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Comparative efficiency of wood sources utilisation in selected European countries

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Abstract

Wood belongs among the renewable, ecological resources used in many variants of primary and secondary production. The efficiency and effectiveness of using wood resources is, therefore, one of the important factors of sustainable economic development of the society. Each country should strive to maximise the efficiency and effectiveness of the use of raw materials. The aim of the paper is to evaluate the different levels of timber use in international comparison based on the available information of timber resources, production, consumption, import and export in the primary processing in natural and value expressions of wood resources. The results indicate the efficiency of the use of wood resources both for the volume of the total woodworking production and the production value of the woodworking industry in the selected countries.

Keywords: Wood sources, efficiency, added value, comparative analysis.

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1. Introduction

The solution of further development of wood processing**,** and thereby the reduction of a rate of raw wood export is not only in the increase of capacity, but also in the search for the optimal arrangement of the processing structure taking into account the current possibilities and the state of processing. On the one hand, there are restrictions in wood sources as described by authors within material flow analysis in studies made at regional levels by Binder, Hofer, Wiek and Scholz (2004) and Mantau (2015), at national levels by Hekkert, Joosten and Worrell (2000) for the Netherlands, Hashimoto and Moriguchi (2004) for Japan, Piskur and Krajnc (2007) for Slovenia, Knaggs and O'Driscoll (2008) for Ireland, Cheng, Xu, Su and Zhen (2010) for China, METLA (2011) for Finland, Weimar (2009) for Germany and also in the European Union as a whole Mantau (2012).

On the other hand, the material balance of resources and their consumption is a problem of capacity arrangement and the search for optimal adjustment towards some key performance characteristics**,** such as total production volume, wood input maximisation and processing cascade producing as much raw material as possible for subsequent processing with additional value added. This work compares the structure of the processing on the basis of available data on the structure of the primary processing in individual countries, the material consumption and the volume of wood in the processing. The established structure of the processing enables to identify the efficiency of the wood resources over the current processing base, which characterises the economic potential of the individual branches of primary processing in relation to the timber resources. It can be seen that even countries depending on timber imports can produce wood-based products very efficiently, with a high value added.

Despite the common effort among the industry, public and political bodies and decision makers to develop and support better condition for European forest sector, only few researches oriented on business economics has been published (Teischinger, 2009). Resource-based view is only a part of complex environment and competition on tightening market**;** it requires new ways and tools for better decision at company, national or global level.

2. Data and methods

Input data needed for the analysis are available official data provided by UNECE/FAO Forestry and Wood Processing Statistics for the year 2018 published in the section of Market Forecast Tables (COFFI, 2018). Based on input data, it was possible to carry out a comparison of domestic wood resources (harvested wood without exports) for own consumption in a production of primary wood manufacturing. Subsequently, the value (sales) for individual types of primary processing was calculated and the ratios between used wood and primary wood manufacturing were determined. Achieved output enables identification of the difference in efficiency of timber resources utilisation in wood processing between countries.

The framework for determining the use of timber resources is limited to timber processing in the timber industry where timber enters first. For this reason, the paper production and energy wood consumption were excluded from the assessment. Wood residues, chips and particles are excluded from the sum of resources, because it is not possible to determine from what source they come from, whether from a forest or from the cascade of processing.

The method used in this work is a comparison of wood efficiency utilisation indicators in a primary production. Wood resources are limited to those that entering the primary manufacturing and the total volume of primary processing is the sum of the production of individual types of primary manufacturing, expressed in technical units.

Production is defined as the solid volume or weight of all production of the products specified below. It includes the production of products that may immediately be consumed in the production. It

is reported in cubic metres of solid volume by round wood, sawn wood and wood based panels and metric tons by pulp.

On the input and output side of the woodworking industry, items by classification used in the data source (COFFI, 2018) were included. As a source of wood, in the work is used the production data of individual countries for the year 2018 of the items: softwood saw logs, hardwood saw logs, pulpwood softwood and pulpwood hardwood. Primary sectors of woodworking manufacturing include the following item: sawn softwood, sawn hardwood, veneer sheets, plywood, particle board, OSB, MDF, HDF, fibreboard other and pulp. The countries included to the analysis are European with a wood production above the boundaries of significance.

