation activities for EU countries and 10 major global competitors based on a set of 25 indicators.
According to the matrix of pairwise correlations (calculated using the data [15; 16; 17]), the most significant relationships (R75%) are relationships between:

- the share of total taxes (including social contributions) in GDP ($T_{tax}^{tot}$) and overall innovation activities index (SII) - R = 0.78,
- the share of total taxes (including social contributions) in GDP ($T_{tax}^{tot}$) and expenditure on innovation activities in GDP ($IE^{tot}$) - R = 0.76,
- the share of direct taxes in GDP ($T_{tax}^{dir}$) and overall innovation activities index (SII) - R = 0.75.

Relationships between all studied variables are direct, which means unidirectional changes in innovation activities and tax burden indicators. The latter can be interpreted in terms of the «loss-benefits» approach as tax incidence reduction and increase in society’s «innovation benefits» against tax burden increase.

To assess the essentiality of the relationships (distinguished as a result of pairwise correlations matrix construction) we used the analytical groupings method. Presented in Table 1 are analytical groupings, used to assess the essentiality of the relationship between tax burden and innovation activities indicators in EU countries.

<table>
<thead>
<tr>
<th>Intervals according to tax burden</th>
<th>Number of countries</th>
<th>Innovation indicator value</th>
<th>The average value of innovation group indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytical groupings to assess the essentiality of the relationship between $T_{tax}^{tot}$ and SII</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26,00 - 33,00</td>
<td>10</td>
<td>0.263; 0.233; 0.221; 0.243; 0.286; 0.566; 0.348; 0.392; 0.278; 0.472</td>
<td>3.300/10 = 0.330</td>
</tr>
<tr>
<td>33,10 - 38,00</td>
<td>9</td>
<td>0.426; 0.319; 0.504; 0.411; 0.622; 0.332; 0.708; 0.503; 0.588</td>
<td>4.412/9 = 0.490</td>
</tr>
<tr>
<td>38,10 - 48,10</td>
<td>8</td>
<td>0.591; 0.578; 0.432; 0.678; 0.609; 0.559; 0.734; 0.697</td>
<td>4.878/8 = 0.610</td>
</tr>
<tr>
<td>SUM</td>
<td>27</td>
<td>12.59</td>
<td>1.430/3 = 0.477</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analytical groupings to assess the essentiality of the relationship between $T_{tax}^{tot}$ and $IE^{tot}$</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>26,00 - 33,00</td>
<td>10</td>
<td>0.86; 0.59; 0.65; 0.48; 0.66; 1.72; 0.60; 1.36; 0.75; 2.01</td>
<td>9.66/10 = 0.97</td>
</tr>
<tr>
<td>33,10 - 38,00</td>
<td>9</td>
<td>1.54; 0.69; 0.49; 1.71; 1.76; 1.19; 2.83; 1.46; 2.28</td>
<td>13.93/9 = 1.55</td>
</tr>
<tr>
<td>38,10 - 48,10</td>
<td>8</td>
<td>1.95; 2.77; 1.26; 3.84; 2.03; 2.24; 3.38; 3.08</td>
<td>20.54/8 = 2.57</td>
</tr>
<tr>
<td>SUM</td>
<td>27</td>
<td>44.13</td>
<td>5.08/3 = 1.69</td>
</tr>
</tbody>
</table>

Source: Composed by the authors

The results of the study on tax burden and innovation activities indicators using the analytical groupings method, which involves the calculation of the total variance $\sigma^2$, intergroup variance $\sigma^2$, correlation ratio $r^2$ and application of correspondence criteria according to the Table 1 of critical values give grounds to the following generalizations:

- The tax burden in the EU, as defined by the percentage of all collected taxes to GDP, and the share of direct taxes are closely related to two innovation activities indicators – innovation activities index and the share of expenditure on innovation activities in GDP.
- The relationship between proportion of the direct taxes and innovation activities index is slightly lower. This can be interpreted as some weakening caused by indirect taxes and social contributions.

To assess the relationship between indicators of tax burden and innovation activities in Ukraine we used the following database (Table 2). This database does not contain the composite index of innovation activities (SII) in Ukraine statistics it is not calculated.

