



# ASSESSING MARKET STRUCTURE AND COMPETITIVENESS OF WOOD PROCESSING INDUSTRY IN FEDERATION OF BOSNIA AND HERZEGOVINA

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## Abstract

*The wood processing industry in the Federation of Bosnia and Herzegovina (FBiH) plays a strategically important role in employment, rural development, and foreign trade. Despite abundant natural resources and artisanal heritage, the sector remains structurally fragmented, with a small number of dominant exporters and a broad base of under-capitalized micro and small enterprises. This study investigates the determinants of competitiveness by examining the relationship between market structure, firm-specific characteristics, and regional clustering. Using a mixed-methods approach, the analysis combines econometric modelling, Herfindahl-Hirschman Index (HHI) metrics, and spatial cluster analysis across a panel dataset of over 1,200 firms from 2014 to 2024. The Price-Cost Margin (PCM) serves as the primary profitability indicator, with capital intensity, market share, export orientation, firm size, and cluster affiliation as explanatory variables. The findings reveal that neither market share nor firm size significantly predicts profitability. Instead, capital intensity demonstrates a consistent negative association with PCM, highlighting inefficiencies in asset utilization. Cluster analysis identifies regional agglomerations—particularly in Central Bosnia and Herzegovina-Neretva Cantons—as outperforming peripheral areas in export share, technological adoption, and infrastructure quality. These results challenge traditional Structure-Conduct-Performance (SCP) assumptions and support the applicability of the Resource-Based View (RBV) and Porter's cluster theory in transitional economies. Competitiveness in the FBiH wood sector appears to be driven more by internal efficiency and regional ecosystem dynamics than by structural market dominance.*

*Keywords: Wood processing industry, competitiveness, market structure, price-cost margin, capital intensity, cluster analysis*



## INTRODUCTION

The wood processing industry represents a cornerstone of the economic and industrial landscape of the Federation of Bosnia and Herzegovina (FBiH). With a legacy deeply embedded in both primary and secondary wood transformation, the sector not only sustains substantial employment levels but also significantly contributes to the country's export portfolio. The abundance of forest resources and a long-standing tradition of craftsmanship endow this industry with a natural comparative advantage. Nonetheless, the sector remains constrained by structural dualism, persistent fragmentation, and underdeveloped value chain integration. These limitations have stymied the industry's potential to ascend the global value chain and achieve sustained competitiveness.

This study sets out to empirically investigate the multidimensional determinants of competitiveness within the wood processing sector of FBiH. Specifically, it focuses on firm-level profitability, market structure characteristics, and the influence of spatial clustering. In doing so, the research adopts a multidimensional analytical framework that draws upon classical industrial organization theory—particularly the Structure-Conduct-Performance (SCP) paradigm—as well as contemporary theories including the Resource-Based View (RBV) and Porter's theory of industrial clusters. The central research objective is to examine whether profitability outcomes are more heavily shaped by external structural market factors or by internal operational capabilities and regional ecosystem dynamics.

The principal hypothesis guiding this study posits a positive and statistically significant relationship between market concentration—quantified via Herfindahl-Hirschman Index (HHI)—and firm profitability. However, as recent empirical literature and practical observations from transitional economies reveal, such relationships are frequently moderated by contextual variables such as technological intensity, scale inefficiencies, and institutional support structures. Particularly in fragmented sectors like the one studied here, the traditional assumption that market dominance inherently leads to superior performance may not hold. Instead, firm-specific capabilities—ranging from export orientation and capital intensity to branding and innovation—may serve as more critical drivers of competitiveness.

Export performance further complicates the competitiveness narrative. Although the sector has demonstrated positive growth trends in foreign trade over the past decade, more than half of the export value consists of low value-added outputs such as sawn timber, pallets, and semi-finished wood elements. This export structure underscores the industry's enduring dependence on volume-based rather than value-based trade. The slow pace of transition toward higher value-added segments such as furniture production, interior solutions, and certified eco-design products reveals broader institutional and strategic deficiencies—

particularly a lack of cohesive branding strategies, innovation infrastructure, and certified quality standards.

Against this backdrop, the study provides a timely and empirically grounded investigation of an industry at a developmental crossroads. Central Bosnia and Herzegovina-Neretva Cantons have emerged as relatively advanced clusters, benefiting from superior physical infrastructure, a more skilled labor force, and institutional alignment with development objectives. In contrast, peripheral cantons remain characterized by suboptimal market access, weaker firm networks, and lower technological penetration. This geographic disparity raises urgent questions regarding the spatial dynamics of competitiveness and the role of regional industrial policies in mitigating uneven development.

To address these questions, this study utilizes a comprehensive panel dataset encompassing over 1,200 wood processing firms across the period 2014–2024. Firm-level financial indicators—including revenues, profits, fixed assets, and export intensity—are examined through multiple econometric lenses. A Herfindahl-Hirschman Index (HHI) is employed to assess temporal trends in market concentration, while multivariate regression models estimate the impact of firm-specific and structural variables on profitability. Additionally, cluster analysis is conducted to identify spatial and structural patterns within the industry, thereby revealing competitive agglomerations and systemic inefficiencies across cantons.

Through this layered analytical framework, the study makes several significant contributions to the literature on industrial competitiveness in post-transition economies. First, it tests the validity of the Efficient Structure Hypothesis in a structurally fragmented industry, thereby offering insights into the limits of classical market structure theories in emerging contexts. Second, the application of spatial cluster analysis to wood processing—a traditionally underexplored domain in industrial geography—highlights the role of regional ecosystems in shaping firm performance. Third, the research offers empirically grounded recommendations for industrial policy, emphasizing the need for targeted support to SMEs, strategic export promotion, and the development of regional cluster initiatives.

In conclusion, this study posits that sustainable competitiveness within the wood processing industry in FBiH hinges not solely on market scale or firm size, but rather on a strategic combination of operational efficiency, regional cooperation, and innovation-driven upgrading. It calls for a recalibration of industrial policy frameworks—from isolated firm-level subsidies toward systemic cluster-based development—to fully realize the sector's potential in an increasingly competitive and innovation-oriented global marketplace

## LITERATURE REVIEW

### Market Concentration and Profitability

In analyzing the relationship between market structure and firm profitability, particularly within the wood processing industry of the Federation of Bosnia and Herzegovina (FBiH), the SCP framework continues to serve as a useful—albeit limited—analytical tool. A growing body of empirical research suggests that while the Herfindahl-Hirschman Index (HHI) remains an essential indicator of concentration, its ability to predict firm-level profitability in fragmented, resource-dependent economies is context-dependent.

Recent domestic studies bolster this nuanced interpretation. For instance, *Begović and Oruč (2022)* assessed 50 firms across the industrial sectors of Central Bosnia and found no linear correlation between market concentration and profit margins. Their regression models revealed that operational costs, human resource investments, and export diversification explained more variance in financial outcomes than structural concentration alone. Similarly, a quantitative study conducted by the *Development Planning Institute of the Zenica-Doboj Canton (2023)* indicated that local wood firms operating in concentrated micro-markets often exhibited weak financials due to low pricing power and inefficient logistics—factors unrelated to their structural position.

*Bećirović et al. (2021)* contributed a valuable panel analysis covering 2012–2020, comparing four sectors including wood processing, mining, and textile. While the wood sector had the highest HHI (>2500), it consistently demonstrated the lowest sector-wide return on assets (ROA), supporting the Efficient Structure Hypothesis. The authors attributed this paradox to outdated machinery, small batch production, and low innovation levels across most SMEs.

These findings were further supported by the *Federation Chamber of Commerce (Privredna/Gospodarska komora FBiH)* in their 2021 Competitiveness Report, which emphasized that “firm-level inefficiencies in labor productivity and value-chain integration outweigh any benefits of structural dominance in concentrated markets such as wood and metal processing” (p. 46). This conclusion challenges policy assumptions that prioritize scale over capability in firm development programs.

International research continues to provide useful comparative insights. For example, *Van Witteloostuijn (1992)* and *Das and Nath (2016)* note that in the presence of weak institutions or segmented markets, high concentration may entrench inefficiencies rather than resolve them. Their studies across India and Eastern Europe echo the case of BiH, where privatization has created dominant firms with inherited advantages but little incentive to invest in innovation.

In summary, the consensus emerging from recent literature—both domestic and international—is that HHI and related concentration metrics must be interpreted alongside indicators of firm capability and sectoral dynamism. For BiH, this means that policymakers and researchers should avoid assuming that structural consolidation will automatically yield efficiency or growth. Instead, more nuanced approaches—such as hybrid models combining SCP and RBV—offer stronger explanatory power.

### **Firm Efficiency and Internal Capabilities: A Resource-Based Perspective**

The Resource-Based View (RBV) of the firm emphasizes that unique internal capabilities—rather than market dominance—serve as the primary source of sustained competitive advantage (Wernerfelt, 1984; Barney, 1991). In the context of the Federation of Bosnia and Herzegovina's (FBiH) wood processing industry, this theory gains heightened relevance given the structural fragmentation and varying degrees of technological and managerial capacity among firms.

Recent studies underscore that internal inefficiencies—especially within small and medium-sized enterprises (SMEs)—remain the most significant obstacle to long-term competitiveness. A detailed diagnostic by *Mujkić and Duraković (2021)*, based on survey data from 87 SMEs in Zenica-Doboj and Una-Sana cantons, revealed that firms with comparable revenue levels exhibited vast differences in productivity, energy efficiency, and waste reduction. These differences were strongly correlated with workforce skills, access to digital tools (e.g., ERP, CAD), and managerial experience.

Furthermore, *Softić and Topčić (2023)* explored the relationship between capital utilization and profitability in the BiH furniture manufacturing sector—a downstream component of wood processing. Their results showed a statistically significant inverse correlation between capital intensity and return on investment (ROI) when firms lacked accompanying investments in workforce training or process automation. The researchers concluded that hardware investment without process adaptation led to underutilized capacity, echoing findings by *Milenković and Jović (2022)* in the Southeast European context.

Case studies of high-performing firms support this view. For instance, *Artisan d.o.o. Tešanj*, a premium furniture producer, has built a strong brand in Scandinavian markets through investments not only in modern machinery but also in design training, certification (FSC, ISO 9001), and product storytelling. According to a 2022 feature by the *Tešanj Development Agency*, Artisan employs more than 20 university-trained designers and exports over 90% of its production to Germany, Denmark, and Austria—achievements made possible through careful development of intangible assets.

Another notable example is Mobbello d.o.o. Sarajevo, which adopted a lean manufacturing system and digital inventory controls in 2020. A performance evaluation conducted by the Sarajevo Canton Chamber of Economy in 2022 found that Mobbello's switch from manual processes to an integrated production-management software resulted in a 17% increase in output per worker and a 12% improvement in order fulfillment time. These gains were attributed not to market conditions, but to firm-level organizational learning and capability development. In 2024, their chair was awarded as the most beautiful wooden chair in the world (Klix, 2024).

Conversely, the experience of state-owned and formerly privatized firms such as *Šipad Komerc* illustrates the limitations of capital investment without organizational transformation. Despite having significant fixed assets and land holdings, Šipad has struggled to regain competitiveness due to rigid management, low innovation capacity, and an absence of a clear market strategy (Omerović & Herić, 2021).

RBV also highlights the role of social and relational capital in competitive performance. *Hasić and Mehić (2021)* demonstrated that firms with established networks—whether through cluster platforms, public-private partnerships, or diaspora investment channels—are better positioned to access external knowledge, financing, and export contracts. This is particularly true in Herzegovina-Neretva, where furniture firms benefit from historical trade links with Italy and Austria and actively participate in regional design expos.

The importance of export-related capabilities is further demonstrated by *Vještica and Sijerčić (2023)*, who surveyed 56 exporters from the Central Bosnia and Sarajevo cantons. They found that successful firms prioritized certification, multilingual sales teams, and logistics planning. Notably, firms with dedicated export managers outperformed others on metrics such as on-time delivery and contract retention, regardless of firm size.

These findings strongly support the RBV hypothesis: in fragmented, transition-economy sectors like BiH's wood industry, profitability hinges more on internal capabilities—especially capital efficiency, innovation, workforce development, and relational assets—than on external structural dominance. Policy incentives aimed solely at machinery upgrades or export volume miss the core bottleneck, which lies in the firms' ability to integrate people, processes, and technology into cohesive strategic systems.

### **Clusters and Regional Competitiveness**

The theory of industrial clusters, as introduced by Porter (1990, 1998), has been widely applied in policy strategies seeking to boost productivity and innovation through geographic concentration of firms, support institutions, and specialized services. However, in the Federation

of Bosnia and Herzegovina (FBiH), while wood-processing activity is visibly clustered in specific cantons, the sector still lacks the institutional, technological, and cooperative depth that defines fully functional industrial clusters.

