

1 **Sustainable, Values-based Banking Model – clustering**
2 **Procedure for Assessing Its Convergence Pattern across**
3 **European Banks**

4
5 The paper subscribes to the strand of literature dedicated to sustainable banking,
6 which represents a major shift from the conventional banking business model.
7 At the core of the business mission and strategy lies the strong commitment of
8 not only achieving profit, but also long-lasting, sustainable social and
9 environmental impacts. The aim of the paper is to uncover whether financial
10 institutions that have consolidated their mission, vision, environmental and
11 societal involvement, as well as regular activity as a sustainable bank (and
12 hence share the same active commitment on sustainable finance) follow a
13 similar business model and strategy, and respectively display a resembling
14 pattern of financial performance and exposure to risks. The classification of
15 sustainable banks into homogenous groups is made by performing an
16 unsupervised learning clustering algorithm called cluster analysis. Clustering is
17 carried out for the most recent year with available data, applying an
18 agglomerative hierarchical method and defining a distance (proximity) measure
19 and a linkage rule. The sample of banks included in the study consists of those
20 European banks that have voluntarily joined the Global Alliance for Banking on
21 Values (GABV). To achieve this goal, we take into account several key
22 financial indicators collected from their 2022 annual reports. In particular,
23 financial performance is proxy by the ROE and ROA, operational efficiency is
24 computed as cost-to-income ratio, the exposure to the liquidity risk is
25 represented by the loan/deposit ratio, capital adequacy is represented by tier 1
26 ratio, while the balance sheet composition is reflected by the share of bank
27 loans to total assets, the share of financial assets to total assets, the share of
28 deposits to total assets. The findings will shed light on whether the business
29 model adopted by GABV sustainable banks, rooted in the strong commitment
30 to a values-based banking model with a positive impact on local communities
31 and the environment, displays highly homogeneous characteristics or, on the
32 contrary, there is dissimilarity in terms of the key indicators considered.

33
34 **Keywords:** sustainable banking; sustainable finance; business model; banking
35 performance; banking risk; cluster analysis; descriptive statistics; proximity
36 matrix

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1 **Introduction**

2

3 The current global challenges faced due to climate change have given a new impetus
4 to the emergence of sustainability in finance and business fields of activity. Broadly
5 speaking, it contributes to redefining the traditional business models of financial
6 intermediaries and channelling the financing not only to achieve profit but also to achieve
7 sustainable social and environmental impacts by taking into account environmental and
8 social aspects (Hasanah et al., 2022) which will lead to a more sustainable economy.

9 Starting from the importance of the transition to a more sustainable economy,
10 sustainable finance plays the main role in enabling the financial sector to mobilize the
11 required capital for this transition (Sommer, 2020). Adopting sustainable finance practices
12 has become an important issue (Munir et al., 2022), as it provides a pathway and
13 opportunity to achieve a sustainable innovation environment (Falcone & Sica, 2019). In
14 addition, the sustainable economy desiderate can be supported by means of green financial
15 decisions (Shershneva & Kondyukova, 2020).

16 Governments, banking supervisory and regulatory institutions, and financial
17 intermediaries are seeking to meet the challenges related to expected financial, economic
18 and climate crises through sustainability (Ziolo et al., 2019). This situation paved the way
19 for bringing sustainable, green finance to the forefront of the banking business, and the
20 banking sector also started to provide environmentally, sustainable products and services
21 (eco-friendly products) as a response (Dikau & Volz, 2021) as well as to voluntarily join the
22 membership of various international initiatives such as the Equator principles, the
23 Principles for Responsible Investment, the United Nations Environment Programme –
24 Financial Initiative, the United Nations Global Compact, the Net Zero Banking Alliance,
25 the European Federation of Ethical and Alternative Banks and Financiers, to name just a
26 few of them. Adherence to any of these international or regional frameworks translates into
27 the alignment of the business vision, strategy, and current operations with a set of core
28 best-practice principles in the field of sustainability.

29 Recent banking activities gravitate around several trends such as digital banking,
30 green bonds, green credit cards, green accounts, and even green mortgages (Prabhu &
31 Aithal, 2021). Furthermore, many concepts referring to sustainable finance are being used
32 today referring to environmental finance, climate finance, green investment, and green
33 finance (Akomea-Frimpong et al., 2021).