The matrix of pairwise correlations of variables describing tax burden and innovation activities in Ukraine proved the significance (R>75%) of the relationships between these variables:

$T_{tax}^{tot}$ and $IR^{tot}$, $T_{tax}^{dir}$ and $IR^{dir}$.

The most significant relationships (between indicators of tax burden, both for total and for direct taxes, and the amount of research and developments) turned to be inverse in terms of direction. The latter can be interpreted as a reflection of the likely reduction in innovation activities caused by growth of total taxes and indirect taxes.

In order to construct an adequate model that can characterize the relationship between indicators of tax burden and innovation activities (based on the Ukrainian data), time-series variables (see Table 2) were tested by the test of a unit root.** Verification showed that it was impossible to construct an adequate model based on the initial data and it was necessary to correct the initial data. In order to correct it we used the method of first differences (augment) – ADF-test of the corresponding variables. When we attempted to construct a model of the pairwise regression parameters of tax burden indicators and innovation indicators and used adjusted data, the obtained results showed no significant relationship (R = 3.5%). Instead, when we dealt with non-adjusted data, which does not give reliable results, we obtained high indicators of significance. Those indicators were enhanced by constructing a model with one year (-1) and two years (-2) lags. Certainly, lag usage when dealing with short data series (which is our case) reduces the findings reliability.

** As it is known, only this test check guarantees the construction of a model which can give the reliable findings.
The results of constructing a model of the relationship between the indicators of research and development (\(R&D\)) and two indicators of tax burden \(T_{inc}\) and \(T_{exc}\) (based on Ukrainian data) are:

**The equation of the regression model:**

\[
IR = 2.58 + 0.025 T_{inc} - 0.02 T_{exc} + (-1) - 0.02 T_{exc} (-2)
\]

**Statistical indicators of the quality of the model:**

\[
\begin{align*}
\text{Adjusted R-squared} & = 0.68; \\
\text{Durbin-Watson} & = 1.24; \\
\text{Prob T_{inc}} & = 0.0490; \\
\text{Prob T_{exc}} & = 0.0482; \\
\text{Prob T_{inc}} (-1) & = 0.0438; \\
\text{Prob (F-statistic)} & = 0.000676
\end{align*}
\]

Source: Composed by the authors using the data [18, 19]

Our findings in the area of the relationship between indicators of tax burden and innovation activities in Ukraine give some grounds to draw the following conclusions:

- This relationship is unlikely to exist or, if it exists, is insignificant;
- Under condition that such a relationship exists, it is inverse, i.e., an increase in the tax burden limits the volume of innovation activities.

Comparison of the conclusions drawn from the calculations for EU and Ukraine forms the basis to answer the question whether there are any differences in the relationship between tax burden and innovation activities in countries with different levels of development. Such differences certainly exist regarding both the essentiality and the nature of the relationship.

The answer to the last question from the set formed at the beginning of this article (in what way can a government use the information about the relationship between tax burden and innovation activities to make management decisions) on Ukraine can be the following. If the conclusion of the absence of relationship is reasonable, the changes in the organization of the tax system should be directed to implement this relationship – creating a favorable tax climate specifically for innovators. Moreover, in order to monitor the actual state of affairs in the sphere of innovation activities it is advisable to use the same tools that other countries do. In particular, it would be effective to determine the relationship between tax burden and innovation activities. Therefore, the reform of the tax system toward fostering innovation activities is of current interest.
ФІСКАЛЬНІ ЕФЕКТИ СТРУКТУРНИХ ЗРУШЕНЬ У ПОДАТКОВІЙ СИСТЕМИ УКРАЇНИ

Анотація. Оціноно обсяг податкових надходжень, на який можуть збільшитися доходи бюджету за умови структурних зрушень у бік оподаткування майна та процентних доходів від депозитних рахунків у банках за незмінного рівня загального податкового навантаження. Обґрунтовано можливість зменшення загального податкового навантаження без ризику бюджетних втрат. Запропоновано альтернативну структуру податкових надходжень у Зведеному бюджеті України.

Ключові слова: податки, податкова система, податкове навантаження, податок на майно, податок на процентні доходи.

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