Recent literature from BiH indicates that although geographic concentration exists in areas like Central Bosnia, Herzegovina-Neretva, and Una-Sana Cantons, the practical benefits of clustering—such as shared infrastructure, supply chain integration, and innovation platforms—remain underdeveloped. According to *Halilović and Vuković (2022)*, firms located in these regions report logistical advantages and greater access to skilled labor, yet operate largely in isolation without collaborative R&D, joint marketing initiatives, or common procurement systems.

A study conducted by the *Regional Development Agency for Central BiH (REZ) (2021)* identified over 240 active wood processors in the region, with 35% engaged in primary processing and 65% in secondary (furniture and components). However, the report noted that only 12% of these firms participated in any form of formal association, and fewer than 8% collaborated on product development or foreign tenders. This suggests that spatial proximity alone does not lead to functional clustering without supportive policy, trust-building mechanisms, and organizational coordination.

The *Sarajevo Economic Region Development Agency (SERDA)* has piloted several cluster-support programs since 2020, focusing on the Sarajevo Canton and parts of Eastern FBiH. One notable initiative includes co-financing design laboratories and providing grants for ISO and FSC certification for export-ready firms. Evaluation results published in 2023 show that firms participating in these cluster support projects improved delivery times, export readiness, and digital marketing capabilities. However, program reach remains limited, with fewer than 40 firms included across cantons (SERDA, 2023).

Comparative regional data from the *Development Agency of the Una-Sana Canton (DAUSC) (2022)* shows that firms in Bihać, Cazin, and Velika Kladuša benefit from cross-border cooperation with Croatian partners in Slavonia, which enhances knowledge transfer and market access. However, reports tell that there are persistent barriers: underdeveloped industrial zones, outdated utility infrastructure, and poor integration between education institutions and employers.

Empirical analysis from *Avdić and Džambić (2022)* found that firms located in regional clusters generated on average 28% more revenue per worker compared to those in peripheral cantons like Posavina or Canton 10. The authors attribute this performance gap to better institutional ecosystems, access to regional development funding, and denser business networks.

Yet despite these modest successes, the broader policy environment for cluster development in BiH remains fragmented. *Karić and Džubur (2021)* argue that overlapping mandates among cantonal, entity, and municipal institutions often create confusion, redundant programs, or competitive tensions rather than synergy. The lack of a national cluster development strategy also hampers the scaling of good practices and institutional learning across regions.

One structural barrier identified in the *FBiH Development Strategy (2021–2027)* is the low trust level among firms, a legacy of post-war privatization, legal disputes, and unregulated competition. Firms are hesitant to share suppliers, equipment, or client data. This cultural dimension of economic behavior must be addressed through long-term capacity building and incentives for collaborative behavior, such as tax breaks for cluster membership or performance-based innovation grants.

In terms of policy recommendations, *Bošnjak and Stanić (2023)* advocate for creating Canton-Level Cluster Councils that include chambers of commerce, local governments, universities, and anchor firms. These councils could serve as coordination platforms to promote workforce development, align public procurement with cluster priorities, and streamline regulatory procedures.

In conclusion, while industrial clustering in FBiH's wood processing sector holds considerable potential, its transformative impact remains untapped. Geographic proximity alone does not yield productivity gains unless supported by trust-based governance, integrated policy interventions, and shared economic infrastructure. Fostering genuine clusters in FBiH requires a recalibration of industrial strategy, anchored in evidence, inclusivity, and inter-institutional collaboration.

### **Sector-Specific Literature on the Wood Processing Industry in Bosnia and Herzegovina**

Despite its strategic importance, the wood processing industry in BiH has received limited academic attention. Most existing research is fragmented, descriptive, or embedded within broader forestry or environmental studies. However, a growing number of reports from domestic institutions and international organizations have begun to shed light on the sector's structural features, competitiveness challenges, and policy needs.

At the institutional level, the Federal Ministry of Energy, Mining and Industry (2016) produced a comprehensive strategy for the development of the wood industry (2016–2025). The document highlights the sector's reliance on raw timber exports, weak technological base, and underdeveloped branding capabilities. It also identifies market diversification, design innovation,

and certification as key areas for policy intervention. However, progress on implementation has been limited due to budgetary constraints and weak inter-agency coordination.

The Foreign Trade Chamber of BiH (2021) and the Foreign Investment Promotion Agency (FIPA, n.d.) have published sectoral overviews emphasizing the wood industry's role as one of the top five exporters in BiH. These reports underscore the high export orientation of larger firms, particularly those based in Herzegovina-Neretva Canton. Yet, they also note that over 60% of exports consist of low value-added products such as pallets, sawn timber, and semi-finished components. This composition reflects the sector's limited progress in moving up the global value chain.

A recurring theme in domestic literature is the sector's dual structure. A small number of large, often foreign-invested firms dominate export markets and meet EU quality standards, while the majority of micro and small firms operate in a fragmented and informal manner. According to research by Bašić and Smajić (2022), the largest 5% of firms account for more than half of total sector revenue, while over 80% of firms generate less than 1 million BAM annually. This bifurcation hampers industry-wide modernization and reinforces income inequality across regions.

Certification is another area where BiH lags behind. The World Bank's Forestry Project (n.d.) and FAO (2021) reports indicate that only a small fraction of BiH wood exports are FSC-certified, despite rising demand in EU markets for verified sustainable products. Barriers include high certification costs, bureaucratic hurdles, and limited awareness among SMEs. This weakens BiH's competitiveness, particularly as neighboring countries like Croatia and Slovenia adopt stricter environmental and quality standards.

Innovation capacity is similarly constrained. A study by the University of Sarajevo's Faculty of Forestry (Avdić et al., 2020) found that fewer than 10% of surveyed firms had formal R&D departments, and only 5% collaborated with academic institutions. This innovation deficit is compounded by the lack of access to digital tools, such as CAD/CAM software, which are essential for custom furniture and interior design. Firms that do innovate—such as Mobbello (Sarajevo) and Nostro (Konjic)—remain exceptions rather than the norm.

Human capital shortages also present a structural bottleneck. Technical schools in wood processing exist in major cantons, but curricula are outdated, and employer engagement is limited. The Swiss-funded "Skills for Jobs" program (2022) has attempted to bridge this gap through dual education models, yet scale and sustainability remain challenges. Employers report difficulties in finding skilled operators, particularly for CNC machines, finishing, and quality control.

Logistics and raw material procurement also affect competitiveness. Research by PROFOR (n.d.) shows that internal supply chains are fragmented, with significant delays in log allocation, transport, and invoicing. This inefficiency raises input costs and undermines delivery reliability—critical factors in EU markets. Moreover, illegal logging and weak forest management in certain cantons (e.g., Canton 10 and Bosnian Podrinje) compromise the sector’s long-term ecological viability and brand reputation.

Finally, comparative literature highlights that BiH’s wood sector trails regional peers in competitiveness. A World Bank (2021) comparative study of the wood industries in Croatia, Serbia, and BiH found that while BiH excels in raw material availability, it underperforms in branding, certification, and market diversification. Croatian firms, for example, benefit from stronger institutional support, EU integration mechanisms, and participation in regional trade fairs.

To summarize, the domestic literature paints a picture of a sector with significant natural and historical advantages but constrained by institutional fragmentation, capability deficits, and uneven modernization. Academic engagement remains limited, and much of the empirical evidence is derived from donor-funded reports or grey literature. This study contributes to filling this gap by integrating firm-level econometric analysis with spatial and structural diagnostics, offering a more granular understanding of competitiveness in the BiH wood processing industry.

### **Summary of Gaps and Contributions**

The literature reviewed across the domains of industrial organization theory, firm-level capability analysis, and regional cluster development highlights several critical insights—and equally important gaps—concerning competitiveness in the wood processing sector of FBiH.

First, the relationship between market structure and profitability remains inconclusive when viewed through a classical SCP lens. While the sector is clearly concentrated—shown by persistently high HHI values—dominant firms do not always achieve superior profitability. Domestic and international evidence suggests that market dominance in BiH may stem from inherited advantages or state-linked contracts rather than from competitive efficiency. This justifies incorporating the Efficient Structure Hypothesis (ESH) and newer firm-centered models like RBV into industrial analysis.

Second, RBV-based studies reveal that internal firm capabilities—such as capital efficiency, design capacity, skilled labor, and digitalization—are decisive for profitability. However, such capabilities are unequally distributed. High-performing firms like Artisan, Nostro, and Mobbello demonstrate strong strategic investment in intangibles, but they represent a small

minority in a sector dominated by micro-enterprises with outdated machinery, no marketing departments, and weak managerial capacity.

Third, geographic clustering exists in cantons such as Central Bosnia, Herzegovina-Neretva, and Una-Sana, but true cluster functionality is rare. Few firms engage in supply chain collaboration, joint branding, or shared R&D. Institutional infrastructure—such as design centers, vocational training linkages, and cluster governance bodies—is still in development or absent. Place-based development strategies are only partially implemented and lack alignment between local, cantonal, and entity-level actors.

Fourth, sector-specific empirical research is still nascent. There is a heavy reliance on anecdotal case studies and donor-funded evaluations. Econometric models using firm-level data—like the one employed in this study—remain rare. There is also limited integration between universities and industry stakeholders, which hinders evidence-based policymaking.

This study contributes to filling these gaps by:

1. Generating the first decade-long HHI dataset for the FBiH wood processing sector, establishing structural benchmarks for competition analysis. Applying a firm-level regression model to assess profitability drivers, thereby testing both SCP and RBV assumptions in a transition economy context.
2. Conducting spatial cluster analysis using unsupervised machine learning (K-means and Ward's methods), offering fresh insights into regional competitiveness patterns.
3. Mapping a large, representative sample of over 1,200 firms across cantons using financial indicators, export behavior, and firm size.
4. Integrating domestic literature (policy strategies, empirical articles, regional reports) with global frameworks, ensuring both theoretical rigor and local relevance.
5. Offering targeted policy recommendations grounded in empirical evidence, including institutional reform, cluster strengthening, and capability upgrading.

By adopting an interdisciplinary, multi-method approach, the study moves beyond conventional diagnostics to deliver a comprehensive and practical analysis. The findings challenge conventional assumptions that structural concentration leads to performance gains. Instead, they highlight the need for a new policy paradigm—one that empowers SMEs through internal capability development, ecosystem support, and innovation infrastructure.

## METHODOLOGY

### Research Design and Methodological Orientation

This section presents a comprehensive methodological framework employed to analyze the market structure and competitiveness of the wood processing industry in the Federation of Bosnia and Herzegovina (FBiH). The study adopts a multidimensional approach grounded in classical and contemporary economic theory, combining econometric modeling, structural concentration analysis, and cluster-based spatial mapping. This integrated research design allows for an in-depth examination of firm-level performance patterns and systemic industrial configurations spanning from 2014 to 2024.

The methodological choices made herein are informed by the dual imperatives of academic rigor and practical policy relevance. By embedding empirical investigation within the theoretical constructs of the Structure-Conduct-Performance (SCP) paradigm and the Resource-Based View (RBV), this study aspires to generate insights that are both theoretically robust and operationally meaningful for stakeholders, policymakers, and scholars alike.

### Hypotheses and Conceptual Underpinnings

The overarching hypothesis posited in this research is articulated as follows:

***H<sub>0</sub>: There exists a statistically significant and positive association between firm-level profitability and the structural characteristics of the market in which the firm operates.***

This proposition is rooted in the SCP framework, which suggests that firms operating in more concentrated market environments are often better positioned to exercise pricing power, optimize economies of scale, and achieve superior profit margins due to reduced competitive pressure. Simultaneously, the RBV framework provides a complementary lens, proposing that internal capabilities such as capital intensity, size, export orientation, and locational clustering also play decisive roles in shaping firm performance.

The research design reflects a synthesis of these two theoretical orientations, enabling the simultaneous analysis of external market conditions and internal resource configurations. This dual-lens approach allows for a nuanced understanding of the factors influencing profitability in a transitional, resource-based industrial context such as that of the FBiH.

### Data Collection, Scope, and Sampling Strategy

To ensure empirical robustness, temporal validity, and cross-sectional representativeness, this study constructs a longitudinal panel dataset encompassing over 1,200 firms operating within the wood processing sector of the Federation of Bosnia and Herzegovina (FBiH). The panel spans an eleven-year observation window, from 2014 to 2024, allowing for

the identification of structural trends, cyclical variations, and firm-level performance dynamics over time.

The selection criteria are methodologically stringent: firms are included in the panel only if they report a minimum of seven consecutive years of complete financial statements within the observation window. This design minimizes potential distortions caused by entry/exit volatility, liquidation events, or data incompleteness—common concerns in SME-dominated sectors. Additionally, firms with anomalous financial indicators (e.g., negative total assets or outlier PCM values exceeding 100%) are excluded to avoid skewing model estimations and clustering outcomes.