34 The scope of the paper is to particularly focus on those banks that joined the Global
35 Alliance for Banking on Values (GABV). Membership of this association signals a firm,
36 transparent commitment of using finance to deliver sustainable economic, social and
37 environmental development, for the general wellbeing of people and the planet.
38 Consequently, these banks have tailored their mission, vision and financial activity in
39 order to accommodate the environmental and societal involvement. The main research aim
40 is to uncover whether there are specificities in terms of the business model adopted or, on
41 the contrary, there is close alignment in terms of several financial indicators. We apply a

1 cluster analysis approach as it is the most suited for revealing the presence of
2 heterogeneity among selected banks, or of similarity patterns in terms of business model
3 and strategy.

4 The paper delineates from existing research in that it proposes a new approach,
5 namely to identify clusters of resembling values-based banks displaying similar financial
6 features in terms of financial performance, operational efficiency, risk exposure, solvency
7 and balance sheet structure. So far, there is limited research on GABV member banks and
8 the research objectives vary broadly. For example, Kocornik-Mina et al. (2021) conduct a
9 systematic multiple case study approach of the best practises implemented by GABV
10 banks to achieve the desired social impact. The defining characteristics of GABV
11 sustainable banks and their differentiating elements are evaluated by Valls Martínez et al.
12 (2021) from a two-fold methodological perspective (factor analysis and cluster analysis)
13 and reveal the delineation between two major groups: Ethical Banks per se and Poverty
14 Alleviation Banks. A different research goal belongs to Valls Martínez et al. (2020) who
15 compare sustainable and conventional banking in Europe in terms of several financial
16 indicators such as liquidity, coverage and solvency. The influence of social banking and
17 financial sustainability on the economic development has been empirically assessed by
18 Dourtmes and Andrikopoulos (2021).

19 Section 2 discusses the various ways sustainable finance is implemented in current
20 banking activity by reviewing a series of conceptual and empirical approaches. Section 3
21 develops the methodological background and presents the specificities of the data. Section
22 4 showcases and explains the results obtained while the last one concludes.

23

24

25 **Implementing the Sustainable Finance Policy and Measures in the Banking Activity** 26 **– A Literature Review**

27

28 From a sustainability perspective, the transition to a more sustainable ecosocial
29 system needs unprecedented sustainable, low-carbon investments, which need not only
30 financial resources but also shifting these resources toward the pathway of sustainability
31 that sustainable finance naturally deals with (Sommer, 2020). According to the Sustainable
32 Banking Network and International Finance Corporation (2020), sustainable finance refers
33 to all practices, policies, and regulations issued by governments or regulators and financial
34 institutions to:

35

- 36 i) manage and reduce the risks resulting from financial sector activities related to the
37 environmental, social, and governance risks;
- 38 ii) encourage assets, projects, investments, sectors, and businesses by facilitating the
39 flow of capital to them.

40

1 The banking sector, through its privileged position as the major intermediary
2 between financial resources and investment projects that need financing, can play a major
3 role in fostering the completion of sustainable goals. To achieve this, banks must improve
4 their range of sustainable products, which will directly benefit the bank's image,
5 reputation and will improve trust and customer loyalty (Ibe-enwo et al., 2019). A study by
6 Mejia-Escobar et al. (2020) indicates a growing trend of developing more sustainable
7 banking projects in the financial markets, with banks that actively take into account the
8 ESG considerations.

9 Liu & Huang (2022) explain the mechanism of how participation in sustainable
10 finance of a bank affects its profitability and asset quality, as follows:

- 11
- 12 ✓banks can increase their market share and enjoy the benefits of expanding
13 sustainable finance, which will lead to higher profitability. In addition, banks with
14 more orientated resources toward sustainable finance can better manage the
15 economic cycle. At the same time, it is likely that banks will face constraints in
16 financing industrial investments with a higher level of pollution or higher
17 consumption of energy;
- 18 ✓sustainable finance increases bank operating costs related to the implementation of
19 new credit screening criteria and adjustment of internal credit rating systems to
20 account for new ESG ones;
- 21 ✓sustainable finance investments are mostly related to the government priorities,
22 therefore banks with sustainable finance investments may gain subsidies from the
23 government to improve their risk management capacities and enhance it to be
24 complying with sustainable finance practices.

