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The role of forest biotechonomy industry in the macroeconomic development model of the national economy of Latvia: a system dynamics approach

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Abstract

With a rapidly expanding global economic growth, issues of sustainability and potential impact on environment become more pressing. While it is clear that future growth should focus on more efficient exploitation of natural resources and higher added-value in processing of biological goods (referred to as biotechonomy), there is an avenue for future research investigating the role of biotechonomic sectors' contribution to national economies. This research attempts to fill that gap.

By using system dynamics, this research evaluates the role of Latvian forest biotechonomic industry in macroeconomic development model of the national economy of Latvia. In addition, research primarily focusses on three notable macroeconomic sectors – natural resource exploitation, education and healthcare. It is assumed that these, as well as other essential segments of national economies, are linked in an endogenous system, constantly reinforcing each other and being subject to certain causalities among them.

For the purposes of investigation, a causal loop diagram and corresponding system dynamics model of the national economy of Latvia was developed. By introduction of forest biotechonomy in the national economic model, indicative results show that financial resources become more available for education and healthcare. Furthermore, biotechonomy introduction also reinforces further development of high-added value industries and general economic growth via productivity increase and prolonging of total working hours, based on health improvement. This is achieved while proportionally diminishing impact of growth on environment and generally decarbonizing traditional bio-economic sectors.

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Keywords: system dynamics; macroeconomic model; environmental modelling; biotechonomy

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1. Introduction

For almost 20 years since 1989, global world markets experienced growth never witnessed before. The promises of better life and global scale introduction of democracy and economic growth went hand-in-hand with individual per capita consumption and gross domestic product (GDP) ratings flowing off charts. The recent global economic recession of 2008 however came as a cold shower for most economies and there are plenty of societies today still facing related challenges.

Since then various scholars and other members of societies' have questioned the structures and the dynamics of mainstream modern-day economies. On a general note, criticisms have focused on lack of normative values of capital markets, as well as complete disregard of traditional, cultural values and growing impact on environment unwitnessed before. Furthermore, most entrepreneurs are continuing to avoid, arguably, the most crucial criticism of mainstream corporate businesses to-date – the extensive impact of business activities on environment and the irreversibility of it [1, 2].

Over last couple of years a more pragmatic approach has been taken by various academics in order to offer solutions to economies that would combine economic growth together with environmental considerations and more efficient exploitation of natural resources [3]. In respect to particular investigation, a system dynamic approach for *biotechonomy* modelling in Latvia should be explored further.

In short, while *biotechonomy* as a field includes technologies and related economic and non-economic processes for extraction, exploitation and processing of biological resources, the system dynamic model for analysis of Latvian biotechonomic potential was developed to test and explore capacity of the national economy of Latvia to become a stand-out example of high added-value and sustainable manufacturing economy [4, 5]. Acknowledging paramount academic success that former model brings in modelling separate sub-sectors of Latvian biotechonomy and related environmental and monetary gains [6], a significant limitation of the research is the inability of the model to incorporate the particular benefits of biotechonomic development in reference to other macro-economic segments of the national economy of Latvia. This research is an attempt to fill this gap while using a forest sector as the case.

2. Brief overview of related previous studies

To begin with, Jay W. Forrester's *The System Dynamic National Model* should be mentioned [7]. Arguably being the frontrunner of the field, already in 1989 particular research focussed on interlinks between national macroeconomics and microeconomic policy decisions. Furthermore, this research focussed on paradigmatic processes of any economy – business cycles, inflation, and stagflation, the economic long wave and growth as such [7].

Not only was the application of the method for the process analysis remarkable on its own, but also definition and inclusion for the first time of economic subsectors in an endogenous, single, bounded system. These included production sector, household sector, labour sector, financial and governmental sector. Such approach has arguably served as the foundation of any further macroeconomic system dynamic modelling.

As another exceptionally influential study should be considered David Wheat's research on teaching macro-economic theory while using system dynamic modelling. What sets apart unique contribution by the scholar is the role solely addressed to feedback loops as separate units of analysis [8]. Particularly successful is also the application of loops in explaining the self-regulating principles of market economies – arguably few other system examples could reflect the nature of complex systems better as self-regulating market.

In reference to particular investigation the *Threshold 21 (T21)* system dynamics model, developed by the *Millennium Institute*, must be explored. This model was the first *all*-encompassing system dynamics framework. It was designed to be universally applicable to various national economies in order to design and implement various macro level policy changes and evaluate different policy scenarios [9]. Even though developed solely for sustainable policy considerations, it does elaborate on three main sectors of any national economy – economy, environment and society – and allows deepening structural understanding in short and long term provisions [9].

Another influential academic investigation was developed by Bernardo and D'Alessandro in 2016, where by system dynamic modelling application impact of low carbon investments on employment and inequality was assessed. The proposed model brings economic growth, carbon emissions, unemployment and related income distribution combined on a macro-level analysis [10], which, in principle, was similarly carried out during the modelling of the national economy model of Latvia.