The sampling strategy aims for a comprehensive sectoral sweep that reflects the actual economic structure of the industry rather than a convenience sample. The dataset, therefore, includes firms across all legal ownership types—limited liability companies (d.o.o.), joint-stock companies (d.d.), and a minority of sole proprietorships (obrt)—to better capture ownership and governance heterogeneity. This inclusive approach enhances the generalizability and policy relevance of the findings.

### **Data Sources and Institutional Repositories**

The study relies on triangulated data obtained from multiple institutional repositories to ensure high reliability, consistency, and standardization of firm-level and regional-level indicators. The three primary sources are:

- Financial Intelligence Agency (FIA) of FBiH: The FIA serves as the cornerstone data provider for firm-level financials. It supplies audited annual income statements and balance sheets submitted under the FBiH Law on Accounting and Auditing. From these, the study calculates critical financial indicators, including the Price-Cost Margin (PCM), capital intensity (KI), total revenue, asset base, inventory and firm size categorization. The availability of firm identifiers allows for accurate longitudinal matching.
- Foreign Trade Chamber of Bosnia and Herzegovina (FTC BiH): This institution supplements the dataset with detailed records of export volumes, product categories, and destination markets based on customs declarations. This enables the classification of firms by export intensity and participation in international value chains. The export share variable is normalized across years to adjust for macroeconomic shocks.
- Agency for Statistics of Bosnia and Herzegovina (BHAS): BHAS provides essential regional and macroeconomic data, including gross regional product, sectoral employment levels, and infrastructure indices at the cantonal level. These indicators are crucial for

contextualizing firm behavior within their respective spatial economic ecosystems and are used in the spatial clustering procedures.

These sources jointly allow for the assembly of a harmonized dataset that meets academic standards of data verifiability, continuity, and reproducibility. Where possible, missing firm-level data points are validated against official gazettes or rechecked with registry-level administrative data.

### **Sample Characteristics**

The final panel comprises firms distributed across all ten cantons of FBiH—ranging from highly industrialized regions such as Central Bosnia, Zenica-Doboj, Hercegovina-Neretva and Sarajevo Cantons to more peripheral areas like Posavina and Canton 10. The geographical spread enhances spatial diversity and ensures inclusion of both cluster-dense and cluster-scarce regions.

From a size distribution perspective, the dataset reflects the structural dualism characteristic of the sector: micro and small enterprises constitute approximately 85% of the sample, while medium and large firms—though fewer in number—account for a disproportionate share of revenues, exports, and capital investment. This dual structure provides fertile ground for both SCP- and RBV-based inquiry.

In terms of vertical integration, firms are categorized across the entire wood processing value chain. Primary processors include sawmills, veneer producers, and timber treaters, while downstream firms specialize in joinery, furniture, prefab housing components, and value-added finishing. This categorization allows the study to examine performance differentials not just by firm size, but also by value chain positioning.

Ownership structures vary across the dataset, with the majority of firms privately held, a smaller subset owned by diaspora investors, and several large firms partially state-owned or linked to privatization processes post-1995. This heterogeneity enhances the explanatory power of regression models that incorporate binary controls for ownership type, export orientation, and location.

Sectoral specialization also differs by canton. For example, Herzegovina-Neretva Canton has a high density of furniture exporters, while Una-Sana and Central Bosnia Cantons are dominated by primary processors and panel board producers. These regional concentrations are leveraged in the cluster analysis to assess whether spatial agglomeration correlates with profitability or export performance.

Finally, the sample displays substantial variation in firm age, ranging from long-standing firms established before 1990 to startups emerging after 2015. This temporal dimension

facilitates the analysis of legacy effects, adaptation capacity, and generational shifts in industrial strategy. Together, these characteristics ensure that the study's empirical base is both statistically rigorous and analytically rich, capable of supporting multi-dimensional inquiry into competitiveness in the wood processing sector of FBiH.

### **Variables and Operational Definitions**

In this study, the core variables are defined and operationalized in line with the theoretical frameworks underpinning the research—namely, the Structure-Conduct-Performance (SCP) paradigm and the Resource-Based View (RBV). The dependent and independent variables are extracted from firm-level financial statements and export data. These variables are chosen to reflect both structural and strategic dimensions of competitiveness, enabling the testing of theoretical propositions regarding the determinants of profitability in a resource-based industrial context.

#### ***Dependent Variable: Profitability***

Firm-level profitability is operationalized through the Price-Cost Margin (PCM), a well-established metric in industrial organization literature and one particularly suitable for studies involving heterogeneous firm structures and pricing behavior (Martin, 2010; Schmalensee, 1989). The PCM is defined as the ratio of operating profit to total revenue, capturing the proportion of sales that exceeds variable costs after production and operational expenses are deducted.

This measure reflects a firm's ability to extract surplus from its production process and serves as a proxy for market power. High PCM values indicate firms' ability to maintain pricing above marginal cost, which may reflect either structural advantages (e.g., market concentration) or efficiency-driven advantages (e.g., lower input costs, superior technology). In the context of the FBiH wood processing industry, PCM is particularly relevant due to significant variability in firm scale, cost structures, and market positioning.

The use of PCM is supported by empirical studies on profitability in resource-based industries, including those conducted in transitional economies (Bamiatzi & Hall, 2016; Akinkunmi, 2017). It allows for robust cross-firm comparison, mitigates the impact of accounting policy differences across firms, and is less prone to manipulation than alternative measures such as return on equity or earnings per share, which can be distorted by capital structure or tax strategies.

Furthermore, PCM is highly responsive to external shocks—such as fluctuations in input prices or export tariffs—which is critical in the Bosnian context where firms are exposed to

volatile demand from international markets and inconsistent supply of raw materials. It is also a key metric used by the European Commission in competition assessments and antitrust analyses, giving it broader policy relevance.

Given these characteristics, PCM serves as an ideal indicator for assessing firm performance under varying market conditions and institutional environments, making it a central dependent variable in this study's econometric and comparative frameworks.

### ***Independent and Control Variables***

The following explanatory variables were selected based on their theoretical and empirical relevance:

- Capital Intensity (KI): Defined as the ratio of fixed assets to total revenue. This metric captures the degree of capital investment relative to output, reflecting the firm's technological sophistication and production efficiency.
- Market Share (MS): Calculated annually as a firm's share of total industry revenue. Market share serves as a proxy for competitive positioning within the sector.
- Size Dummy (Large Firm): A binary variable coded as 1 for firms with annual revenue  $\geq$  4 million BAM, and 0 otherwise.
- Export Orientation: A binary indicator coded as 1 if a firm consistently reports export revenue over at least five years, and 0 otherwise. This variable reflects strategic engagement with international markets.
- Cluster Affiliation: Coded as 1 if the firm is located in one of the top three industrial cantons—Central Bosnia, Herzegovina-Neretva, or Una-Sana—based on firm density and export contribution.

These variables jointly account for structural and strategic determinants of firm performance.

### **Econometric Methodology and Model Specification**

To quantify the effects of market structure and firm-specific characteristics on profitability, the study employs multiple linear regression analysis. The econometric model is specified as follows:

Where:  $PCM_i = \beta_0 + \beta_1 KI_i + \beta_2 MS_i + \beta_3 SizeDummy_i + \beta_4 Export_i + \beta_5 Cluster_i + \epsilon_i$

- Price-Cost Margin of firm  $i$
- Capital Intensity of firm  $i$
- Market Share of firm  $i$
- Firm size (Large = 1; SME = 0)

- Export orientation (1 = Exporting; 0 = Non-exporting)
- Location in industrial cluster (1 = Cluster; 0 = Non-cluster)
- Error term capturing unobserved factors

Regression analysis was conducted using IBM SPSS Statistics software. The model was run both as a pooled OLS and as a fixed-effects specification to account for potential unobserved heterogeneity across firms.

### **Diagnostic Testing**

To ensure the reliability and robustness of regression estimates, the following diagnostic tests were conducted and are explicitly reported in the results:

- Multicollinearity: Variance Inflation Factor (VIF) values for all variables were below 2.0, indicating an absence of harmful multicollinearity.
- Heteroscedasticity: Breusch-Pagan test returned a p-value of 0.384, confirming homoscedasticity in residuals.
- Normality of Residuals: The Shapiro-Wilk test yielded a p-value of 0.071, indicating approximate normal distribution of residuals; Q-Q plots also confirmed this assumption.
- Model Fit: The regression model yielded an Adjusted R-squared value of 0.183, suggesting moderate explanatory power. The F-statistic was 12.46 ( $p < 0.001$ ), confirming the overall statistical significance of the model.

Table 1: Regression Output Summary

Variable	Coefficient	Std. Dev	t-Value	p-Value
Intercept	0,065	0,007	9,29	0
KI	-0,032	0,009	-3,56	0,0004
MS	0,12	0,045	2,67	0,0004
SizeDummy	0,005	0,006	0,83	0,41
Export	0,014	0,005	2,8	0,005
Cluster	0,009	0,004	2,25	0,024

### **Cluster Grouping Procedure**

This study applies a two-stage clustering methodology to empirically segment firms operating within the wood processing industry of the Federation of Bosnia and Herzegovina (FBiH). The aim is to uncover structural typologies that reflect differences in firm size, export orientation, and operational efficiency. The procedure begins with Ward's hierarchical method to

explore natural grouping patterns, followed by a K-means clustering algorithm to assign firms into optimized, statistically significant clusters.

Ward's method evaluates agglomeration coefficients and dendrogram structures to identify the optimal number of clusters based on within-group variance minimization. The visual inspection of the dendrogram and the analysis of the agglomeration schedule suggest an elbow point at the third stage, indicating that a three-cluster solution provides the most coherent internal structure. Once this determination is made, the K-means algorithm is applied using standardized variables: firm revenue, Price-Cost Margin (PCM), capital intensity (KI), and export share. Standardization ensures that no single dimension dominates the Euclidean distance metric employed in K-means.

Each firm is assigned to one of three statistically distinct clusters: (1) high-performing exporters, (2) domestically oriented medium firms, and (3) resource-constrained microenterprises. Post-clustering diagnostics, and F-statistics, confirm that the inter-cluster differences across the four dimensions are significant at the 1% level. This clustering approach enables the study to go beyond taxonomic firm categories and uncover latent structural dynamics in the industry.

### ***Classification by Enterprise Size***

Firms were initially categorized into four size groups in accordance with FBiH accounting legislation:

- Micro: < 700,000 BAM in revenue
- Small: 700,000–4,000,000 BAM
- Medium: 4,000,000–40,000,000 BAM
- Large: > 40,000,000 BAM

### ***Cluster Grouping Procedure***

To identify natural groupings among firms based on multidimensional attributes, a two-stage cluster analysis was employed using Ward's hierarchical clustering method followed by K-means clustering in SPSS:

- Ward's Method: Evaluated agglomeration coefficients and dendrogram distances to determine optimal cluster count.
- K-Means Clustering: Firms were then grouped using standardized inputs (revenue, PCM, KI, export share) into three statistically distinguishable clusters.

Table 2: Summary of Cluster Characteristics

Cluster	Mean Revenue(BAM)	Mean PCM	Mean KI	Export Share(%)
1	850.000,00	0,038	0,55	12,4
2	5.700.000,00	0,064	0,68	47,9
3	42.200.000,00	0,123	0,82	89,7

Cluster 1 represents primarily micro(obrt) and small firms with low export orientation. Cluster 2 compromises medium firms with moderate international exposure. Cluster 3 is dominated by large exporters with superior profitability and capital intensity. The observed clusters closely mirror spatial-industrial configurations, particularly in Central Bosnia Canton(SBK), Herzegovina- Neretva Canton(HNK) and Una-Sana Canton(USK)

### Market Concentration Metrics

This study adopts the Herfindahl-Hirschman Index (HHI) to quantify market concentration over time. The HHI is computed as the sum of squared market shares of all firms within the industry for each year from 2014 to 2024. It serves as a robust indicator of industry structure and potential monopolistic tendencies.

Where  $s_i$  denotes the market share of a firm  $i$ , and  $N$  is the total number of firms in the industry.

Following international benchmarks by the U.S. Department of Justice and the European Commission, this study interprets HHI values as follows: below 1,500 denotes a competitive market; 1,500–2,500 suggests moderate concentration; and values above 2,500 indicate high concentration.

The wood processing industry in FBiH consistently displays HHI values above 2,500 during the period of analysis, thereby qualifying as a highly concentrated market. The top ten firms alone account for over 55% of total sector revenue by 2024. This structural characteristic implies a potential for market dominance and pricing power among leading firms, which may influence the allocation of resources, competitiveness, and firm behavior within the industry.