Coming from the production data, basic indicators for evaluation of efficiency of local wood production and manufacturing were calculated:

- Wood Resources Production: sum of saw logs and pulpwood's production as removals of wood in the rough in 1,000 m^3.
- Primary Wood Production Sum of production by product group of primary production in technical unit (technical unit taken from source table definition).
- Resource efficiency: share of wood resources on one unit of production in %.
- Primary wood manufacturing value: sum of value on structure of primary production, in 1,000 CZK.

To determine the efficiency of raw timber utilisation in a primary production, we performed a calculation of a production value in technical units per volume of harvested raw material in technical units and in value expression of production to technical units of harvested wood in the rough. The financial value represents multiplication of a production volume and an average price of corresponding product category. The average price is derived from the average prices of foreign trade statistics of monitored commodities obtained from the Eurostat foreign trade services, converted using the conversion coefficients given in the HS/SITC classification table (UNECE, 2018) and converted to EUR/CZK based on the Czech National Bank data for 2018, rounded to hundreds.

Elimination of import and export from the available disposable wood for production created an opportunity to compare the different processing capacity of individual countries, and thus their dependence on foreign trade by raw wood.

The work is suitable for a quick picture of the state and development of efficiency of wood resources in a woodworking industry for the selected countries and it is sufficiently indicative for the synthetic expression of the structure and its effect on production value.

3. Results and discussion

Sufficiency of wood sources for industrial use does not mean achieving the maximum value from primary manufacturing as seen from the results of this work. Countries with a very small volume of timber harvesting or countries dependent on timber imports can generate more value (sales). The established woodworking structure in individual countries has allowed to create value expressions of production and to derive resource efficiency in total production in both the natural and the financial terms.

The volume of production in technical units has shown the significant dominance of several countries that are above the average of the whole group (see Figure 1). Average production per country is 8,876 thousand technical units and only eight countries are above the group average: Austria, Germany, Finland, France, Poland, Romania and Turkey. The Czech Republic lags behind Italy, whose primary wood sources are almost nine times smaller.

Domestic production of wood reaches average value of 14,788,000 m^3 and only seven countries are above this average (Sweden, Finland, Germany, Poland, France, Turkey and Czechia). Sweden and Finland dominate within a selected group of European countries as shown in Figure 2.

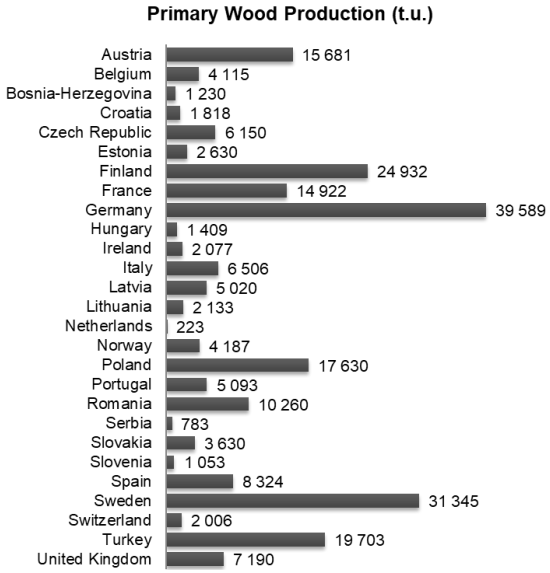

Figure 1. Primary wood production in technical units

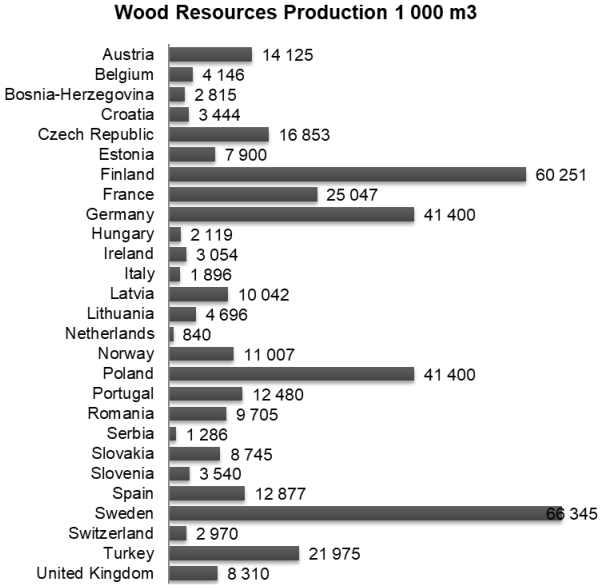

Figure 2. Production of wood for industrial use

The average value achieved in financial terms in the observed group of countries is 72,058,100 thousand CZK. Eight countries are above this average: Sweden, Finland, Germany, Poland, Austria, Turkey, France and Spain. A significant drop in the Czech Republic is already visible in value terms, and compared to Italy the production is lower in 22% (See Figure 3).