25

26 A complementary research strand investigates the relationship between banking
27 involvement in sustainable finance and the new related risks. Prudential regulation and
28 supervision can guide and help banks identify and address financial risks related to
29 sustainability proactively, which encourages the banking sector to continue its involvement
30 in sustainability and deal with the inherent risks related to sustainable finance (Alexander &
31 Fisher, 2019). Indeed, most experts point out that environmental risks related to
32 sustainability may negatively affect the banking sector due to increased volatility in asset
33 prices and borrower default, in addition to the limitation and restriction of credit for some
34 economic sectors that had been classified as unsustainable from an environmental
35 standpoint. Liu & Huang (2022) bring a different point of view. If the scale of the bank's
36 sustainable finance activities compared to all its other business lines is too low, it indicates a
37 tendency to neglect risk management associated with sustainable finance objectives and the
38 management's preference to maximise profits and minimise risks related to sustainable
39 finance.

40 A point-by-point explanation of the various typologies of risks that can affect banks'
41 desire to involve in sustainable practices belongs to Bank of England (2018). Corporate

1 credit risk is defined as the sudden exit from the market of companies that depend on high
2 carbon emissions for reasons like changes in customer preference or even government
3 policies to encourage certain kinds of investments. The retail credit risk occurs when a
4 climate event occurs that significantly impairs the borrower's real assets. It applies
5 especially to commercial banks that hold large portfolios of mortgage loans. Banks will be
6 subject to face market risks because in case of changes in the economic policy or economic
7 priorities, there may occur a change in the price of assets. Finally, the policy and legal risk
8 arises when a country extends environmental protection in its national policies and law.

9 From the perspective of Cato (2022), the risk of sustainability should be reflected in
10 the prudential consideration of the bank capital requirements. Assets included in the bank
11 collateral can be evaluated higher when these assets do not have negative environmental
12 effects, compared to assets they do have.

13 Prudential regulation which has duties in maintaining financial stability has to make
14 sure that these risks are considered as systemic risks. In the same vein banks have to
15 recognize it by taking sustainability risks into account in their internal risk management
16 models. However, the response of most banks to these risks was related to adopting various
17 green banking practices or improving existing practices and principles with a focus on the
18 management of ESG risk (Alexander & Fisher, 2019).

19 A survey of the existing literature shows that some banks started to delineate from the
20 mainstream banking industry in terms of business mission, targeted customers, and
21 expected environmental and/or societal impact. Some of them label themselves green
22 banks, sustainable banks, social, or ethical banks. Weber & Remer (2011) define social
23 banks as banks that are orientated to have positive social effects for the local communities.
24 For example, sustainable banks with a social dimension try to reach social and financial
25 inclusion and embed sustainability in the financial sector through many practices such as
26 transparency and accountability, tax payment, and prevention of corruption. These practices
27 apply not only to bank employers, but also to all potential partners of the banking business.
28 In addition to that, several social banks provide financial education programmes for specific
29 target groups such as disadvantaged people (Lange & Schmitt, 2019).

30 The main role of sustainable finance is to channel financial resources towards social
31 and environmental added value projects and investments. This progress can be achieved
32 through ethical banks, which aim to encourage sustainable and responsible investments.
33 The efficiency of ethical, sustainable banking activity is reflected in the ability of an ethical
34 bank to support socially responsible projects (Barbu & Boitan, 2019). In the same vein, the
35 banking sector, by reallocating financial resources to more sustainable sectors, plays an
36 important role in supporting the transition of the economy to a more sustainable one
37 through the following:

- 38 ✓ supporting the adoption of climate change and environmental changes;
- 39 ✓ mitigation of the environmental risk when it occurs;
- 40 ✓ supporting recovery efforts (Barbu & Boitan, 2019)

41

1 Green banks or environmentally responsible banks represent an important form of
2 banking activity that leads to the emergence of several synergistic effects: i) the economic
3 efficiency of the bank will increase; ii) positive impact on the social image of the bank; iii)
4 the harmful, negative effects of banking activity on the environment are expected to
5 decrease; iv) environmentally responsible bank practice is susceptible to generate social
6 benefits in the future (Shershneva & Kondyukova, 2020). According to Mir & Bhat (2022),
7 green banking practices represent all sustainable banking services that have the main role in
8 achieving environmental sustainability, which will lead to protecting our planet by
9 preventing environmental damage. Green banking practices have impacts on both the
10 environmental performance of banks and the source of green finance of banks, according to
11 Chen et al. (2022).

12 According to the empirical results of Zhang et al. (2022), green banking activities have
13 a significant positive effect on the performance of environmental banks, in addition to their
14 role in achieving sustainable economic development. Green banking development plays the
15 main role in reducing costs and increasing the benefits of development, such as increasing
16 competition between banks and increasing the rate of online banking facilities, in addition
17 to reducing the costs related to long-term projects and investments.