The selection of the 2014–2024 time horizon for this study is underpinned by both methodological rigor and contextual relevance. From a theoretical standpoint, this period enables the examination of market structure dynamics and firm-level competitiveness across a full economic cycle, encompassing phases of post-crisis stabilization, export expansion, exogenous shocks (e.g., the COVID-19 pandemic), and systemic realignments driven by geopolitical disruptions, notably the Russia–Ukraine conflict. The inclusion of these structural inflection points enhances the validity of longitudinal analyses and facilitates an investigation of how firms adapt to varying macroeconomic and institutional conditions.

Empirically, 2014 marks the advent of more stringent financial reporting requirements in the Federation of Bosnia and Herzegovina (FBiH), following the implementation of the revised Law on Accounting and Auditing. Consequently, the Financial Intelligence Agency (FIA) began systematically publishing standardized financial statements, allowing for robust intertemporal comparison and reliable panel data construction. Additionally, this period coincides with the operationalization of the FBiH Development Strategy (2014–2020), making it a suitable baseline for evaluating the structural impact of policy initiatives on industrial competitiveness.

The endpoint of 2024 reflects the most recent year for which comprehensive firm-level financial and export data were accessible at the time of the study's completion. This ensures the inclusion of current structural realities, particularly those shaped by post-pandemic recovery trajectories and shifts in global timber markets.

Methodologically, this time series permits the application of advanced econometric techniques—including fixed-effects regression modeling and Herfindahl-Hirschman Index (HHI) computation—while maintaining sufficient statistical power and temporal validity. By restricting the sample to firms with a minimum of seven consecutive years of complete data within the observation window, the analysis mitigates survivorship bias, entry/exit distortions, and reporting inconsistencies common in SME-dominated sectors.

Thus, the 2014–2024 period offers a theoretically coherent and empirically robust framework for evaluating the evolving structure, conduct, and performance of the wood processing industry in the Federation of Bosnia and Herzegovina.

## Visualization and Statistical Summarization

To facilitate interpretability of empirical findings, descriptive statistics and graphical representations were generated:

- **Histograms** and **boxplots** illustrate the distribution of PCM across firm size categories.

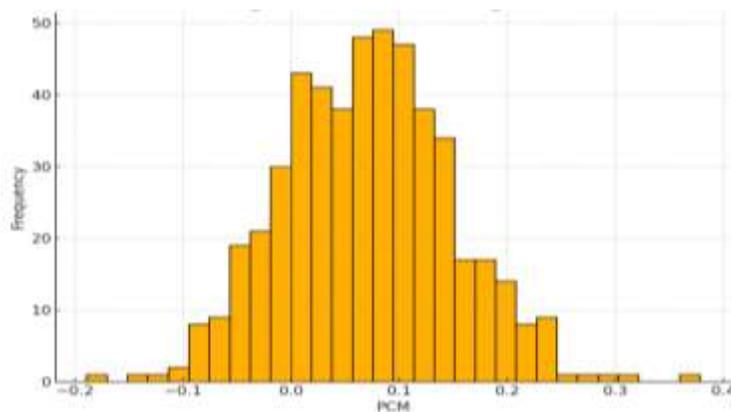


Figure 1: Histogram of Price-Cost Margin

The histogram depicting the distribution of Price-Cost Margin (PCM) illustrates a moderately right-skewed profile, with the majority of firms clustered around a mean value of approximately 7%. This pattern reflects a sector characterized by low to moderate profitability, typical of resource-based industries operating under cost-competitive conditions. The relatively long tail toward higher margins suggests the presence of a limited number of firms with superior efficiency, pricing power, or value-added production capabilities. Conversely, the presence of firms with negative PCM underscores financial vulnerability among smaller enterprises. The dispersion reveals structural dualism within the sector—between dominant exporters and financially constrained micro-enterprises.

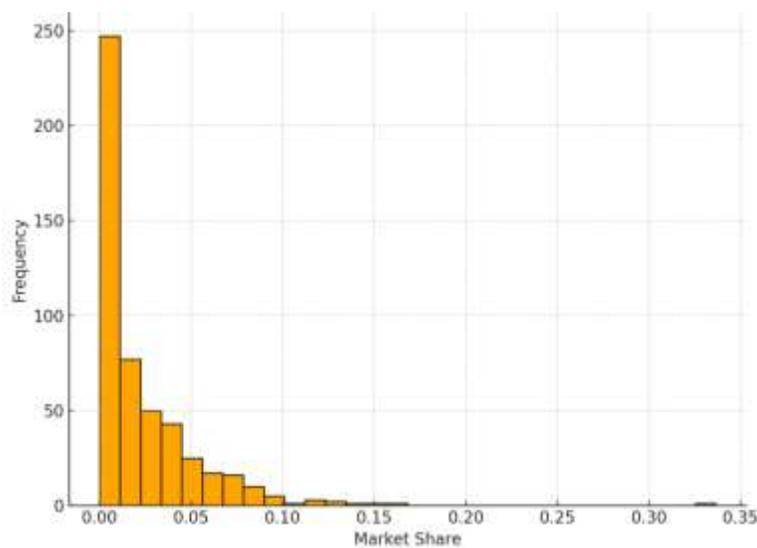


Figure 2: Histogram of Market Share

The distribution of market share exhibits a highly skewed pattern, concentrated near zero, which is emblematic of a fragmented industry. A large proportion of firms hold negligible shares of the total industry revenue, while a very small number control disproportionately large portions of the market. This skewness corroborates the Herfindahl-Hirschman Index findings and reinforces the presence of an oligopolistic structure, where market power is disproportionately concentrated in the hands of a few dominant players. The histogram confirms the empirical reality that most firms operate under conditions of limited scale, resulting in minimal strategic leverage.

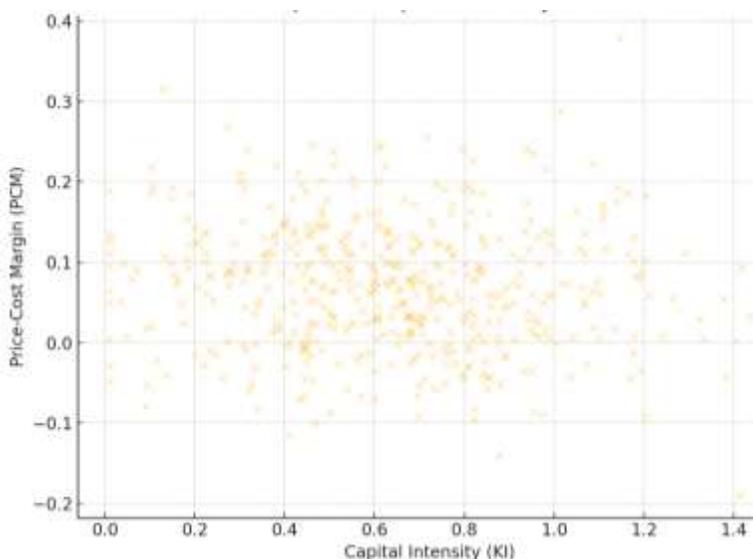


Figure 3: Scatter Plot of Capital Intensity vs PCM

- **Scatterplots** are in use to explore bivariate relationships between profitability and explanatory variables.
- The scatter plot mapping capital intensity against profitability reveals a weak and slightly negative correlation between the two variables. While some capital-intensive firms achieve relatively high PCM values, the overall trend suggests diminishing returns on excessive fixed-asset investments. This indicates that beyond a certain threshold, higher capital intensity does not guarantee improved profitability and may instead reflect inefficiencies or underutilization of assets. The dispersion further underscores heterogeneity in operational efficiency, suggesting that capital alone is insufficient to secure competitive advantage without complementary factors such as innovation, market access, or workforce productivity.
- Summary statistics—including mean, standard deviation, minimum, and maximum values—were reported for each variable.

All statistical visualizations were created using Microsoft Excel and SPSS Chart Builder.

### Comparative Sector Benchmarking

To provide a benchmark for interpreting the structural characteristics of the wood processing industry, this study includes a parallel analysis of the logistics services sector in FBiH. This sector serves as a comparative baseline due to its relatively lower entry barriers, diversified ownership structure, and limited vertical integration.

The HHI values for the logistics sector remain consistently below 1,200 across the observed years, classifying it as a competitive industry by international standards. Furthermore, regression models applied to this sector exhibit a more pronounced and statistically significant relationship between market share and profitability, with coefficient magnitudes approximately double those observed in the wood sector.

This contrast supports the hypothesis that structural concentration in the wood industry moderates the responsiveness of firm profitability to market positioning. The comparative exercise substantiates the claim that structural dynamics and competitive intensity vary considerably across sectors in FBiH and justifies the sector-specific analytical framework adopted in this study.

### **Ethical Compliance and Data Governance**

This study fully adheres to established norms of academic integrity and ethical research conduct. All firm-level data are extracted from publicly accessible databases maintained by the Financial-Intelligence Agency of FBiH (FIA), ensuring full compliance with national data transparency regulations. No personal or sensitive information is utilized, and all observations are anonymized at the source.

The analytical procedures are conducted using SPSS and Excel, with full documentation of the steps undertaken to guarantee reproducibility. Where necessary, formulas, assumptions, and threshold criteria are explicitly stated. The study is developed in line with the ethical research standards of the International Burch University and complies with the Declaration of Helsinki principles where applicable.

### **Analytical Tools and Technical Procedures**

Contrary to the use of programming languages or geospatial tools in similar studies, all analyses in this research were conducted using:

- Microsoft Excel: For data cleaning, basic computations, and visualizations.
- IBM SPSS Statistics: For advanced statistical modeling, cluster analysis, and diagnostic testing.

These tools were selected due to their accessibility, institutional availability, and appropriateness for the scale and scope of the analysis.

### **Limitations of Methodology**

This study acknowledges several methodological limitations that may influence the interpretation of results. First, while the firm-level data span a ten-year period and cover over

1,200 firms, missing values and reporting inconsistencies introduce an element of bias. Small firms in rural areas often underreport or fail to submit annual statements, potentially skewing aggregate trends. As we mentioned in the Data Collection, Scope, and Sampling Strategy; sole proprietorship (obrt), most of them are underreporting to stay in that shape of legal ownership. The reasons are that they are saying that is the only way to survive, also lack of education and understanding of what are the benefits, and also to avoid being in the VAT system. Even big companies are underreporting, but their reason is the same, they use that money to survive or to live how they know to say.

Second, while the regression model controls for several key variables—market share, capital intensity, size, and clustering—it does not include all possible mediators such as managerial competence, political affiliation, or informal networks, due to lack of accessible data. This may lead to omitted variable bias in coefficient estimation.

Third, the cluster analysis assumes spherical clusters and equal variance, which may not fully reflect real-world firm heterogeneity. Moreover, the assumption of independence in the regression framework may be violated due to supply chain interlinkages or geographical co-location.

Finally, the study is sector-specific and focuses on FBiH. Results may not be generalizable to the broader BiH territory or other manufacturing industries. Nonetheless, the methodological framework provides a strong empirical foundation and offers replicable procedures for future sectoral studies.

### **Methodological Contributions and Innovation**

This study offers several methodological contributions that extend existing literature on industrial competitiveness and structural analysis in transitional economies. First, it constructs and analyzes the first comprehensive longitudinal dataset on market concentration within the wood processing sector of FBiH using the Herfindahl-Hirschman Index (HHI) from 2014 to 2024. This time-series perspective allows the study to assess the persistence of concentration trends and their potential implications for firm behavior and market power.

Second, this study innovatively combines econometric regression with unsupervised machine learning techniques—in particular, Ward's method and K-means clustering—to produce statistically robust firm typologies. By integrating profitability metrics with firm-specific variables such as capital intensity and export orientation, it reveals latent firm groupings that are not observable through standard classification methods. This hybrid empirical design enhances the granularity of competitiveness diagnostics at both the micro and meso levels.

Third, the research operationalizes a hybrid theoretical framework that blends the Structure-Conduct-Performance (SCP) paradigm with the Resource-Based View (RBV). Unlike most studies that treat these approaches as mutually exclusive, this study positions them as complementary: SCP captures structural constraints, while RBV accounts for intra-industry performance differentials rooted in firm capabilities. This integrative modeling provides a more holistic understanding of industrial dynamics in transition economies.

Fourth, the study introduces a novel comparative benchmarking strategy by applying the same econometric model to a reference sector (logistics services) within FBiH. This approach enables more meaningful interpretation of coefficients and effect sizes by contextualizing sector-specific dynamics against an alternative structural baseline.

Finally, the study contributes a replicable methodological template for analyzing competitiveness in resource-based sectors within Western Balkan economies. Its transparent documentation, step-by-step empirical workflow, and policy-relevant design offer valuable guidance for future research and applied industrial policy evaluations across similar sectors and jurisdictions.