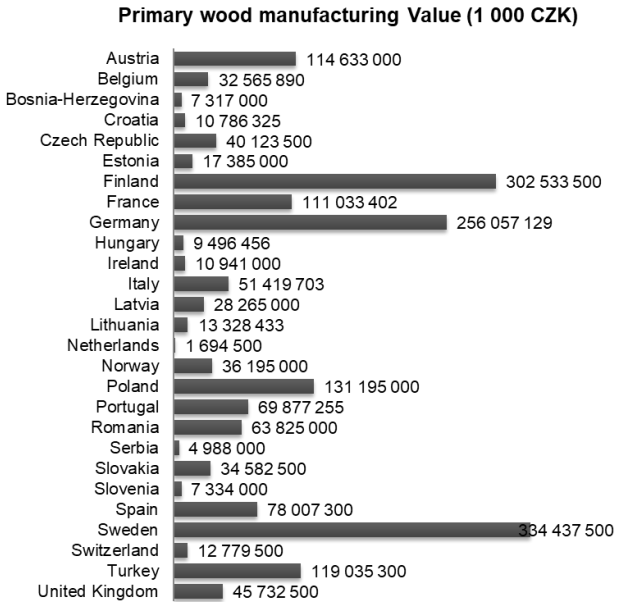

Figure 3. Manufacturing value by country

The structure of primary wood processing in technical unit is presented in Figure 4, and in financial value it is presented in Figure 5. According to the timber primary manufacturing structure (Figure 4), the overall efficiency of domestic wood resource use varies, ranging from 27% for the Netherlands to 343% for Italy (Figure 6). In the case of the Netherlands, there is a lack of own manufacturing capacities, such as the production of plywood, particleboards or OSB and fibreboard. On the other hand, Italy has more advanced production of flat wood materials than other countries with a larger volume of available raw material.

The Czech Republic is a country with a similar pattern of processing structure as Germany or Austria expressed in technical units of production. In the value expression of the structure (revenues from production), it can be seen that Germany and Austria rely on the creation of value in a larger proportion of pulp and sheet materials than in lumber production. Although the volume of lumber produced is much higher in both Austria and Germany.

The differences between the source of the wood, the technical capacity of processing and efficiency (Figure 6) are significant, and after exclusion of extreme values of Italy and the Netherlands, the average value of efficiency is 61%. Only 10 countries exceed this value. The Czech Republic achieves the third worst result.

Determination of sources efficiency presented in Figure 7 has shown that Germany has an ideal position to use its own resources at the level almost 100%. At the same time, it creates a very high value in primary processing. A similar value for the efficiency of the timber resources utilisation is achieved by Turkey.

The average level of source efficiency is 70% in all countries under review. The Czech Republic is below an average efficiency in using domestic wood for primary manufacturing, and it also creates lower overall value for primary processing, whereas it is not significantly dependent on external sources of wood as Austria and Italy.

