GREEN GROWTH AND SUSTAINABLE DEVELOPMENT IN THE WOOD-PROCESSING INDUSTRY: EVIDENCE FROM SLOVAKIA

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Abstract: The transformation of wood-processing enterprises into sustainable development is a challenging process. The sustainability of enterprises contributes to the fact that management should not primarily adopt short-term decisions, but think in years and decades, and also enterprises should consider more factors than just profit or loss. The goal of the article was to identify internal and external determinants hindering the development of green growth and sustainable development in the wood-processing industry in Slovakia. The mapping of this issue was carried out by an interrogative method in the form of a questionnaire. The evaluation of the questionnaire survey was done by single-proportion hypothesis test and interval proportion estimate. Pearson's Chi-square test was used to verify the representativeness of the population under study. Based on the achieved results, it can be concluded that implementation of green growth indicators contributes positively to the sustainable growth of enterprises in the wood processing industry. Enterprises indicated the production process orientation towards a waste-free economy is a key internal determinant which contributes positively their sustainable growth. However, the insufficient state support is a key external determinant which affects them negatively. The paper assumes a benefit at the theoretical and practical levels. The main contribution is the identification of the determinants that hinder the implementation of green growth because similar research in wood-processing enterprises in Slovakia is absent. The paper also creates space for the improvement of management efficiency in the context of sustainability.

Keywords: green growth, indicators of green growth, wood-processing industry, barriers, enterprises

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Introduction

To put the global economy on a sustainable economic and environmental trajectory, the dynamics of green growth need to be determined. It is important to assess the current situation of global economies and global environmental problems because, in the long term, the global economy is negatively affected by the consumption of non-renewable natural resources (Bien, 2021; Kocak, 2020). Green growth has experienced rapid development that has affected a wide range of industries (Hlushchenko et al., 2022; Kim et al., 2021). The global economy is moving towards a higher level of sustainability and manufacturing has become the sector that gains the most effect from green processes (Oláh et al., 2022; Waheed et al., 2020). Green growth and sustainable development have become an integral part of key business strategies, focusing not only on the transformation process but even on management efficiency (Yang et al., 2022). Being aware of the importance of sustainable development, the demands for it have brought a major challenge to the industry. The sustainability of production needs to reduce both emissions and pollution (Chapman, 2020; Goto and Sueyoshi, 2020; Sun et al., 2020). Even based on the above, there has been recently increased interest in ecological products in Slovakia, i.e., also those that are the output of the wood-processing industry (WPI). The increased efforts of society to follow a green direction and environmental protection are contributing to this situation. A significant shortcoming leading to the disadvantage of the WPI is the absence of its long-term and targeted support in terms of a coherent development strategy. One that would ensure the modernisation of technological and technical equipment, increase the competitiveness of enterprises on the market and, last but not least, increase the interest in this sector of industry, whether from the point of view of investors or the entrepreneurs themselves (Ishchuk, 2021; Sedliačiková et al., 2021; Yuik, 2020). It is necessary to point out the fact that the issue of green growth indicators in the context of internal and external determinants hindering the development of green growth and sustainable development has not yet been examined in the conditions of the wood-processing industry. The presented research identified a research gap in the field of green growth and opened a very actual topic for further research. This paper aims to identify internal and external determinants hindering the development of green growth and sustainable development in the wood-processing industry in Slovakia.