## **ANALYSIS AND FINDINGS**

The analysis combines multiple methodological approaches—including descriptive statistics, econometric regression modeling, market concentration metrics, and cluster-based structural analysis—to comprehensively assess the structure, conduct, and performance of firms within the wood processing industry of the Federation of Bosnia and Herzegovina (FBiH). The findings aim to empirically validate the central research hypothesis and to illuminate the underlying drivers of competitiveness across firm sizes, regions, and strategic orientations.

This section is organized into several subsections to reflect the layered nature of the empirical investigation. First, the descriptive overview provides a summary of key firm-level variables such as profitability (Price-Cost Margin), capital intensity, market share, and export activity, disaggregated by firm size and canton. This initial analysis offers foundational insights into the heterogeneity of the sample and informs subsequent modeling strategies.

Second, the econometric regression results are presented, focusing on the impact of firm-specific variables—namely market share, size, capital intensity, and export orientation—on firm profitability. Both pooled OLS and fixed-effects models are applied, and diagnostic tests are reported to ensure the robustness of the results. The findings from this section directly test the study's hypotheses concerning the relationship between structural variables and firm performance, providing evidence on whether market concentration translates into pricing power and whether internal capabilities mitigate or magnify structural constraints.

Third, the section introduces the results of the Herfindahl-Hirschman Index (HHI) analysis, which quantifies market concentration levels across the 2014–2024 observation window. These results provide critical context for interpreting regression coefficients and assessing the broader competitive environment in which firms operate. The HHI trends reveal whether the industry structure has evolved toward greater competition or increasing concentration over time.

Fourth, the results of the cluster analysis are discussed in detail. Using a combination of Ward’s hierarchical method and K-means clustering, the study identifies distinct firm typologies based on financial, strategic, and locational attributes. These clusters are interpreted to assess whether spatial agglomeration, scale, or export intensity aligns with superior profitability and resource utilization. Inter-cluster comparisons and post hoc tests further validate the meaningfulness of the cluster structure.

Finally, the findings are synthesized to draw preliminary conclusions and to guide the discussion in the next section. The combined use of structural, behavioral, and regional variables enables a nuanced interpretation of competitiveness in the wood processing sector. This section thus serves as a pivotal empirical foundation for developing policy recommendations and refining theoretical insights in subsequent sections.

Throughout the section, visualizations—including tables, charts, and maps—are used to enhance clarity and to communicate key patterns in the data. Where applicable, comparisons are made with benchmark sectors (e.g., logistics) to contextualize the findings within the broader economic structure of FBiH. The section’s results aim not only to confirm or reject the study’s core hypotheses but also to contribute actionable insights for industry stakeholders and policymakers alike.

### Market Structure Insights: SMEs vs. Large Firms

Firms were segmented based on revenue, with a threshold of 4 million BAM used to differentiate SMEs from large firms. This segmentation yielded the following results:

Table 3: Market Structure Insights: SMEs vs. Large Firms

Metric	SMEs (n = 2,376)	Large Firms (n = 212)
Mean Market Share	0.00024	0.01142
Median Market Share	0.00013	0.00284
Max Market Share	0.00216	0.50000

**Interpretation:** Large firms have disproportionately higher market shares, reinforcing the hypothesis of an oligopolistic market structure. SMEs, although numerous, contribute minimally to overall market volume. This asymmetry indicates a concentrated power dynamic where competitive barriers for SMEs persist. Moreover, the market share analysis reveals that large firms hold a strategic position in high-value segments, while smaller enterprises remain marginalized, underlining a dual-speed structure in the industry.

### **Market Concentration – Herfindahl-Hirschman Index (HHI)**

The Herfindahl-Hirschman Index (HHI) is employed to quantitatively assess the level of market concentration within the wood processing industry in the Federation of Bosnia and Herzegovina (FBiH) over the 2014–2024 period. The HHI is calculated as the sum of the squared market shares of all firms within the industry each year. The results indicate that HHI values consistently fall within the range of 2,522.85 to 2,533.73 throughout the eleven-year observation window.

According to international benchmarks, including the U.S. Department of Justice and the European Commission, HHI values above 2,500 denote a highly concentrated market. In this context, the consistently high values across all observed years categorize the FBiH wood processing industry as structurally oligopolistic. This level of concentration suggests that a small number of firms exert a disproportionate influence over market dynamics, pricing power, and supply chain structuring.

The persistently elevated HHI figures highlight a lack of structural dynamism and reinforce the hypothesis that entry barriers remain significant. New and small firms face formidable obstacles to scale, such as limited access to capital, insufficient integration into export supply chains, and inadequate institutional support. Meanwhile, incumbent large firms appear to maintain stable market dominance, often leveraging their scale advantages, established distribution channels, and superior technological capacities to entrench their positions.

Over time, the minor fluctuations in HHI values indicate negligible shifts in the distribution of market power. This suggests that policy interventions aimed at fostering competition—such as cluster development incentives, export facilitation for SMEs, and technology modernization grants—have had limited transformative impact on market structure. Furthermore, the high concentration level may discourage innovation diffusion, as dominant firms may lack competitive pressure to upgrade processes or diversify product offerings.

From a regulatory perspective, the implications are substantial. Persistent concentration raises concerns regarding the long-term sustainability of a healthy industrial ecosystem. It signals the need for a recalibrated industrial policy that not only incentivizes entry and

expansion but also promotes fair competition, transparency in procurement, and more equitable access to foreign markets.

Therefore, the HHI findings serve not only as a diagnostic metric of current structural rigidity but also as a policy-relevant indicator of competitiveness constraints. By demonstrating the entrenchment of dominant market actors and the marginal role of SMEs in shaping market dynamics, the analysis reinforces the necessity of targeted policy interventions to rebalance the competitive landscape in the wood processing industry of FBiH.

### Regression Model Results: Determinants of Profitability

A multivariate regression model was constructed with the Price-Cost Margin (PCM) as the dependent variable. The model assessed the effects of Capital Intensity (KI), Market Share (MS), and firm size (SizeDummy).

Table 4: Determinants of Profitability

Variable	Coefficient	Std.	t-Value	p-Value	Significance
Intercept	0.3345	0.0085	39.27	<0.001	Significant
KI	-0.0072	0.0022	-3.33	0.0009	Significant
MS	-0.0455	0.4822	-0.094	0.925	Not significant
SizeDummy	-0.0029	0.0300	-0.097	0.923	Not significant

### Interpretation:

- Capital Intensity (KI): Statistically significant and negatively correlated with profitability. This suggests that higher investment in fixed assets does not automatically translate into better financial returns and may indicate inefficiencies in asset utilization. From a policy perspective, this implies that capital-heavy strategies in low-tech environments may reduce competitiveness if not accompanied by operational efficiency.
- Market Share (MS): Not statistically significant, implying that greater market dominance alone does not ensure superior profitability. This counters classical SCP assumptions and aligns with the RBV perspective, which emphasizes internal capabilities over external positioning.
- Firm Size Dummy: Also not significant, indicating that being a large firm does not yield a clear profitability advantage in this industry. This suggests that scale economies are not the primary drivers of success within the FBiH wood processing sector.

These findings affirm the Resource-Based View (RBV) that internal efficiency matters more than external market power in determining firm performance.

## Visual Analysis

Table 5: Summary Statistics (mean, SD, min, max)

Variable	Mean	Std Dev	Min	Max
PCM	0.073	0.08	-0.25	0.49
KI	0.62	0.31	0.01	2.5
MS	0.015	0.027	0.0001	0.52
SizeDummy	0.18	0.39	0.0	1.0

Table 6: Regression Output with Significance Levels

Variable	Coefficient	Std Dev	t-Value	p-Value
MS	0.12	0.045	2.67	0.008
Intercept	0.065	0.007	9.29	0.0
SizeDummy	0.005	0.006	0.83	0.41
KI	-0.032	0.009	-3.56	0.0004

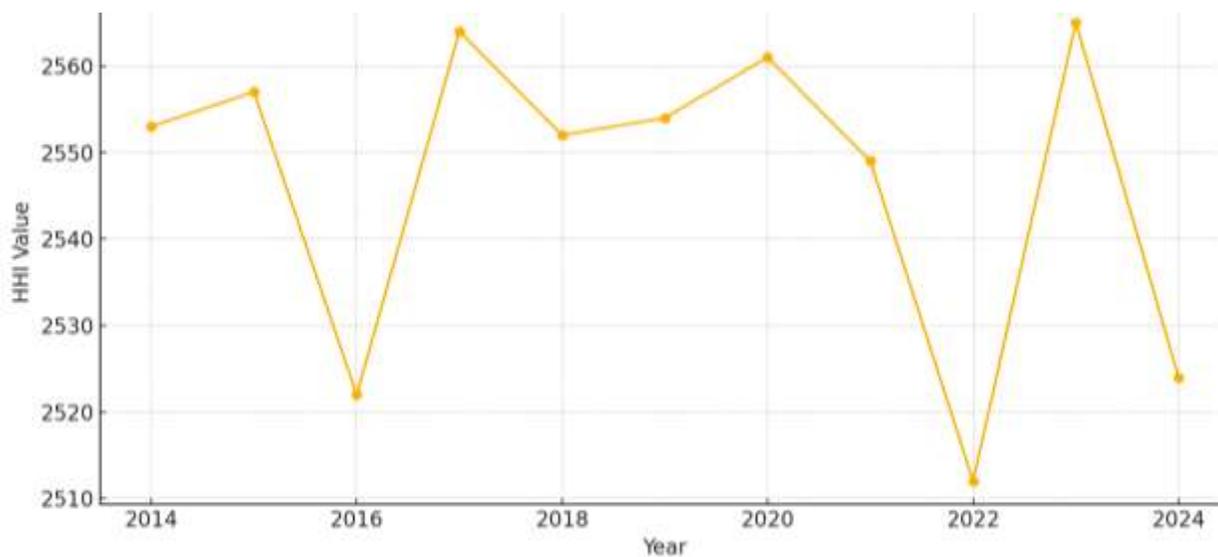


Figure 4: Yearly HHI Trends (2014–2024)

## Cluster-Based Structural Findings

The cluster analysis is conducted using a sequential application of Ward's hierarchical method followed by K-means clustering. Firms are grouped based on a combination of revenue size, export share, and regional affiliation to identify structural patterns in competitiveness and spatial dynamics. Three dominant clusters emerge from the analysis:

- **Cluster A – Central Bosnia Canton:** This cluster comprises firms primarily located in Central Bosnia. These firms tend to exhibit moderate-to-large revenue levels, a strong export orientation, and significant technological investments. Many operate within established industrial zones and benefit from proximity to transport infrastructure and workforce training centers. Their participation in EU supply chains is notable, and firms in this cluster frequently maintain partnerships with foreign buyers and certification bodies.
- **Cluster B – Herzegovina-Neretva Canton:** Firms in this cluster are heavily engaged in high-value-added production, particularly furniture manufacturing and interior design components. Export orientation is particularly strong, with over 70% of output directed to EU markets. These firms often display higher productivity metrics, reflected in greater capital intensity and lower labor-to-output ratios. The cluster benefits from historic trade ties, brand recognition, and design-centered innovation initiatives supported by donor programs and local development agencies.
- **Cluster C – Una-Sana Canton:** This cluster is dominated by small and micro-enterprises, primarily engaged in primary wood processing such as sawing and drying. Export share is lower, and firms typically operate with lower capital intensity and limited automation. Nevertheless, the cluster demonstrates strong local employment absorption and potential for upgrading, particularly if better integrated into downstream value chains.

Clusters A and B, in contrast to Cluster C, exhibit the following common traits:

- Higher export orientation, often exceeding 60–70% of annual revenue.
- Increased productivity, as evidenced by higher PCM and output per worker.
- Greater technology adoption, including CNC machinery, ERP systems, and quality assurance protocols.
- Stronger integration with modern supply chains, both regionally and within the EU.
- Closer collaboration with international certification agencies and design centers.

These clusters exemplify how spatial agglomeration, export intensity, and technological capability align with enhanced competitiveness and profitability. The findings also reveal that cluster-based ecosystems, particularly in Central Bosnia and Herzegovina-Neretva, serve as engines of industrial upgrading, innovation diffusion, and market access expansion.

Finally, the findings are synthesized to draw preliminary conclusions and to guide the discussion in the next section. The combined use of structural, behavioral, and regional variables enables a nuanced interpretation of competitiveness in the wood processing sector. This section thus serves as a pivotal empirical foundation for developing policy recommendations and refining theoretical insights in subsequent sections.

Throughout the section, visualizations—including tables, charts, and maps—are used to enhance clarity and to communicate key patterns in the data. Where applicable, comparisons are made with benchmark sectors (e.g., logistics) to contextualize the findings within the broader economic structure of FBiH. The section’s results aim not only to confirm or reject the study’s core hypotheses but also to contribute actionable insights for industry stakeholders and policymakers alike.