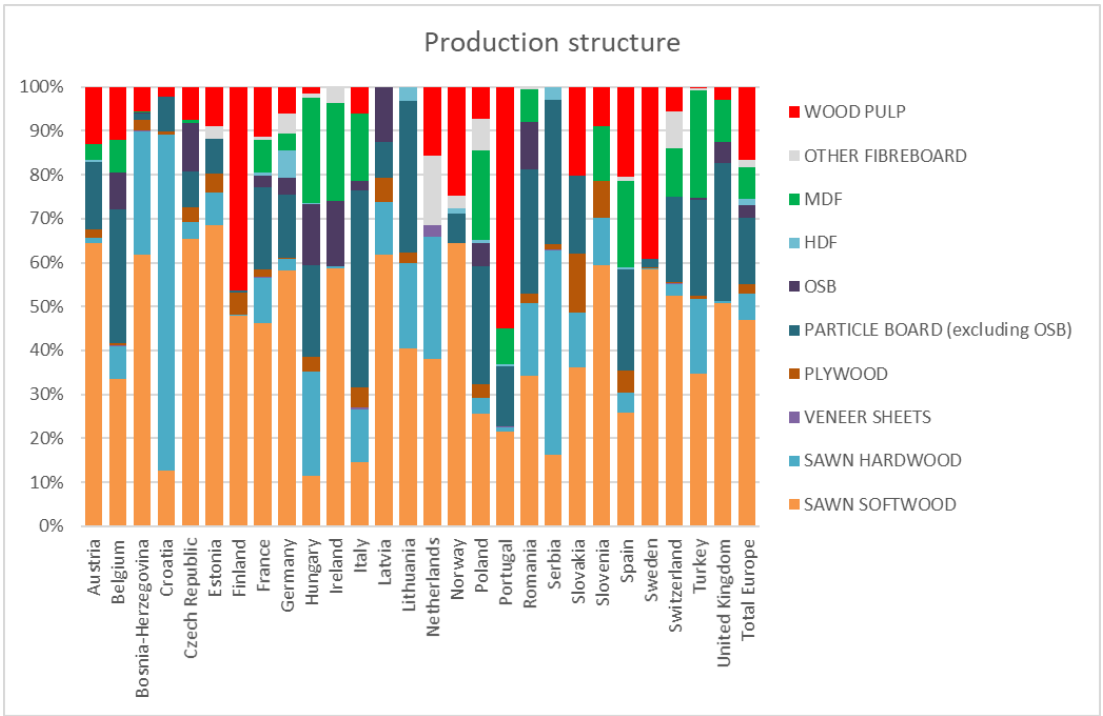

Figure 4. Primary wood production structure by country (based on sum of technical unit output)

