THE EU BIOECONOMY ROLE IN WEALTH AND EMPLOYMENT. A SAM ANALYSIS

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Summary

This paper characterises and profiles the biobased sectors in terms of their wealth generation characteristics for the entire EU region. To this end, Backward and Forward Linkages multipliers are calculated from a brand new set of EU Member States (MS) Social Accounting Matrix (SAM) benchmarked to 2010 with a large coverage of biobased activities.

Keywords: European Union, Bioeconomy, Social Accounting Matrix, Backward and Forward Linkages, Employment Multiplier

1. Introduction

The biobased sectors in the European Union (EU) account for approximately 2.2 billion euros in turnover and 18.6 million jobs (JRC, 2017). Consequently, the bioeconomy strategy has non-trivial role to play in contributing to a sustainable model of EU growth. The idea of the "bioeconomy" promotes biologically-renewable resources (biomass). Within this paradigm, the "cascading principle" prioritises biomass usage based on the reuse and recycling of products and raw materials, committing energy applications only when other options are exhausted (EC, 2012). As one part of the policy debate, the economist could profile and identify the most promising bio-based sectors from the perspective of economy-wide wealth generation. The lack of comparable data, with sufficient coverage of bioeconomic activities across EU countries explains the scarce literature. In this paper, updated Social Accounting Matrixes (SAM) for the 28 EU Member States (MS), with a high disaggregation of activities are accomplished. Then, the wealth generation potential of bio-based activities are studied by calculating relevant multipliers, which are further used to identify common patterns across EU MS and key biobased sectors.

2. Methodology

The SAMs used in this study (dubbed as bioSAMs) feed on previous works by Muller et al.(2008) and Philippidis et al.(2014). BioSAMs expands the original detail on agrifood and forestry sectors to broader contemporary sources and uses of biomass benchmarked to year 2010. The BioSAMs contain 80 activity/commodity accounts (Mainar-Causapé et al., 2017). For the purpose of this study, though, multipliers are calculated for 32 biobased activities, which can broadly classified into 11 agriculture activities (7 crops and 4 livestock), 11 food processing, 3 bioenergy (first and second generation fuels, bioelectricity), 3 other biomass (forestry, energy crops and pellets), 3 bio-industry (textiles, wood and biochemical) and fishing. The non bio-based activities are grouped into natural resources, energy, manufactures and services.

In the SAMs, inter-sectoral linkages create direct and indirect ripple effects or multipliers, that can be used to measure wealth demand driven (or backward linkage) and supply driven (or forward linkage). Backward linkage (BL) and forward linkage (FL) multipliers are relative measures (i.e. the average across activities is 1). A higher multiplier by sector *j* in country *A* compared with country *B* means that relative to the average of all economic activities the importance of sector *j* in generating wealth in *A* is greater than it is in *B*, but does not necessarily imply that sector *j* in region *A* generates more absolute wealth. A BL (FL) in sector *j* greater than one shows that for every euro of intermediate input demand (output supply), more than one euro of economic activity to the upstream input suppliers (downstream end users) is generated. A sector with a BL (FL) multiplier greater than unity, and a FL (BL) multiplier less than unity, is classified as 'backward' ('forward') oriented. If neither linkage is greater than unity, the sector is designated as 'weak', whilst 'key sectors' are those which simultaneously exhibit FL and BL multipliers above unity. Several statistical tools and tests are applied in order to establish wealth generation patterns for bio-based sectors across the 28 EU MS.

3. Results

A hierarchical cluster analysis using both BL and FL for each of the 32 biobased activities as segmenting variables led to five clusters: 'Northern & Central' (Austria, Belgium, Denmark, Germany, Ireland, Lithuania, Netherlands, Slovenia, Sweden and United Kingdom), 'Islands & Luxembourg' (Cyprus, Malta,

Luxembourg), 'Mainly Eastern' (Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania, Slovakia, Finland, France), 'Baltic' (Estonia, Latvia) and 'Mediterranean' (Greece, Italy, Portugal, Spain). One-way Anova tests confirms that there are statistical differences in 29 mean BL and 22 mean FL across regional clusters. Paired mean t-tests between mean BL and FL within each cluster reveal a clear backward orientation in the "Mainly Eastern" (31 sectors), "Mediterranean" (28) and "Northern & Central" (31 sectors) groups (i.e. in 23 EU MS BL is statistically higher than FL in a vast majority of sectors) (Table 1).