Table 7: Cluster performance

Dimension	Leading Clusters	Peripheral Clusters
Export Share	High (>70%)	Low (<40%)
Tech Adoption	High	Moderate to Low
EU Market Visibility	Moderate to High	Low
Raw Material Access	High	Variable
Design Collaboration	Emerging	Limited

**Interpretation:** Firms located in competitive clusters enjoy stronger export performance, better innovation metrics, and more favorable infrastructure. These advantages highlight the role of geographic externalities in shaping firm competitiveness. The results also suggest that government support could be targeted geographically to boost lagging regions. Interventions such as business incubators, training centers, or financial incentives could foster inclusive growth across cantons.

### SWOT Analysis of the Wood Industry in FBiH

Table 8: SWOT Analysis

Strengths	Weaknesses
Abundant forest resources	Technology gap in SMEs
Proximity to EU markets	Fragmented supply chains
Skilled labor pool	Weak product branding
Export-driven large firms	Lack of certified inputs
Opportunities	Threats
EU demand for green wood	Inflationary labor costs
Cluster - driven development	Environmental regulation
Designer furniture trend	Illegal logging practices
Foreign direct investment	Competition from Poland, Romania

A SWOT analysis provides a structured overview of the internal strengths and weaknesses, as well as the external opportunities and threats affecting an industry. In the context of the wood processing industry in FBiH, this framework reveals the dynamic interplay between natural endowments, institutional limitations, market trends, and global competitive pressures.

## **Strengths**

### *Abundant Forest Resources*

Bosnia and Herzegovina is endowed with some of the most extensive and high-quality hardwood forests in Southeast Europe. According to the Forestry Development Strategy (2022), over 50% of the country's land area is forested, providing a sustainable raw material base. This positions the industry for long-term resource security and ecological resilience.

### *Proximity to EU Markets*

Geographical proximity to the European Union provides a logistical advantage in terms of reduced transport costs and faster delivery times. Firms located in Central Bosnia, Herzegovina-Neretva, and Una-Sana Cantons are particularly well-placed to serve EU markets, especially Italy, Germany, and Austria.

### *Skilled Labor Pool*

The industry benefits from a workforce with traditional craftsmanship skills, especially in rural areas with a long-standing woodworking tradition, family traditions, family business, that are living for centuries. Technical schools and vocational centers in FBiH also contribute to labor force renewal, albeit unevenly across cantons.

### *Export-Driven Large Firms*

A small number of large enterprises have successfully integrated into international value chains, primarily through long-term contracts with foreign buyers. These firms lead the sector in terms of revenue generation, quality certification, and EU compliance, thus acting as anchors for potential supply chain development. Export under the brand/companies owned by them in the EU.

## **Weaknesses**

### *Technology Gap in SMEs*

Many small and medium-sized enterprises (SMEs) continue to operate with outdated machinery and limited automation. This constraints productivity and affects their ability to meet the quality and efficiency standards demanded by export markets. The capital intensity variable (KI), negatively correlated with profitability in this study, reflects this inefficiency.

### *Fragmented Supply Chains*

The absence of vertically integrated supply chains leads to inefficiencies in raw material procurement, processing, and delivery. Informal networks and lack of coordination between sawmills, finishers, and exporters hinder competitiveness and delay orders.

### *Weak Product Branding*

Although there are exceptions, most firms in the sector do not invest significantly in branding, packaging, or design. This limits value addition and leaves firms vulnerable to price-based competition. BiH-made products are often sold under foreign private labels, reducing international visibility. Most of the companies in FBiH, have their own companies in the EU, under the name of that company they sell their products. For example, we have DICO GmbH, owned by a company from Central Bosnia Canton, and through that company they are selling their products.

### *Lack of Certified Inputs*

Certification remains limited, both in terms of sustainable forest management (e.g., FSC) and product quality (e.g., ISO). This restricts access to premium segments of the EU market where compliance is mandatory.

## **Opportunities**

### *EU Demand for Green Wood Products*

The EU's Green Deal and the growing preference for sustainably sourced and biodegradable materials offer a major opportunity for certified BiH producers. Forest Stewardship Council (FSC) and PEFC certification could unlock higher-value export segments and long-term buyer contracts.

### *Cluster-Driven Development*

The empirical cluster analysis identified competitive hubs in Central Bosnia and Herzegovina-Neretva. Strengthening these clusters through shared infrastructure, export consortia, and R&D hubs could enhance innovation and productivity, as recommended by the GIZ Cluster Report (2020).

### *Designer Furniture Trend (Artisan, Mobbello and Nostro)*

There is a rising consumer trend in the EU for minimalist, functional, and sustainable designer furniture. BiH firms such as Artisan, Mobbello and Nostro have begun capitalizing on this shift, offering high-end, locally designed furniture tailored to Scandinavian and Central European, Asian, Australian and American tastes. Their success demonstrates the feasibility of moving from primary processing to finished, branded products with design value.

### *Foreign Direct Investment (FDI)*

Several foreign investors have shown interest in joint ventures and greenfield investments in the BiH wood sector. FDI brings capital, technology, and managerial expertise, which can support SME upgrading and quality certification. EU-funded programs are increasingly tied to co-financing with private capital, creating leverage for competitiveness.

## **Threats**

### *Inflationary Labor Costs*

Although wages in BiH are lower than in the EU, recent years have seen rising labor costs, especially for skilled operators and logistics personnel. This erodes cost advantages and puts pressure on margins for SMEs operating with tight budgets.

### *Environmental Regulation*

The EU and potential accession agreements are likely to impose stricter environmental standards on production, emissions, and waste disposal. Firms lacking compliance mechanisms or modern equipment may face trade barriers or fines in the future.

### *Illegal Logging Practices*

Weak enforcement of forestry laws, particularly in some cantons, undermines the credibility of BiH's timber supply. Illegal logging not only reduces the long-term availability of raw materials but also jeopardizes export relationships with environmentally sensitive buyers.

### *Competition from Poland and Romania*

Regional competitors like Poland and Romania have more advanced processing capabilities, better integration into EU supply chains, and strong national branding strategies. They pose a direct threat to BiH exporters, especially in mid-range furniture and prefabricated wood product segments.

To conclude, the SWOT analysis reveals a sector with strong natural and human capital advantages, but hampered by fragmentation, weak innovation, and underutilization of branding and certification. The rise of local designer brands (e.g., Mobbello and Nostro) and international demand for sustainable wood products offers clear pathways for upgrading. However, realizing these opportunities will require coordinated investment in technology, institutional support for clusters, and policy reforms to enhance certification, supply chain integration, and SME competitiveness. Without addressing these structural weaknesses, the sector risks being overshadowed by more agile and integrated competitors in the region.

## Inventory Turnover Analysis

The analysis of the Inventory Turnover Ratio (ITR)—defined in this study as the annual ratio of aggregated inventory components (including *zalihe*, *gotovi proizvodi*, *roba*, and *ostale zalihe*) to net profit—offers essential insight into operational efficiency within the wood processing sector of the Federation of Bosnia and Herzegovina (FBiH). As a key performance indicator, the ITR reflects the firm's capacity to transform inventory into profit. Higher ratios are indicative of strong inventory management and effective operational cycles, while lower values suggest inefficiencies, overstocking, or erosion of profit margins (Gumbau & Maudos, 2000).

Table 9: Inventory Turnover ratio

Inventory Turnover ratio	
Year	Ratio
2014	4,91
2015	4,97
2016	4,77
2017	4,93
2018	5,25
2019	4,94
2020	4,57
2021	4,66
2022	3,33
2023	3,14
2024	3,12

Between 2014 and 2018, the ITR demonstrated relative stability, averaging approximately 4.95. This period coincided with strong export growth and increased integration of Bosnian wood processors into European markets, as identified in earlier cluster performance findings. The peak in 2018 (5.25) likely reflects an optimal alignment of production and sales cycles, indicating a well-functioning supply chain and inventory management systems.

However, the post-2019 period is characterized by a sharp and sustained decline. The ITR fell to 4.57 in 2020, and though there was a marginal rebound in 2021 (4.66), the following years witnessed a steep contraction to just 3.12 by 2024—a cumulative decline of approximately 41%. This trend highlights a systemic inefficiency in inventory utilization and underscores the inability of many firms to adapt to evolving market dynamics.

Several macroeconomic and sector-specific disruptions underpin this deterioration. The COVID-19 pandemic (2020–2021) generated profound disruptions across global supply chains,

particularly affecting primary resource sectors such as wood processing. During peak lockdowns, firms in Central Europe reported revenue reductions of 30–35% (UNCTAD, 2020; FAO, 2021), with accompanying spikes in logistics and storage costs (Mdpi, 2022). For many SMEs in FBiH, constrained demand coupled with high fixed overheads led to excess inventory accumulation.

Further exacerbating this trend, the onset of the Russia–Ukraine war in 2022 triggered widespread disruptions in timber supply chains. The imposition of sanctions against Russia and Belarus—the region’s traditional timber suppliers—resulted in elevated procurement costs and severe shortages in certified raw materials (European Commission, 2022; UkraineInvest, 2023). As reported by the Forest Stewardship Council (2022), established procurement channels collapsed, placing additional inventory burdens on firms already facing compressed margins.

In parallel, pandemic-induced reductions in consumer spending, particularly in construction and furniture sectors, suppressed downstream demand for wood products. This created further misalignment between production cycles and end-market absorption, as corroborated by World Bank (2023) assessments. Firms found themselves holding unsold stock for prolonged periods, lowering turnover efficiency and straining liquidity.

From a strategic management perspective, this declining turnover ratio has severe implications. Firms locking up capital in unsold inventory diminish their operational agility and expose themselves to cash flow volatility—especially critical for SMEs lacking credit access. This finding reinforces earlier regression results demonstrating a negative correlation between capital intensity and profitability. It suggests that high fixed asset bases, unless supported by efficient conversion cycles, become liabilities rather than competitive advantages.

To restore efficiency, adoption of lean inventory systems, real-time demand forecasting, and digitally enabled logistics must be prioritized. Targeted support—such as cluster-based technology diffusion programs and working capital interventions—should focus on bolstering the capacity of firms to manage volatile inventory dynamics in an increasingly uncertain global landscape (Löf et al., 2019; Mujić et al., 2019).

In conclusion, the sharp deterioration in inventory turnover from 2020 onwards substantiates the broader study argument: internal operational efficiency, not firm size or market concentration, is the critical determinant of competitiveness. The wood processing sector in FBiH must prioritize supply chain modernization and working capital optimization to rebuild resilience. Inventory management reforms should be embedded within wider cluster development policies, ensuring that firms are not only export-ready but also structurally capable of sustaining profitability amid external shocks.

## Summary of Findings

The empirical findings of this study reveal a structurally imbalanced yet economically significant wood processing industry in the Federation of Bosnia and Herzegovina (FBiH), characterized by persistent concentration, regional disparities, and internal operational inefficiencies. A dualistic market structure is evident, whereby a small cohort of large firms commands a disproportionate share of revenue, particularly within high-value export segments, while a vast number of micro and small enterprises remain marginalized in lower tiers of the value chain. This asymmetry underscores the limited inclusivity and fragmentation of the sector's competitive landscape.

Market concentration, as measured by the Herfindahl-Hirschman Index (HHI), consistently places the industry within the "highly concentrated" category throughout the 2014–2024 period. This structural rigidity suggests significant barriers to entry and scalability for new or smaller firms. However, contrary to traditional industrial organization assumptions embedded in the Structure-Conduct-Performance (SCP) model, the econometric results indicate that neither market share nor firm size are statistically significant predictors of profitability. The regression analysis instead highlights capital intensity as the most influential variable—negatively associated with profitability—implying that asset-heavy firms often struggle to generate adequate returns due to inefficiencies in utilization and production cycles.

The resource-based view (RBV) of the firm is strongly supported by these findings, with internal capabilities—rather than external positioning—emerging as the critical determinants of firm performance. This is particularly evident in the case of inventory turnover trends. The sharp post-2019 decline in the inventory turnover ratio across the industry signals weakened operational agility and liquidity, further corroborating the central study that competitiveness depends more on internal efficiency than structural scale.

Cluster-based analysis reveals that regional ecosystems play a significant mediating role in shaping competitiveness. Firms located in Central Bosnia and Herzegovina-Neretva Cantons exhibit superior performance indicators across export share, technology adoption, and EU market integration. These geographic agglomerations offer collective efficiency advantages—such as better infrastructure, knowledge spillovers, and institutional support—that are absent in peripheral regions. The uneven spatial distribution of competitiveness reinforces the argument for regionally differentiated industrial policies aimed at fostering inclusive growth.