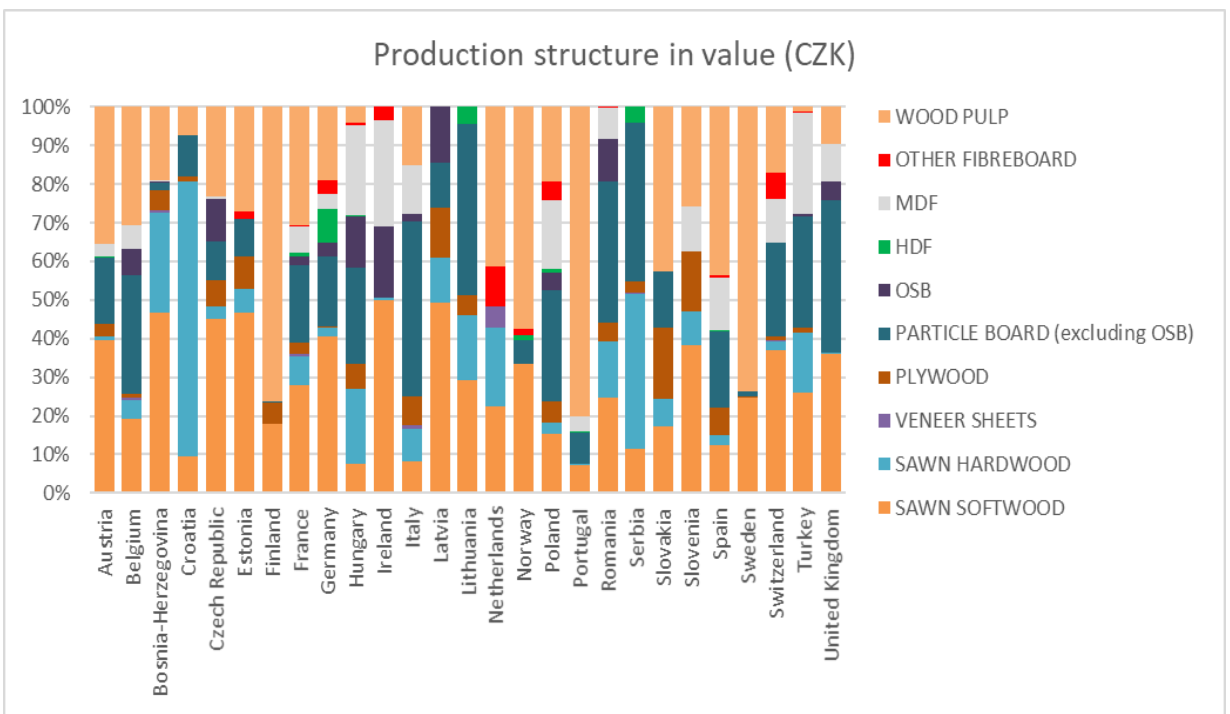

Figure 5. Value on production structure by country

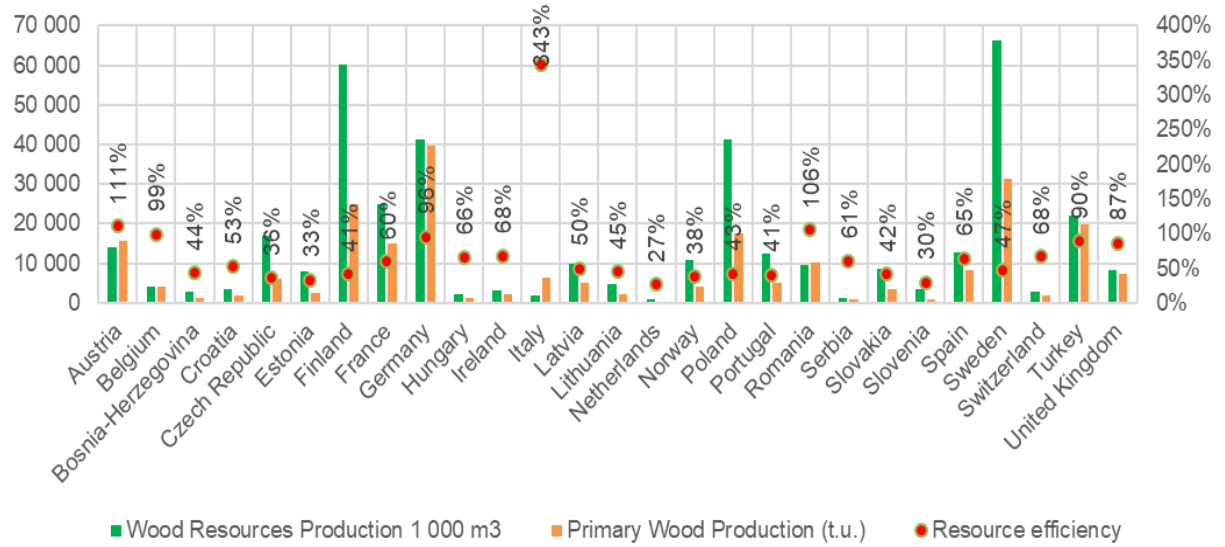

Figure 6. Resource efficiency based on own sources of wood raw

From the results achieved, it is obvious that direct dependence on own wood resources and created value is not a conditional relation. In terms of the value creation, the structure of the wood-processing industry is, therefore, essential in primary wood processing.