18
19

20 **Methodology and Data**

21

22 Cluster analysis is included in the category of unsupervised learning algorithms and
23 is widely used as a classification tool. It performs a structural differentiation of banks
24 (Korzeb et al., 2022) by grouping them, according to some pre-established input variables,
25 into meaningful and relatively homogeneous groups or clusters. Its main purpose is to
26 group cases according to their degree of similarity or proximity so that observations
27 included within a specific cluster are more homogeneous than observations between
28 clusters (Figueiredo Filho et al. 2014, Cymerman and Cymerman 2017).

29 The approach used to form clusters is the hierarchical one, because we have no prior
30 knowledge on how many clusters should be generated. Due to this important feature it is
31 largely employed by existing studies, regardless the purpose of the analysis. The major
32 advantage lies in that there is no need to specify the expected number of clusters in
33 advance because it is automatically determined as a hierarchy of nested partitions and
34 displayed in the form of a tree diagram called dendrogram (Gagolewski et al., 2023). It is
35 applied an agglomerative algorithm that begins by including each case into a single cluster,
36 then according to the distance measure computed the closest clusters are merged in each
37 successive step, giving rise to high-quality partitions inside each hierarchical framework
38 displayed in a simple and intuitive manner (Cena & Gagolewski, 2020). As a similarity
39 measure we rely on distance measures represented by the squared Euclidean distance. In
40 the next step we use the matrix of distances between the various input variables or
41 characteristics to perform a similarity-based clustering, by means of a linkage rule called

1 average linkage method. According to this approach, the distance is defined by computing
2 the arithmetic mean between all pairwise distances (Gagolewski et al., 2023).

3 The study is carried out on a sample of 11 commercial banks operating in Europe
4 that are active members of the GABV network. The list of banks included in the study, as
5 well as the country of origin and some specific business model features are summarized in
6 table 1.

7

8 **Table 1.** *List of GABV banks included in the study*

Name of the bank	Country	Mission/vision/strategy
3Bank	Serbia	Provides financial services to customers who make a positive economic, social and environmental impact, with special focus on clients who have difficulty in accessing such services (equal rights to financial services for all).
Fiare Banca Etica	Spain	Intends to act as a tool of social transformation through the financing of third sector projects, the social and solidarity economy and the promotion of a culture of financial intermediation, under the principles of transparency, participation and democracy.
Banque Alternative	Switzerland	Positions itself as an ecological, social and transparent bank, committed through its business activities to the common good, to human beings and the environment. Social and ecological principles are put before profit.
Charity Bank	UK	Defines itself as an ethical bank that creates lasting social change for the communities. It supports charities with loans that they couldn't find elsewhere and ensures people that their savings could be invested ethically.
Cultura Bank	Norway	Follows a banking business where money is not viewed as an end in itself but as a tool to create social justice and a better environment.
Ecology Building Society	UK	Aims at building a greener society by providing mortgage loans for properties and projects that respect the environment

		and support sustainable communities, funded through transparent savings accounts.
Bank of Karditsa	Greece	Its mission is to be dynamically present in the development of the local economy by meeting the financial needs in the most personalized way, with speed, friendliness and transparency.
MagNet Bank	Hungary	Positions itself as a community-building financial institution, a values-based bank which aspires for active social participation and consciously develops its environment.
Merkur	Denmark	Denmark's largest value-based bank that serves both business and private customers who search for an ethical and responsible bank.
Triodos Bank	Netherlands	Its mission is to make money work for positive change, in ways that benefit people and the environment, and to create a society that protects and promotes quality of life and human dignity for all.
Unity Trust Bank	UK	Its mission is to help create a better society by supporting organizations to prosper and contribute to positive economic, social and environmental change. It only lends to creditworthy organizations that comply with bank's ethical values and are able to deliver quantifiable impact in their local communities.

1 *Source: authors, based on information collected from banks' websites*

2

3 The list of input variables that are included in the study as proxies for the business
4 model specificity in terms of risk, return, financial soundness and balance sheet
5 composition is described in table 2 below. Data is collected from banks' annual reports for
6 the 2022-year end.