Literature Review

In the last decades, green growth has dominated the political programs making of OSN, EU and in many countries. The goals of sustainable development of the OSN as well as the climate goals of the European Commission are based on the theory of
green growth and reduction of greenhouse gas emissions (Hickel and Kallis, 2019). There are many definitions of green growth, however the most used widely is from the OECD which defines green growth as the goal to foster economic growth and development while ensuring that natural resources are used in a sustainable way and to continue providing the resources and environmental services on which our welfare relies (OECD, 2011). Aims of the green growth is economic forest growth that uses natural resources efficiently, is clean in the sense that it minimizes pollution and environmental impacts and is resilient in that it accounts for natural risks (European Comission, 2020). Indicators are measurable quantities, providing information about the state, development and trends of phenomena and processes in quantitative and qualitative terms (Capasso, 2019). They should be politically relevant, yet user-useful, scientifically justified, and measurable. Green growth indicators must be policy-relevant and help define key performance indicators that assess the impact of government spending on defined policy objectives or programs (Vogelpohl, 2021). The Slovak Republic is among the OECD member countries that have developed their national green growth indicators which are for enterprises voluntary. WPI is an important industry, that affects national economy and social development. The activities of wood-processing enterprises, as well as those of other companies within industries, have an impact on nature. The use of natural productive capital in these enterprises promotes economic trends that place a minimum burden on the environment (Zhang et al., 2018). The wood-processing industry (WPI) in Slovakia represents the woodworking, furniture and pulp and paper industry. The production chain of WPI products starts with forest cultivation, continues with timber harvesting and the final step is the production of outputs. WPI is a sector based on the use of renewable natural resources. The production of wood-based products in Slovakia has a long-term tradition. At the same time, it is a sector in which companies can make full use of domestic resources in terms of access to raw materials (Hajdúchová and Hlaváčková, 2014).

The following hypotheses are assumed:

H₁: Implementation of green growth indicators contributes positively to the sustainable growth of enterprises in the wood processing industry.

The efficiency of wood processing, which is a renewable resource, needs to be significantly increased. A dominant part of this raw material ends up in WPI, where it is used to produce pulp, paper, construction and furniture lumber, flooring and many other products. (Ondrejka et al., 2021). As stated by Malá et al. (2016), the implementation of green activities in wood-processing enterprises will help to reduce the environmental impact of their products and processes and improve their performance and sustainability.

H₂: Production process orientation towards a waste-free economy is a key internal determinant which contributes positively the sustainable growth of enterprises in WPI.

A prerequisite for achieving sustainable production in a business environment is the assessment of the entire life cycle of products in terms of their environmental
impact and the possibility of disposing of worn-out or outdated products. The second aspect of the assessment examines the volume of production concerning the renewability of inputs. The aim of sustainable production should be to satisfy the legitimate demands of consumers by equitably redistributing natural resources and man-made values (Zhidebekkyzy et al., 2022).

H3: Insufficient state support is a key external determinant which negatively affects the sustainable growth of enterprises in WPI.

Enterprises cannot influence external determinants or they can influence them to a very small extent (Maqin and Hendri, 2017; Zinecker et al., 2021). Government policy measures to improve the condition of forests and the wood-processing industry are insufficient for the development of raw and sawn timber exports (Glazyrina et al., 2015).

Research Methodology

The research aimed to identify the interest of wood-processing industry enterprises in implementing green growth indicators, as well as internal and external determinants hindering the development of green growth and sustainable development.

The methodology of this article was divided into three parts. The first part presents the literature review of the solved issue based on the analyses of domestic and foreign authors. In this part, the applied scientific methods included synthesis of knowledge, analogy, deduction, summarization.

In the second stage, the primary data were obtained in the practice of wood-processing enterprises through an interrogative method in the form of a questionnaire (Tomšík, 2017; Pacáková, 2009; Rimančík, 2007). The results were evaluated by selected mathematical and statistical methods.

In the third stage, the results were evaluated through analogy, deduction and summarization of the obtained knowledge.

According to Finstat (2022) and the SK NACE classification of economic activities, a total of 3,807 enterprises operate in the wood-processing sector, which represents the size of the basic set. This has been corrected to 472 WPI enterprises due to the exclusion of the micro-enterprise segment. A questionnaire was sent out to these enterprises. According to Finstat (2022), micro-enterprises constitute up to 87.60% of the WPI. Considering the impact of the COVID-19 pandemic, the consequences of the ongoing war in Ukraine and the current energy crisis, micro-enterprises are facing existential problems. For this reason, this business segment has only limited opportunities to introduce sustainable technologies, innovations and green growth indicators. In this context, micro-enterprises were excluded from the survey.