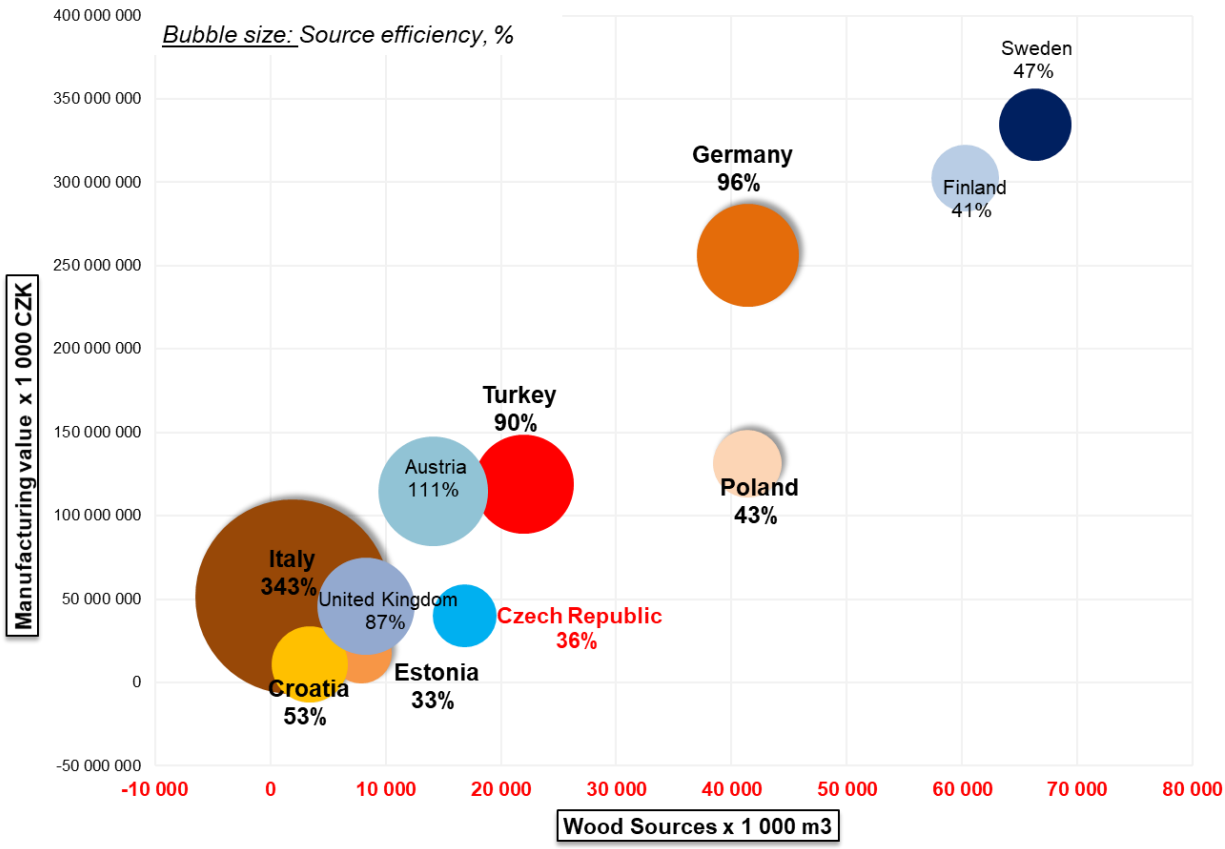

Figure 7. Sources efficiency

The whole forestry wood sector is very complex and several value chains within the sector can be identified. The boundaries of the sector have not been yet well defined which still makes great trouble in analysing the sector (Teischinger, 2009). To understand an economic sector, specific data and information has to be provided. One of the propositions (Hurmekoski & Hetemaki, 2013) is that the sector provides information on the part of the present and seeks to address the issues of prospects at a certain level, but without deeper application of structural change, even when they can be a key element of future development, these works are ineffective.

4. Conclusion

Demand for wood may soon significantly exceed the offer in Europe (Mantau et al., 2010), mainly due to EU subsidy policy to promote energy use of wood. Despite the wood's renewability, its raw material use is limited by the long-term production. Therefore, to meet the increasing demand for wood, new concepts of wood utilisation are needed.

The approach chosen in this work represents a simple expression of the use of the input renewable raw material and the values obtained, expressed both in technical units and in value. It points to the great differences between individual countries and, especially for the countries with a high proportion of timber exports; it is a challenge for increasing overall efficiency. This paper provides a comparative basis which can be further deepened and supplemented by more detailed dependencies within the woodworking cascade. It is possible to create a model of the use of wood resources within regions crossing borders, depending on the development of consumption and production optimisation as can be seen in work of Hailu and Veeman (2003) or Salehirad and Sowlati (2005). There is a limited scope of the framework for the currently prevailing types of primary processing. In the future, it will be necessary to redefine primary processing and add to manufacture—production base the increasing share of biochemical and energy use of wood. There are various methods how to solve optimisation of wood use. Cascading, as the sequential use of wood material in material application with energy generation as a final step, may enhance the resource efficiency of wood utilisation. But, there are other factors based on the facts of European independent capacity investments policy, regardless to basic wood flow in a foreign trade and current state of woodworking manufacturing structure of individual countries as it was shown in this paper. This is very important for the current position of the Czech Republic, which could support investments in capacity increase and structure optimisation. A significant change in the structure of processing must be in the Czech Republic in order to achieve greater value of the efficiency of processing of own wood resources. However, this would have a significant impact on the flow of timber in Austria and Germany, where more than 4 million m^3 of timber goes from the Czech Republic each year. From this point of view, the Czech Republic has to apply client-oriented evaluation of creative destruction in policy mixes, as was made in Finland (Kivimaa, Kangas & Lazarevic, 2017).

Acknowledgements

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