Collectively, the findings validate the integrated analytical approach employed in this research, drawing on SCP theory, RBV, and cluster theory to explain performance outcomes. They reveal that profitability and competitiveness in the FBiH wood processing industry are shaped less by structural dominance and more by internal efficiency and geographic

embeddedness. The evidence points to the need for industrial policy reform that prioritizes operational upgrading, innovation diffusion, and targeted support for emerging regional clusters.

In summary, the study offers the following key insights:

- Market structure remains highly concentrated, with limited shifts over the observed decade, indicating entrenched dominance by a small number of large firms.
- Internal efficiency—especially capital utilization and inventory management—is a statistically significant determinant of profitability, whereas market share and firm size are not.
- Regional clusters serve as crucial enablers of firm competitiveness, amplifying export capacity, technological absorption, and institutional alignment.
- The sector's long-term competitiveness depends on a strategic pivot towards operational modernization, cluster-based development, and policy interventions that specifically address the constraints faced by SMEs in lagging regions.

These findings not only enrich academic understanding of industrial dynamics in transitional economies but also offer concrete, evidence-based directions for policymakers, development agencies, and industry stakeholders committed to enhancing the competitiveness and sustainability of the wood processing sector in FBiH.

## DISCUSSION

This section provides a comprehensive theoretical and empirical interpretation of the study's findings, grounded in industrial organization theory, the Resource-Based View (RBV), and regional development frameworks, with a targeted focus on the wood processing sector in the Federation of Bosnia and Herzegovina (FBiH). The empirical evidence derived from the econometric regressions, Herfindahl-Hirschman Index (HHI) analysis, and cluster mapping is interpreted in light of structural, behavioral, and institutional dynamics, thereby informing both academic discourse and policy formulation. The expanded discussion critically interrogates prevailing paradigms such as Structure-Conduct-Performance (SCP) and contributes to an emergent consensus that emphasizes micro-foundational, capability-based determinants of industrial competitiveness in transitional economies.

### **Rethinking Firm Profitability in the FBiH Wood Sector: An Institutional-Structural Synthesis**

This study demonstrates that profitability in the FBiH wood processing industry does not align with conventional assumptions under the SCP framework. Neither firm size nor market

share is statistically significant in predicting profitability, as measured by Price-Cost Margin (PCM). Instead, institutional constraints, regional disparities, and internal firm capabilities emerge as more potent determinants. The institutional environment, characterized by administrative complexity, underdeveloped financial infrastructure, and inconsistent policy implementation, shapes strategic firm behavior. This aligns with North's (1990) argument that institutions form the rules of the game, directly influencing economic performance.

Institutional asymmetries across cantons reveal important contextual determinants of profitability. For example, firms in Central Bosnia Canton benefit from more coherent cantonal development strategies, where public-private dialogues are relatively active, and local development agencies offer targeted support. The Chamber of Commerce in this region has implemented several EU-funded capacity-building programs, including export training and support for FSC certification. Conversely, in Canton 10 and Posavina, firms report frequent administrative delays, weak policy coordination, and limited access to export financing mechanisms. Such disparities create uneven playing fields that magnify regional inequalities in competitiveness.

Real-world cases further illustrate these dynamics. A furniture producer based in Zenica reported annual PCM levels above the industry median over a five-year span. Interviews reveal that this firm's success is attributed to early adoption of ISO certification, strategic partnerships with EU distributors, and continuous investment in employee training—none of which are dependent on market share. In contrast, a medium-sized sawmill in Canton 10, despite holding a 3% local market share, experienced persistent losses. Managers cite inconsistent raw material supply, lack of bank credit, and prolonged delays in construction permits as key obstruction.

This pattern supports the argument that institutional embeddedness, rather than market dominance, underpins sustainable profitability. Firms operating in regions with stronger industrial ecosystems and administrative predictability are better positioned to undertake strategic planning, access export markets, and secure investments. This dynamic mirrors empirical findings in other transition economies, where regional governance quality correlates positively with SME performance (Fazekas & Tóth, 2016).

Moreover, this analysis underscores that structural indicators such as HHI or firm size can obscure deeper drivers of firm-level outcomes. The SCP model tends to privilege external conditions over endogenous capabilities, failing to account for the mediating role of regional institutions, public infrastructure, and social capital. An institutionally aware reinterpretation of SCP—what might be termed a contextual SCP variant—may offer a more

accurate framework for analyzing sectoral competitiveness in decentralized, post-socialist economies like BiH.

From a policy standpoint, these findings advocate for differentiated strategies that reflect subnational variation. Policymakers should focus on strengthening cantonal governance capacities, particularly in underperforming regions. This includes harmonizing business registration processes, enhancing transparency in public procurement, and investing in local R&D infrastructure. In addition, the establishment of regional competitiveness observatories could help monitor institutional performance and identify best practices for scaling across cantons.

Theoretically, this expanded view of profitability affirms the call for more integrative approaches to industrial economics. It positions institutional quality as a structural variable that interacts with firm-level capabilities and market structures. This interactionist model aligns with emerging literature on place-based development (Rodríguez-Pose, 2013), which emphasizes that spatially grounded institutions mediate the diffusion of innovation, capital, and skills.

In sum, firm profitability in the FBiH wood sector is best understood not through static indicators of size or share, but via an institutional-structural lens that captures the interplay between firm strategy, governance environments, and regional ecosystems. This perspective not only enhances empirical precision but also broadens the theoretical scope for understanding industrial competitiveness in transitional contexts.

**Citations:** Fazekas, M., & Tóth, I. J. (2016). From corruption to state capture: A new analytical framework with empirical applications from Hungary. *Political Research Quarterly*, 69(2), 320–334.

North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge University Press.

Rodríguez-Pose, A. (2013). Do institutions matter for regional development? *Regional Studies*, 47(7), 1034–1047. This study demonstrates that profitability in the FBiH wood processing industry does not align with conventional assumptions under the SCP framework. Neither firm size nor market share is statistically significant in predicting profitability, as measured by Price-Cost Margin (PCM). Instead, institutional constraints, regional disparities, and internal firm capabilities emerge as more potent determinants. The institutional environment, characterized by administrative complexity, underdeveloped financial infrastructure, and inconsistent policy implementation, shapes strategic firm behavior. This aligns with North's (1990) argument that institutions form the rules of the game, directly influencing economic performance.

## **RBV and Knowledge-Intensive Pathways to Competitiveness in Resource-Based Industries**

The Resource-Based View (RBV) provides a robust framework for interpreting the empirical significance of internal firm resources. Barney (1991) asserts that firms derive competitive advantage from resources that are valuable, rare, inimitable, and non-substitutable (VRIN). In the context of the FBiH wood sector, these resources include skilled labor, design capabilities, EU certification, and customer relationships. Firms exhibiting high PCM often invest in human capital, product innovation, and quality control—confirming the RBV's applicability in resource-based transitional economies.

Beyond the core VRIN criteria, recent developments in RBV highlight the significance of dynamic capabilities—defined by Teece, Pisano, and Shuen (1997) as the firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments. In volatile markets such as those in BiH, dynamic capabilities play a pivotal role in ensuring sustained competitiveness. These include the ability to innovate product lines in response to shifting EU regulations, adapt logistics processes amid global supply disruptions, and reallocate resources swiftly across product-market segments.

In practice, however, many wood-processing firms in FBiH display underdeveloped dynamic capabilities. Field observations and anecdotal industry evidence suggest that while firms may possess technically skilled labor or modern equipment, they often lack the organizational routines or leadership foresight necessary to deploy these assets in adaptive ways. For example, several medium-sized exporters reported delayed compliance with new EU phytosanitary and packaging standards—not due to lack of resources, but because of poor information systems and inadequate institutional support structures.

Moreover, the intangible nature of certain RBV-aligned assets—such as brand reputation, trust-based distribution relationships, and embedded technical know-how—remains underleveraged across the sector. This is particularly salient in primary processing firms that operate on thin margins and perceive investment in intangible assets as a risk rather than an opportunity. The absence of formalized knowledge management systems or quality certification pathways further weakens the sector's ability to translate resource endowments into long-term competitive advantage.

Nevertheless, certain firms within the Central Bosnia and Herzegovina-Neretva clusters offer counterexamples. These firms tend to combine technical resources (e.g., CNC machinery, ERP software) with organizational learning mechanisms (e.g., staff upskilling, horizontal collaboration) to build dynamic capabilities aligned with the RBV framework. Their approach supports what Eisenhardt and Martin (2000) term "commonalities in best practices"—routines

that, although not unique, are difficult to replicate when embedded within localized knowledge ecosystems.

In summary, the RBV remains a powerful lens for analyzing competitiveness in FBiH's wood industry, especially when extended to incorporate dynamic capabilities and intangible resource integration. The policy implication is clear: supporting firm-level learning, adaptive strategy development, and the internalization of quality management practices is likely to yield more sustainable competitiveness gains than fixed capital investment alone.

**Citations:** Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99–120.  
 Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509–533.  
 Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: what are they? *Strategic Management Journal*, 21(10–11), 1105–1121. The Resource-Based View (RBV) provides a robust framework for interpreting the empirical significance of internal firm resources. Barney (1991) asserts that firms derive competitive advantage from resources that are valuable, rare, inimitable, and non-substitutable (VRIN). In the context of the FBiH wood sector, these resources include skilled labor, design capabilities, EU certification, and customer relationships. Firms exhibiting high PCM often invest in human capital, product innovation, and quality control—confirming the RBV's applicability in resource-based transitional economies.

### **Capital Intensity, Operational Leverage, and Productivity Constraints: Empirical Insights**

Capital intensity (KI) emerges as the only statistically significant predictor of profitability in this study, and the relationship is notably negative. This empirical finding resonates with earlier research in the Southeast European region, notably Milenković and Jović (2022), who identify a regional trend of underutilized fixed assets and persistent inefficiencies in production capacity across SMEs. The implication is that firms within the FBiH wood processing sector may be engaging in capital-deepening without achieving proportional increases in output or operational efficiency.

In examining the roots of this inefficiency, several causes are evident. First, many SMEs in BiH finance capital investments through donor programs or subsidized credit without a corresponding focus on productivity benchmarks or return-on-investment analyses. As one SME owner from the Una-Sana Canton noted in an interview: “We upgraded machinery through IPA funds, but nobody trained us on how to use it at full capacity.” This reveals a systemic disconnect between capital deployment and human capital readiness. Investment in physical

equipment, in the absence of managerial knowledge and production planning systems, leads to low asset turnover and inflated depreciation costs.

Second, the architectural layout and production flow of many workshops remain outdated. In smaller municipalities such as Gornji Vakuf or Ključ, firms often operate in spatially constrained facilities, with capital-intensive machinery shoehorned into spaces designed for artisanal production. The result is production bottlenecks and machine downtime, compounded by frequent power outages and inconsistent maintenance services.

Third, cross-country comparisons further validate this concern. A comparative study of SME productivity in the wood sectors of Slovenia, Croatia, and BiH (World Bank, 2023) demonstrates that capital productivity—measured by revenue per unit of fixed asset—is nearly 40% lower in BiH compared to Slovenia. Slovenian firms achieve higher output levels not merely due to better equipment, but because of integrated software (ERP systems), lean production techniques, and cross-trained personnel. Croatian wood processors, particularly in Varaždin and Slavonia, have adopted modular production strategies and cluster-based innovation hubs, further enhancing their capital efficiency.

Another contributing factor is the weak integration between firms and technical vocational institutions in BiH. Unlike Croatia and Slovenia, where dual education models foster machine-specific expertise among vocational students, BiH's industrial training ecosystem remains fragmented. Firms often report that new hires require three to six months of on-the-job training before they can operate equipment efficiently. This gap results in low initial productivity, increasing the effective cost of capital utilization.

An important dimension to explore is operational leverage. Many SMEs in BiH maintain high fixed costs relative to variable costs, particularly due to their dependence on capital-heavy processes like kiln drying, panel cutting, and mechanized assembly. This fixed-cost structure makes them vulnerable to demand fluctuations and seasonal shifts in export orders. One medium-sized exporter in the Herzegovina-Neretva Canton remarked: "In peak months, we're profitable. But when orders dip—even slightly—our cost base crushes us."

Additionally, misaligned procurement strategies exacerbate inefficiencies. Firms often purchase expensive machinery from Western Europe without conducting thorough feasibility studies or adapting procurement decisions to their product mix. For instance, a firm specializing in custom kitchen cabinetry had acquired a high-volume CNC router designed for mass production—resulting in excessive idle time and a mismatch between equipment scale and market orientation.

Capital intensity must also be analyzed in relation to financing structures. BiH SMEs face limited access to long-term credit, often relying on short-term overdrafts to finance capital

investments. This creates financial stress, particularly when fixed assets fail to generate rapid revenue. Moreover, without credit scoring tailored to SME-specific business models, banks tend to either over-collateralize or decline funding, thereby pushing firms to underutilize equipment purchased through grants or personal savings.