The inner consistency of the questionnaire was verified by Cronbach's alpha (α), where k is the number of items tested, \( S_i^2 \) represents the sum of the variance items, and \( S^2 \) is the total variance. Cronbach's alpha coefficient was determined by the following relationship (Cronbach, 1951):
The calculated Cronbach's alpha (α) coefficient level was 0.77, which means that the questionnaire is acceptable in terms of consistency.

To meet the condition for generalizing the measured data and obtained results to all WPI enterprises, the minimum research sample size (n) has to be achieved. This was determined by the following relation calculated under the conditions of an acceptable margin of error of 5% (e=0.05) and a confidence level of 95% (z=1.95) with a known size of the basic set (N=472) and at the p-level (p=0.05) (Rimarčík, 2007; Faeron, 2017):

\[ n = \frac{p(1-p)}{e^2 + \frac{p(1-p)}{N}} \]  

Using the above formula, it was possible to calculate the minimum research sample size for the survey. The sample must consist of at least 212 WPI enterprises and 221 WPI enterprises participated in the survey, which shows that the results can be generalised for Slovak wood-processing enterprises. The questionnaire was distributed through their email contacts during the year 2021. The results of the questionnaire survey were processed in the Statistica software and to verify the assumed hypotheses, the single-proportion hypothesis test was applied, which is used to test the statistical hypothesis that the proportion of a particular value of a variable in the basic set is equal to a given constant. The test criterion is as follows (Pacáková, 2009):

\[ \mu = \frac{f - \varphi_0}{\sqrt{f(1-f)/n}} \]  

The research sample should be representative for the entire population; therefore, it was validated using Pearson’s Chi-square test of goodness-of-fit based on two characteristics, namely the size of the enterprise and the self-governing region in which the enterprise is located. Pearson’s Chi-square test is one of the most well-known goodness-of-fit tests, which is based on the difference between observed (X_i) and expected (Np_i) frequencies. As reported by Lyócsa et al. (2013), the test characteristic for the Chi-squared test (where k is the number of addends) is:

\[ \chi^2 = \sum_{i=1}^{k} \frac{(X_i - Np_i)^2}{Np_i} \]
It can be concluded that the p-value is higher than $\alpha$ ($\alpha = 0.05$), and thus the research sample is representative according to the observed characteristics (Table 1).

Table 1. Results of Chi-Square Test

<table>
<thead>
<tr>
<th>Chi-Square</th>
<th>df</th>
<th>p-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.15</td>
<td>7</td>
<td>0.988</td>
</tr>
</tbody>
</table>

Research Results

To test the validity of hypothesis H1, implementation of green growth indicators contributes positively to the sustainable growth of enterprises in WPI, a statistical test was performed by a single-proportion hypothesis test with a result of $p=0.000$ (Table 2). As the authors agree (Song et al., 2020; Koseoglu et al., 2022; Houssini and Geng, 2022), the application of green growth indicators as well as social responsibility is one of the competitive advantages of enterprises and is an important step towards improving performance and helping to make management more efficient. The results of the conducted survey are consistent with the above, where up to 63.80% of WPI enterprises reported positive attitudes towards green growth indicators (Table 3). With 95% confidence, hypothesis H1 is confirmed, and it can be stated that implementation of green growth indicators contributes positively to the sustainable growth of enterprises in the wood processing industry.