7

1 **Table 2.** *Description of variables*

Variable name	Definition
return on assets - ROA	Computed as the ratio of bank's after tax profit in total assets
cost to income ratio	Designates the operational efficiency. Usually banks are targeting a level of around 60% or less, as a strategy of controlling the operational expenses that will further improve their profitability.
common Equity tier 1	Is a measure of capital adequacy, of how much capital is available to withstand unexpected losses or shocks, computed as a percentage of a bank's risk-weighted credit exposures. The higher the capital ratio the wider bank's resilience to unexpected shocks.
loan/deposit ratio	Quantifies the exposure to the liquidity risk. A value close but below one suggests that loans are funded mainly by customer deposits (core, stable accounts), which indicates a safe balance sheet structure.
financial assets to total assets	Evaluates the proportion of income-generating assets (other than loans) represented by shares and bonds. Banks' intention of holding them (for frequent trading, for sale, or until maturity) provides clues on its financial behavior: speculative or precautionary.
bank loans to total assets	Is a proxy of the size of bank lending to customers.
deposits to total assets	Indicates bank's level of indebtedness to the customers, in the form of deposit accounts attracted from them.

2 *Source: authors*

3

4 Before proceeding with the cluster analysis, the main descriptive statistics are
5 discussed in order to uncover some initial characteristics of our dataset, and then a
6 correlation matrix is generated to verify whether our variables are highly correlated to each
7 other.

8

9 **Table 3.** *Descriptive Statistics*

	No. obs.	Minimum	Maximum	Mean	Std. Deviation
ROA (%)	11	.0000	2.38	.75	.79
cost to income (%)	11	36.80	80.00	66.57	13.73
common Equity tier 1 (%)	11	9.05	22.91	16.29	4.17
loan/deposit (%)	11	43.90	145.00	86.21	30.91
financial assets to total assets (%)	11	.38	31.31	8.69	8.55

bank loans to total assets (%)	11	35.75	84.44	65.80	13.78
deposits to total assets (%)	11	55.97	93.91	84.52	10.89

1 *Source: authors*

2

3 The mean value of ROA is 0.75 and the standard deviation is 0.79 which indicates
4 that the values of the variable tend to be close to the sample's mean. The minimum value
5 of ROA is 0 and is recorded by Merkur Bank while the maximum value is 2.38 and
6 belongs to 3Bank.

7 The minimum value of cost to income ratio is 36.80 and is registered by Unity Trust
8 Bank, while the maximum one is 80, being recorded by Merkur Bank and Triodos Bank.
9 The standard deviation is 13.73 indicating that the values of the ratio are spread out over a
10 wider range; hence, there is high data variability among banks.

11 The maximum value of the Common Equity tier 1 indicator is 22.91 and belongs to
12 3Bank while the minimum value is 9.05 and is recorded by MagNet Bank.

13 The mean value of the loan/ deposit ratio is 86.21 and the standard deviation is 30.91
14 indicating high deviation of the values from the sample's mean and thus the presence of
15 broad heterogeneity in terms of this indicator. The minimum value is 43.90 being
16 registered by Merkur Bank while the maximum one is recorded by Cultura Bank.

17 The maximum value of financial assets to total assets is 31.31 and belongs to Cultura
18 Bank while the minimum one is 0.38 and is registered by 3Bank.

19 The minimum value of bank loans to total assets is 35.75 registered by Merkur Bank
20 while the maximum one is 84.44 registered by Banca Etica. The standard deviation of
21 13.78 suggests high deviation of the values of variables, which tend to be far away from
22 the mean value which is 56.80.

23 The maximum value of deposits to total assets is 93.91 and is recorded by Ecology
24 Building Society while the minimum one is 55.97 and is recorded by 3Bank.

25

26 **Table 4.** *Correlation matrix*

		ROA (%)	cost to income (%)	equity tier 1 (%)	loan/ deposit (%)	bank loans to total assets (%)	financial assets to total assets (%)	deposits to total assets (%)
ROA (%)	Pearson Correlation	1	-0.57	0.26	0.23	0.04	-0.21	-0.46
	Sig. (2-tailed)		0.06	0.43	0.48	0.89	0.53	0.15
cost to income (%)	Pearson Correlation	-0.57	1	0.28	0.27	0.16	-0.04	-0.32
	Sig. (2-tailed)	0.063		0.40	0.41	0.62	0.89	0.33