Table 1. *Summary description of Backward and Forward Linkages across regional clusters*

Cluster	Frequency (max = 32 sectors)					Mean		Coef.Variation (%)	
	BL >1	BL>2	FL>1	BL>FL	'Key'	BL	FL	BL	FL
Northern & Central	25	5	4	31	4	1.42	0.59	40	55
Isles & Lux	11	1	1	11	1	0.81	0.40	64	80
Mainly Eastern	29	14	9	31	9	1.88	0.81	32	51
Baltic	24	9	7	4	6	1.52	0.70	62	88
Mediterranean	29	20	10	28	10	2.08	0.81	28	44

In the 'Mediterranean' and 'Mainly Eastern' clusters, the bioeconomy is 'active' with particularly strong backward orientation (BL mean ≈ 2, FL mean ≈ 0.8). Across the 32 biobased sectors, demand driven wealth (BL > 1) is highly pervasive, particularly in the 'Mediterranean', whilst supply driven wealth (FL >1) is also observed. In both regional clusters, these wealth properties are consistent across sectors (relatively low CoVs), whilst approximately one-in-three biobased activities are 'key sectors' (BL > 1; FL > 1). The 'Baltic' cluster is characterised by 'moderately' active biobased activity with strong backward orientation (BL mean ≈ 1.5, FL mean ≈ 0.7). Across the 32 sectors, demand driven wealth generation is almost comparable to the 'Mediterranean' and 'Mainly Eastern' regions, although it is much less consistent across sectors (relatively high CoV). Evidence of supply driven wealth is intermittent and inconsistent across the 32 sectors (relatively higher CoV). Approximately one-in-five biobased activities are 'key sectors'. The 'Northern & Central' (ten EU MS) regional cluster has a comparable degree of demand driven growth to the 'Baltic' region (BL mean ≈ 1.5, FL mean ≈ 0.6), although like the 'Baltic' region, it is inconsistent. Evidence of supply driven wealth is scarce, whilst this cluster only contains one key sector (raw milk). Finally, the 'Isles & Lux' cluster exhibits a weak bioeconomy (BL mean < 1, FL mean = 0.4), whilst examples of supply driven wealth are particularly scarce. The relatively higher CoV reflects the narrower focus of biobased activity (existence of zero BL multipliers) which is explained by climatic factors or geographical limitations. This cluster only contains one key sector (raw milk).

The most prolific key sectors are generally in the agriculture and food industries, whilst in 20 of the biobased sectors, there are no examples of 'key sector' performance. 'Raw milk' is key in all five clusters and 'intensive livestock' in four. 'Cereals', 'animal feed', 'forestry', 'wood' and 'other food' are strong contenders (three regional clusters), whilst in a fourth regional cluster group ('Northern & Central'), both 'animal feed' and 'wood' have 'potential key sector' status. Of the newer biobased activities (i.e., first- and second-generation biofuels, biochemicals, bioelectricity, biomass from energy crops and pellets), there are no key sector examples, although bioelectricity has 'potential key sector' status in three group clusters.

4. Conclusions

The economic value added of biobased activity is highly heterogeneous, both across sectors and regional clusters. In two regional clusters ('Mediterranean' and 'Mainly Eastern'), the bioeconomy is a key engine of wealth generation, whilst in all regional clusters, wealth generation is found to be predominantly backward-oriented. Agriculture and food sectors provide numerous examples of key sectors across EU regions while no key sectors are found amongst the 'new' biobased sectors.

The biophysical cascading hypothesis of 'last resort' usage of bioenergy is fully consistent with the economic contribution of these sectors to economic prosperity: none of the bioenergy sectors exhibit 'key' status. Indeed, all three bioenergy sectors are heavily backward oriented, whilst supply generated wealth is particularly weak in first and second generation biofuels.

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