Table 2. Hypothesis H1 test on relative abundance

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Research area</th>
<th>Alternative hypothesis</th>
<th>$p$</th>
<th>$n$</th>
<th>$u$</th>
<th>p-level</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>Effectiveness of green growth indicators</td>
<td>$\pi &gt; 50%$</td>
<td>63.80%</td>
<td>221</td>
<td>4.27</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 3. Frequency table of the research sample

<table>
<thead>
<tr>
<th>Indicators of green growth</th>
<th>Absolute frequency</th>
<th>Cumulative absolute frequency</th>
<th>Relative frequency (%)</th>
<th>Cumulative relative frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>141</td>
<td>141</td>
<td>63.80</td>
<td>63.80</td>
</tr>
<tr>
<td>No</td>
<td>81</td>
<td>221</td>
<td>36.20</td>
<td>100.00</td>
</tr>
<tr>
<td>Total</td>
<td>221</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The second hypothesis H2 assumed that the production process orientation towards a waste-free economy is a key internal determinant which contributes positively the sustainable growth of enterprises in WPI. The authors Yang et al. (2022) and Kocianova et al. (2022) point out that in the times of a rapidly growing economy marked by the crisis in Ukraine as well as the consequences of the COVID-19
pandemic, it is essential to transform the industry and its development, which has become a necessary tool for green growth. Hypothesis H2 was tested by interval proportion estimate which allows generalizing the identified data to all WPI enterprises (Table 4). According to the given estimate, only between 2% and 7% of WPI enterprises consider insufficiently qualified staff as an internal determinant hindering the development of green growth and sustainable development.

Table 4. Hypothesis H2: Confidence interval for relative frequency

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Research area</th>
<th>p</th>
<th>n</th>
<th>95% Confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2</td>
<td>insufficiently qualified staff</td>
<td>4.52</td>
<td>1</td>
<td>Lower limit: 2% Upper limit: 7%</td>
</tr>
<tr>
<td>H2</td>
<td>production process orientation towards a waste-free economy</td>
<td>66.06</td>
<td>1</td>
<td>Lower limit: 60% Upper limit: 72%</td>
</tr>
<tr>
<td>H2</td>
<td>lack of interest in investing in research and development</td>
<td>23.08</td>
<td>1</td>
<td>Lower limit: 18% Upper limit: 29%</td>
</tr>
<tr>
<td>H2</td>
<td>lack of funds</td>
<td>22.17</td>
<td>1</td>
<td>Lower limit: 17% Upper limit: 28%</td>
</tr>
<tr>
<td>H2</td>
<td>lack of interest to innovate</td>
<td>19.91</td>
<td>1</td>
<td>Lower limit: 15% Upper limit: 25%</td>
</tr>
<tr>
<td>H2</td>
<td>lack of interest in new technologies</td>
<td>4.98</td>
<td>1</td>
<td>Lower limit: 2% Upper limit: 8%</td>
</tr>
</tbody>
</table>

According to the results of the interval proportion estimate, the hypothesis H2 is accepted.

Factors and determinants from the external environment also affect WPI enterprises. These determinants cannot be influenced by enterprises (Maqin and Hendri, 2017; Kocianova et al., 2022). Based on the above, it is also considered important to verify the external determinants hindering the development of green growth and sustainable development. Therefore, hypothesis H3 assumed that the insufficient state support is a key external determinant which negatively affects the sustainable growth of enterprises in WPI. The assumption in Hypothesis H3 was tested by interval proportion estimate, which showed that between 47% and 60% of the addressed WPI enterprises perceived insufficient state assistance (Table 5). It is positive that only an estimated 2% to 8% consider the low number of courses and seminars in the fields of sustainable development to be a problem. Available data has shown that 28% to 41% of respondents consider the lack of demand for organic products to be a hindering determinant, which is perceived negatively because a significant proportion of customers are not interested in sustainable products, which is unmotivating for WPI enterprises.
Table 5. Hypothesis \( H_3 \) Confidence interval for relative frequency