Common Equity tier 1 (%)	Pearson Correlation	0.26	0.28	1	0.45	-0.15	0.35	-0.53
	Sig. (2-tailed)	0.43	0.40		0.15	0.64	0.28	0.09
loan/deposit (%)	Pearson Correlation	0.23	0.27	0.45	1	0.55	0.37	-0.46
	Sig. (2-tailed)	0.48	0.41	0.15		0.07	0.25	0.15
bank loans to total assets (%)	Pearson Correlation	0.04	0.16	-0.15	0.55	1	-0.21	-0.27
	Sig. (2-tailed)	0.89	0.62	0.64	0.07		0.53	0.42
financial assets to total assets (%)	Pearson Correlation	-0.21	-0.04	0.35	0.37	-0.21	1	0.35
	Sig. (2-tailed)	0.53	0.89	0.28	0.25	0.53		0.28
deposits to total assets (%)	Pearson Correlation	-0.46	-0.32	-0.53	-0.46	-0.27	0.35	1
	Sig. (2-tailed)	0.15	0.33	0.09	0.15	0.42	0.28	

1 *Source: authors*

2

3 The probabilities associated with the correlation coefficients between variables are
 4 not significant, therefore we can conclude that variables are not statistically correlated and
 5 hence redundant information is not present in the dataset considered. All of them will be
 6 further included in the cluster analysis.

7

8

9 **Findings and interpretation**

10

11 The distance matrix (Table 5) showcases in numerical form the computed distances
 12 between banks, according to their intrinsic features represented by the seven variables
 13 abovementioned.

14

15 **Table 5. Squared Euclidean Distance**

Cases	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11
B1	0,00	2030,00	3416,18	3538,45	2489,77	4683,00	6897,38	5195,91	10988,17	4718,65	10092,81
B2	2030,00	0,00	752,23	372,28	3004,94	868,40	2569,25	1053,89	5994,34	1132,19	4686,03
B3	3416,18	752,23	0,00	633,43	4913,73	567,97	1838,63	547,69	2888,63	235,74	3669,00
B4	3538,45	372,28	633,43	0,00	4395,93	255,07	1059,56	365,76	4176,66	714,29	2577,89
B5	2489,77	3004,94	4913,73	4395,93	0,00	5353,65	7892,16	5689,49	11678,01	5176,42	10038,88
B6	4683,00	868,40	567,97	255,07	5353,65	0,00	924,75	62,98	2900,99	311,45	2353,83
B7	6897,38	2569,25	1838,63	1059,56	7892,16	924,75	0,00	877,80	2435,04	1548,68	573,05
B8	5195,91	1053,89	547,69	365,76	5689,49	62,98	877,80	0,00	2607,00	267,70	2273,43
B9	10988,17	5994,34	2888,63	4176,66	11678,01	2900,99	2435,04	2607,00	0,00	2137,70	2741,12

B10	4718,65	1132,19	235,74	714,29	5176,42	311,45	1548,68	267,70	2137,70	0,00	2953,76
B11	10092,81	4686,03	3669,00	2577,89	10038,88	2353,83	573,05	2273,43	2741,12	2953,76	0,00

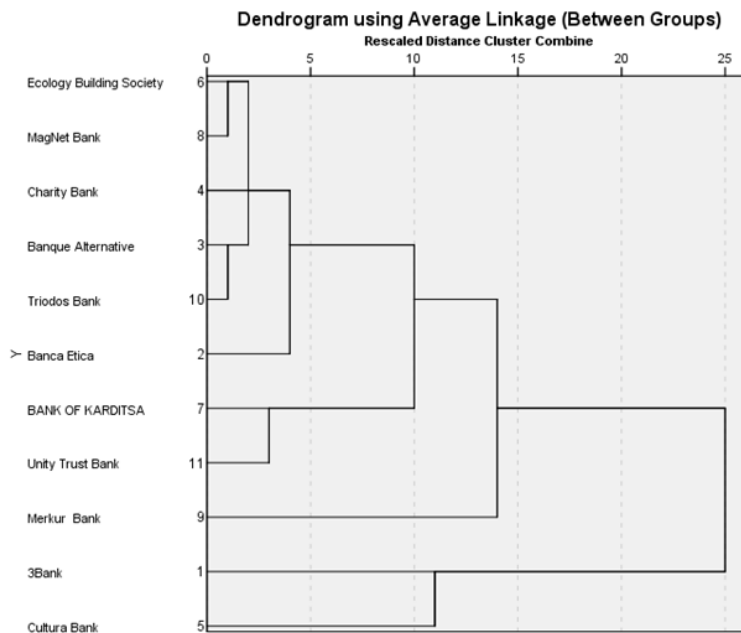
1 *Source: authors based on SPSS analysis*

2

3 The final outcome of the cluster analysis is presented synthetically in the form of a
 4 dendrogram or hierarchical tree that illustrates the hierarchical composition of a group of
 5 banks, in successive stages of clustering, due to the decreasing degree of similarity
 6 between them. The clustering solution that is kept for interpretation purposes is the one
 7 generated for the distance range 0-5, as it is the most meaningful and detailed in terms of
 8 identifying homogenous clusters. The highest the distance clusters merge the broadest the
 9 dissimilarity between them.