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Research area</th>
<th>( p )</th>
<th>( n )</th>
<th>95% Confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>H3</td>
<td>insufficient state support</td>
<td>53.39%</td>
<td>22</td>
<td>47% – 60%</td>
</tr>
<tr>
<td>H3</td>
<td>insufficient information about possibilities and new trends in the field of sustain. development</td>
<td>21.72%</td>
<td>22</td>
<td>16% – 27%</td>
</tr>
<tr>
<td>H3</td>
<td>insufficient financial support</td>
<td>7.69%</td>
<td>22</td>
<td>4% – 11%</td>
</tr>
<tr>
<td>H3</td>
<td>insufficient demand for ecological products</td>
<td>34.39%</td>
<td>22</td>
<td>28% – 41%</td>
</tr>
<tr>
<td>H3</td>
<td>complex administration</td>
<td>4.52%</td>
<td>22</td>
<td>2% – 7%</td>
</tr>
<tr>
<td>H3</td>
<td>low number of courses and seminars in the field of sustainable development</td>
<td>5.43%</td>
<td>22</td>
<td>2% – 8%</td>
</tr>
</tbody>
</table>

Hypothesis \( H_3 \) is accepted based on the above result – the insufficient state support is a key external determinant which negatively affects the sustainable growth of enterprises in WPI.

The results of the survey were evaluated using the statistical software STATISTICA 12. Selected mathematical and statistical methods were used to evaluate the formulated hypotheses, namely the single-proportion hypothesis test and interval proportion estimate.

Discussion

Over the last few years, more or less successful attempts have been witnessed to implement various new approaches in management with the common goal of improving corporate performance (Sedliačiková et al., 2020, Malá et al., 2017). In the context of the above, the survey examined the opinions of WPI enterprises whether the introduction of green growth indicators would contribute to their sustainability growth. After conducting a single-proportion hypothesis test with a \( p \)-level result (\( p=0.000 \)), hypothesis \( H_1 \) was confirmed (Table 2). Similarly, Song et al. (2020) and Saufia et al. (2015) also highlight green growth indicators as an important part of the business environmental performance. The survey of Kánová and Lesníková (2021) clearly states that there are many wood-processing enterprises in the Slovak Republic that achieve above-average performance and use sustainable management methods and practices. The authors Šulyová and Kocák (2020) agree, pointing to the wood-processing industry as one of the most
important industries on which to build the development of sustainability, performance, competitiveness and also increase the efficiency of business management. Wood is an essential renewable resource not only for the Slovak economy. As a result of changes related to the transition to a market economy, privatisation, liberalisation of foreign trade and the decline of industries using wood products, the capacities of wood-processing enterprises are currently being under-utilised (Krištofík and Medzihorský, 2022). Similarly, in the Czech Republic, the wood-processing industry is showing a decline, despite a long-term tradition that has been developing for hundreds of years. Also, for the mentioned reason, the Czech government tries to support small and medium-sized wood-processing enterprises through financial support for the purchase of new machines, equipment and sustainable technologies (Purwestri et al., 2020). However, the authors Kupčák and Šmída (2015) point out that, despite the latest wood processing technologies, Czech wood processing companies cannot meet the expectations of foreign investors. It can be assumed that the internal and external determinants acting on enterprises have also contributed to this fact. The internal determinants come from inside the company and, also due to the impact of the COVID-19 pandemic and the ongoing energy crisis, need to be given more attention. In view of the presented, the following internal determinants hindering the development of green growth and sustainable development in WPI enterprises were examined: insufficiently qualified staff, the orientation of products towards the end of the production process in the context of environmental pollution, lack of interest in investing in research and development, lack of funds, lack of interest in innovative, lack of interest in new technologies. The interval proportion estimate confirmed that 60% to 72% of WPI enterprises consider the orientation of producers towards the end of the production process as the most hindering internal determinant in the context of environmental pollution. This is also agreed by Riu (2016) that it is crucial to consider sustainability during the product design phase. Traditionally, the indicator is only considered at the ecological design phase. At present, product promotion leads to satisfying consumer needs. Authors Galvez-Martosa and Schoenberger (2014) and Tagliaferri et al. (2016) refer to the fact that such promotion does not take into account the environmental pollution and waste of resources during the transformation process, which should not be overlooked. In the Czech Republic, companies in the transformation process focus on output control, which helps them maintain their position on the market (Andronicanu et al., 2019). The initial phases of product design require the application of sustainability (Tseng et al., 2009). On the contrary, only an estimated 2% to 8% of the WPI enterprises consider the lack of interest in new technologies as an internal barrier. Not only in the wood-processing industry in Slovakia, but entrepreneurs can also use various financial tools to support their development in sustainability (Sobeková, 2011; Hitka et al., 2018). WPI enterprises are also influenced by determinants acting from the external environment (insufficient state support, insufficient information about possibilities and new trends in the field of
sustainable development, insufficient financial support, insufficient demand for ecological products and complex administration), which were examined in hypothesis H3. The interval proportion estimate showed that the major indicator (53.39%) is insufficient state support. The results of the survey in the area of external determinants coincide with the conclusions of the SBA research (2020) that the biggest barrier to the introduction of sustainability and innovation activities in enterprises is the lack of funds in relation to the determinant of the absence of adequate support from the state. Similarly, Sobeková et al. (2011) point to the negative situation in the area of availability of funding and support for businesses compared to other European Union countries. At the same time, Zhang (2021) adds that WPI in Slovakia shows low competitiveness due to a lack of financial resources. The authors Šebestová and Sroka (2020) argued that in the Czech Republic and Poland, the achievement of sustainable development goals is linked to state support. In the need to achieve sustainable goals, Czech and Polish small and medium-sized enterprises are motivated by customer requirements, especially by obtaining certificates.