10

11 **Figure 1. Dendrogram**



12

13 *Source: authors based on SPSS analysis*

14

15 The hierarchical clustering for the year 2022 shows the presence of five clusters with
 16 specific distinctive features:

17 ➤ Charity Bank, Banque Alternative, Ecology Building Society, MagNet Bank,
 18 Triodos Bank and Banca Etica feature some of the lowest levels of ROA, below the
 19 sample's average of 0.75%. The cost to income indicator ranges around the sample's
 20 average of 66.57%, as well as the tier 1 indicator and the loan/deposit ratio. These banks
 21 are scoring the highest values in the sample for loans to total assets and deposits to total
 22 assets, and some of the lowest, below-average values of financial assets to total assets.
 23 Thus, banks included in this cluster have as main source of financing the deposits attracted
 24 from customers while on the asset side, the most prominent part is hold by the loan

1 portfolio. Lending is the main financial activity conducted by these banks signaling their
2 commitment for the financing of sustainable, green investment projects. In addition, they
3 exhibit a medium operational efficiency, capitalization and exposure to the liquidity risk
4 arising from the mismatch between the maturity of the deposit accounts and the one of
5 loans.

6 ➤ Bank of Karditsa and Unity Trust Bank record one of the highest ROA levels in the
7 entire sample (1.64%), the lowest values for cost to income ratio and for the share of
8 financial assets in total assets, below average values for tier 1 indicator, loan/deposit ratio
9 and loans/assets ratio, and high values of deposits to total assets. Consequently, these
10 banks are best performers in terms of minimizing their operational costs and maximizing
11 financial return. Most of their financial liabilities are represented by deposit accounts.
12 However, lending has a share of only 50-57% of total assets.

13 ➤ Merkur Bank is an outlier bank that features the minimum value of ROA, of
14 loans/assets and of loan/deposit ratios among all the banks in the sample, and the highest
15 cost to income ratio. Tier 1 and deposits/assets position above the average, while financial
16 assets to total assets record a below average value. It appears that the bank succeeds to
17 attract large amounts of financing from customers in the form of core deposit accounts,
18 has a low exposure to the liquidity risk and is well capitalized, but it faces profitability
19 problems and deficiencies in the operational cost management (the lowest operational
20 efficiency). The explanations for obtaining these low levels are included in the 2022
21 annual report. From the total operational costs, IT costs (in areas such as cybersecurity,
22 compliance, GDPR and anti-money laundering) have been steadily increasing in the past
23 years and account for a large proportion of Merkur's total costs. Staff costs also increased
24 due to the fierce competition for hiring high-skilled, specialized employees. The main
25 source of income is the interest income associated with the loan portfolio and it is
26 declining because customers have refinanced their mortgage loans, thereby reducing their
27 outstanding debt with the bank. The ratio of loans to total assets is of only 36%. This fact
28 is explained by the decreasing interest of bank customers to apply for new loans, the
29 refinancing of existing loans as well as bank's involvement in the impact investment field
30 related to green and ethical investment products. In addition, by having a look at the
31 composition of the balance sheet, it appears that cash in hand and demand deposits with
32 central banks represent almost 53% of total assets. Therefore, this bank exhibits a cautious,
33 precautionary financial behavior.

34 ➤ 3Bank features the maximum value of ROA in the entire sample of banks (2.38%),
35 a large value of cost to income ratio, and the maximum value of the tier 1 (22.9%). It holds
36 the second highest value of the loan/deposit ratio (135%), a large value of bank loans to
37 total assets, but at the same time the lowest value of financial assets to total assets (0.38%)
38 and of deposits to total assets (55.97%). Consequently, it is the best performer in terms of
39 generating financial returns, being also the best capitalized bank. Its business model is
40 different in that only half of its liabilities are represented by deposit accounts attracted
41 from customers. A remaining amount of 26% is represented by deposits and other

1 liabilities attracted from banks and other financial institutions. This fact puts further
2 pressure on the exposure to liquidity risk, as the loans granted are only partially covered by
3 the stable customer deposit accounts. Deficiencies appear also in terms of cost
4 management.

5 ➤ Cultura Bank records below average values for ROA and bank loans to total assets,
6 above average values for cost to income ratio and large deposits to assets ratio (89.9%),
7 the 2nd highest value in the entire sample of the tier 1 equity ratio (20.79%), the highest
8 value of loans to deposit ratio (145%) and of financial assets in total assets (31.31%). The
9 strength of this bank, that is included in a distinct cluster, is represented by a strong
10 capitalization. However, it seems that it faces some problems with the cost management as
11 it exhibits a large level of operational cost inefficiency, which puts further pressure on the
12 profitability indicators. Bank loans to total assets represent around 62%, indicating that
13 lending to the real economy and households is not an aim in itself, being complemented
14 with holding a high share of financial assets. A closer look into the annual report shows
15 that the portfolio of financial assets is mainly composed by sovereign and corporate bonds
16 that generate stable, fixed-income. Thus, the bank appears to follow a precautionary
17 financial behavior with a steady increase of income revenues, as it invests in low risk
18 financial assets that generate a predictable, recurrent income. However, the bank is highly
19 exposed to the liquidity risk as its loans are not fully covered by core deposit accounts and
20 it has to rely on additional sources of financing such as loans from other banks. In its latest
21 2023 annual report this drawback is clearly acknowledged, together with the board
22 commitment of redesigning the bank's business strategy in order to decrease the risk
23 tolerance to liquidity risk.

24 25 26 **Conclusions**

27
28 The findings generated through our unsupervised exploratory analysis revealed that
29 the business model adopted by a sample of European sustainable banks affiliated to the
30 GABV network displays heterogeneous features in terms of the key indicators considered.
31 Although they all acknowledge a strong commitment for the implementation of a
32 values-based banking model with positive impact on local communities and environment,
33 the current global/regional factors (macroeconomic, geopolitical) as well as the banking
34 competition in the domestic banking system are leaving their mark on the major banking
35 business indicators.

36 As the clusters' features indicate, some banks (Bank of Karditsa and Unity Trust
37 Bank) have succeeded to balance the financial goals with the social and environmental
38 ones, maintaining at the same time good resilience to unexpected shocks and appropriate
39 management of operational costs and liquidity risks. It should be mentioned that there is
40 no bank or group of banks that are rated worst in all the considered financial indicators.
41 Instead, some of them (Merkur Bank, Charity Bank, Banque Alternative, Ecology

1 Building Society, MagNet Bank, Triodos Bank and Banca Etica) exhibit the worst
 2 profitability, other record some of the highest cost to income ratios (Merkur Bank, 3Bank,
 3 Cultura Bank) or the highest exposure to the liquidity risk (3Bank, Cultura Bank).

4 Another finding is related to the accomplishment of their basic, traditional function
 5 namely the financial intermediation between depositors, as holders of capital, and
 6 borrowers. The banks that prioritize lending to customers, by holding the largest share of
 7 the loan portfolio in total assets, are those included in the first cluster (Charity Bank,
 8 Banque Alternative, Ecology Building Society, MagNet Bank, Triodos Bank and Banca
 9 Etica) and the one included in the fourth cluster (3Bank).

10 At the opposite are some banks that involve in both lending (although at a smaller
 11 scale, of up to 60% of total assets) and investing in the purchase of financial assets such as
 12 shares and bonds: Cultura Bank (31.31%), Unity Trust Bank (15.4%) and Triodos Bank
 13 (10.9%). Consequently, these banks display a more diversified but prudent business model.
 14 They exhibit a precautionary financial behaviour by investing in fixed-income bonds
 15 issued by the sovereign or financial institutions in order to achieve stable interest income
 16 and use them as a collateral in case of liquidity shortage (the loans received from the
 17 central bank have to be mandatorily guaranteed with a portfolio of eligible assets, such as
 18 bonds). In addition, some of them prefer to hold large cash amounts in accounts with the
 19 central bank (Unity Trust Bank, Triodos Bank). Therefore, these amounts of money are
 20 used neither for lending nor for investment purposes, but are kept in the form of liquid
 21 assets to serve as a buffer of liquidity in case of emergency or sudden shocks. It is a
 22 conservative strategy implemented as a result of the economic and financial uncertainty
 23 that has dominated the past few years, during the pandemic crisis.

24 To conclude with, economic literature summarizes the most desired approach in the
 25 conduct of the banking business by social (ethical) banks: those exhibiting noticeable
 26 resilience in periods of financial stress and operating under moderated risk exposure are
 27 positively connected to economic development (Dourtmes and Andrikopoulos, 2021).

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