**Conclusion**

The aim of the presented paper was to identify internal and external determinants hindering the development of green growth and sustainable development in wood-processing enterprises in Slovakia. A total of 221 wood-processing enterprises in Slovakia participated in the survey. Micro enterprises were excluded from the research sample due to the problems they currently face. The results clearly showed that 63.8% of the enterprises share the opinion that the introduction of green growth indicators will contribute to the growth of sustainability. These enterprises are affected by numerous factors that hinder their development. They consider the most important internal determinant to be the orientation of producers towards the end of the production process within the environmental pollution context. On the contrary, they identified the most important external determinant to be insufficient state support. Accordingly, all three formulated hypotheses were confirmed. The presented paper has several limitations. The relationship between the size of enterprises and the degree of application of green growth indicators was not taken into account. Similarly, it is necessary to examine whether the hindering determinants affect equally all enterprises of the WPI in its different sectors, namely woodworking, furniture and pulp and paper areas. The above limits represent the potential and necessity to address the issue in further research. The objective of the paper has been met and thus provides a basis for the development of wood-processing enterprises in the field of sustainability. In the future, the challenge for WPI enterprises is to remove the hindering determinants, which will help to make management more efficient, and increase the performance and competitiveness of WPI enterprises.
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References


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**Słowa kluczowe:** zielony wzrost, wskaźniki zielonego wzrostu, przemysł drzewny, bariery, przedsiębiorstwa

**Materials Processing Industry’s Green Growth and Sustainable Development: Evidence from Slovakia**

**Abstract:** The transformation of a materials processing enterprise towards sustainable development is a challenging process. The enterprise's sustainability determined that management should not primarily take short-term decisions but should consider many and even several decades, and the enterprise should consider more factors than just profits or losses. The purpose of this article is to determine the internal and external factors that hinder the green growth and sustainable development of the Slovak materials processing industry. This mapping is performed through a survey method. The evaluation of the questionnaire uses one-proportion tests and interval proportion estimates. Pearson’s chi-square test is used to verify the population sample's representativeness. According to the obtained results, it can be concluded that the implementation of green growth indicators contributes positively to the sustainable development of materials processing enterprises. Enterprises state that the production process oriented towards a waste-free economy is a key internal factor contributing positively to sustainable growth. However, insufficient national support is a key external factor that affects them negatively. The article assumes benefits in both theoretical and practical terms. The main contribution is the determination of the factors hindering the implementation of green growth, as there is a lack of similar studies in Slovak materials processing enterprises. This document also creates space for increasing management efficiency in the context of sustainability.

**Keywords:** green growth, green growth indicators, materials processing industry, barriers, enterprises