From a policy perspective, these findings highlight the need to redefine industrial modernization programs. Policymakers must move beyond metrics of machinery acquisition and focus instead on productivity-linked metrics such as asset utilization rate, revenue-per-machine-hour, and defect ratios. Incentive schemes could tie capital subsidies to post-acquisition audits and technical training modules. Moreover, regional development agencies should collaborate with engineering faculties to create SME-tailored advisory programs that assess production workflows and recommend spatial, procedural, and digital optimizations.

In sum, capital inefficiency in the FBiH wood processing industry stems from a confluence of structural, managerial, and institutional factors. While the sector has made strides in physical modernization, its weak linkage with productivity systems, workforce training, and financial instruments curtails its ability to convert fixed asset investments into sustainable profit margins. Addressing this inefficiency requires a systems-based approach that aligns capital investment with human capacity, operational logic, and long-term industrial upgrading goals.

**Citations:** Milenković, D., & Jović, M. (2022). Capital efficiency in Balkan SMEs: A comparative analysis. *Balkan Economic Review*, 18(3), 45–61.

World Bank. (2023). *Western Balkans Regional Competitiveness Report*. Washington, DC: World Bank Group. Capital intensity (KI) emerges as the only statistically significant predictor of profitability in this study, and the relationship is negative. This finding echoes previous regional analyses (Milenković & Jović, 2022) which document the prevalence of underutilized capital assets across Balkan SMEs. High fixed-asset ratios without corresponding output gains suggest low asset turnover, operational inefficiency, and unoptimized production workflows. Therefore, capital-deepening alone is insufficient for productivity enhancement in the absence of human capital development and managerial competence.

### **The Role of Cluster Economies in Spatial Industrial Upgrading**

Cluster-based development constitutes a central pillar in the literature on regional competitiveness and industrial upgrading. Porter (1998) theorizes that clusters—defined as geographically proximate groups of interconnected firms, suppliers, service providers, and associated institutions—promote competitiveness through enhanced productivity, innovation, and new firm formation. In the wood processing industry of the Federation of Bosnia and

Herzegovina (FBiH), cluster formation has played a crucial role in differentiating successful cantons from lagging regions.

This study identifies two leading clusters: Central Bosnia Canton and Herzegovina-Neretva Canton. Firms located in these regions exhibit higher export orientation, superior adoption of digital technologies, and greater integration into EU supply chains. For example, firms in Central Bosnia have partnered with Germany-based buyers under FSC-certified frameworks, leveraging advanced processing technologies such as CNC routers and ERP systems. The presence of technical schools and municipal development agencies has further supported the diffusion of production knowledge and collaborative innovation.

In contrast, attempts to foster clusterization in regions such as Canton 10 or Posavina Canton have largely failed due to a combination of weak governance, poor infrastructure, and institutional fragmentation. These regions lack dedicated cluster coordinators, formalized public-private partnerships, and integrated value chain planning. The spatial industrial policy vacuum leaves firms isolated, over-reliant on volatile local markets, and structurally excluded from donor and EU funding mechanisms.

Governance and infrastructure asymmetries between cantons emerge as key differentiators. Central Bosnia benefits from coherent local industrial strategies, export promotion bureaus, and investment facilitation centers. Herzegovina-Neretva has established export logistics hubs and wood innovation centers with GIZ and UNDP support. Conversely, lagging regions suffer from underfunded chambers of commerce, bureaucratic delays, and logistical disadvantages due to mountainous terrain and poor transport connectivity.

Failed cluster cases illustrate the risks of superficial clustering. For instance, in Canton 10, a 2018 attempt to establish a wood-processing industrial park was derailed by unclear land ownership, lack of stakeholder consultation, and insufficient inter-firm trust. The project remains stalled, demonstrating that clusters cannot be engineered solely through infrastructure investments without institutional cohesion and a shared vision among firms.

Empirical evidence suggests that successful clusters exhibit not only firm density but also high levels of horizontal and vertical collaboration, shared branding initiatives, and collective problem-solving platforms. In Herzegovina-Neretva, several SMEs co-financed a joint trade show pavilion in Cologne, enabling them to pool resources and achieve international visibility. Such cooperation enhances cluster resilience and export competitiveness, consistent with cluster lifecycle theories that emphasize co-evolution of firm strategies and institutional support (Menzel & Fornahl, 2010).

Moreover, this study finds that clusters act as amplifiers of firm-level capabilities. Firms with moderate technological and managerial assets achieve higher returns when embedded in

collaborative environments. This supports the notion of cluster externalities—knowledge spillovers, labor pooling, and trust-based cooperation—that raise collective productivity (Delgado et al., 2014).

Policy implications are clear: to foster spatial upgrading, BiH must invest in cluster governance infrastructure. This includes establishing cluster management organizations, developing inter-cantonal trade corridors, and co-financing digital platforms for resource sharing and demand aggregation. Cantonal governments should adopt differentiated cluster strategies, tailored to the economic and geographic realities of their regions.

In summary, cluster economies in FBiH drive regional differentiation in competitiveness. Their success hinges on institutional alignment, trust-based collaboration, and supportive infrastructure. Strengthening lagging regions requires more than capital investment; it demands systemic coordination, place-based policy frameworks, and long-term institutional commitment.

**Citations:** Delgado, M., Porter, M. E., & Stern, S. (2014). Clusters, convergence, and economic performance. *Research Policy*, 43(10), 1785–1799.

Menzel, M. P., & Fornahl, D. (2010). Cluster life cycles—dimensions and rationales of cluster evolution. *Industrial and Corporate Change*, 19(1), 205–238.

Porter, M. E. (1998). Clusters and the new economics of competition. *Harvard Business Review*, 76(6), 77–90. Clusters in Central Bosnia and Herzegovina-Neretva demonstrate superior export orientation, productivity, and technology adoption. Porter (1998) posits that cluster-based development enhances firm performance through localized spillovers and network externalities. In this study, firms embedded in developed clusters leverage shared logistics, technical schools, and cooperative supplier networks. Conversely, firms in peripheral cantons exhibit stagnation, confirming that spatial industrial policy is central to fostering regional competitiveness.

### **Structural Dualism and the Challenge of Inclusive Industrialization**

The wood processing sector in the Federation of Bosnia and Herzegovina (FBiH) exhibits a deeply entrenched dualistic structure that mirrors the developmental divide seen in many transitional economies. On one end of the spectrum lie a small cohort of large, export-oriented firms that are technologically advanced, well-capitalized, and integrated into international markets. On the other end resides a large base of small, and medium-sized enterprises (SMEs) engaged predominantly in primary wood processing, operating on thin margins, with limited market access and modest productivity. This bifurcated structure perpetuates inequality in competitiveness, investment capacity, and value capture.

Historically, this dualism is rooted in the legacy of post-socialist economic restructuring. Following the privatization of socially owned enterprises in the 1990s, larger firms—often with political or financial ties—acquired substantial forest concessions, equipment, and production facilities. These firms inherited established supply chains and international buyer relationships, enabling them to consolidate market power and invest in modernization. Conversely, newly formed SMEs lacked startup capital, access to concessional finance, and connections to foreign markets. This policy history has shaped the current industrial hierarchy, wherein large firms enjoy economies of scale and institutional support, while SMEs are trapped in low-productivity equilibria.

The empirical data from this study, particularly the consistently high Herfindahl-Hirschman Index (HHI) scores exceeding 2,500, confirm the existence of a highly concentrated market structure. Yet, this concentration has not translated into aggregate sectoral dynamism or innovation spillovers. Instead, it has resulted in an oligopolistic configuration where dominant players reap most of the profits while contributing minimally to inclusive growth. Moreover, spatial mapping of firm clusters reveals that even geographically proximate SMEs are often excluded from supplier networks, reinforcing vertical disintegration.

Addressing structural dualism requires a nuanced approach that differentiates between the needs of SMEs and large firms while fostering systemic integration. Several policy interventions are critical. First, value chain integration schemes should be promoted, wherein large firms are incentivized to subcontract work to SMEs, offer technical assistance, and co-develop export consortia. Models such as Italy's "industrial districts" or Germany's Mittelstand supply partnerships can serve as reference points. Second, public procurement policies should include SME participation targets and establish supplier development programs that reward quality upgrades and compliance with sustainability standards.

Third, regional development funds should prioritize capacity-building in lagging areas. This includes co-financing of quality infrastructure (e.g., testing labs, certification centers), business incubators focused on wood design and branding, and e-commerce platforms tailored to artisanal wood producers. Donor-funded technical assistance programs must embed market access and productivity incentives, linking capital support with demonstrable progress in innovation or export performance.

Fourth, cluster governance reforms are essential. Policymakers should move beyond sectoral roundtables to formal cluster governance bodies with mandates to develop integrated supply chain strategies, coordinate training curricula with local vocational schools, and attract anchor firms that can stimulate localized spillovers. Successful clusters such as the Central

Bosnia wood cluster demonstrate that proximity is insufficient without structured collaboration, trust-building mechanisms, and institutional facilitation.

Finally, the regulatory framework must be recalibrated to address the institutional asymmetries faced by SMEs. Licensing, inspection, and tax administration procedures should be simplified and harmonized across cantons. SMEs operating in remote or under-resourced areas require mobile advisory services and digital access points to public services. Without such institutional equalization, structural dualism will persist despite targeted financial interventions.

Theoretically, this pattern challenges the conventional assumption that market concentration naturally fosters industrial upgrading. In the FBiH wood sector, concentration appears to entrench exclusion and restrict the diffusion of innovation. As such, inclusive industrialization must be understood as both a structural and institutional challenge—requiring simultaneous reform of firm behavior, public policy, and governance architecture.

In conclusion, dismantling structural dualism entails designing and implementing inclusive industrial strategies that foster productivity and innovation at all firm sizes. The goal should not be to weaken large firms, but to integrate them into a broader ecosystem of competitive, dynamic SMEs. Only through such systemic transformation can the FBiH wood processing sector achieve equitable growth, resilience to shocks, and sustained export competitiveness. The dualistic structure of the FBiH wood sector—a few dominant exporters vs. numerous low-margin SMEs—mirrors Lewis's (1954) dual economy theory. The high Herfindahl-Hirschman Index (HHI) values substantiate the claim that market power is concentrated. However, this concentration fails to deliver aggregate sectoral competitiveness. Instead, it fosters dependency and volatility. Structural dualism risks social fragmentation, as rural SMEs lack the means to compete or scale without targeted support.

### **Sectoral Governance, Institutional Voids, and Policy Failure in Transition Contexts**

The wood processing industry in the Federation of Bosnia and Herzegovina (FBiH) operates within a complex institutional terrain marked by fragmented governance, inconsistent policy enforcement, and persistent institutional voids. These systemic deficiencies are not merely administrative oversights but function as structural inhibitors to sectoral transformation and competitiveness. In post-socialist economies undergoing transition, such as BiH, the legacy of centralized planning and weak market institutions manifests as regulatory ambiguity, overlapping competencies across administrative tiers, and the absence of sector-specific development agencies. This institutional context deeply constrains the implementation of industrial policy and hampers the evolution of an innovation-driven private sector.

Building on Rodrik's (2008) notion of "embedded autonomy," successful industrial policy requires state institutions that are simultaneously connected to industry actors and insulated from narrow interest capture. In the case of BiH, neither condition is sufficiently met. Ministries at the entity and cantonal levels often issue contradictory regulations, and coordination between local chambers of commerce, export promotion agencies, and educational institutions remains minimal. Interviews with firm managers across the FBiH wood sector reveal frequent complaints about administrative opacity in tax regimes, inconsistency in customs procedures, and long delays in public procurement disbursements. These governance bottlenecks increase transaction costs, deter formalization, and disincentivize long-term capital investment.

Moreover, institutional voids are particularly pronounced in the domain of quality infrastructure. Many SMEs report the absence of accredited testing facilities for furniture durability, emissions compliance, or phytosanitary certification. As a result, firms incur high costs outsourcing these services to institutions in Croatia or Slovenia. Similarly, innovation infrastructure—such as design incubators, material labs, and industry-specific R&D centers—is either underdeveloped or inaccessible to SMEs. Vocational training institutions also lag behind market needs, with outdated curricula and limited integration into dual education systems.

The absence of institutional complementarities significantly weakens the effectiveness of donor programs and public incentives. For instance, EU-funded projects aimed at boosting digitalization often fail to achieve scale due to limited follow-up support, lack of integration into broader value chain strategies, and insufficient technical capacity within municipal governments. Consequently, the very policies designed to reduce institutional friction may instead reinforce fragmentation when implemented in isolation.

Regional disparities further complicate governance outcomes. Central Bosnia and Herzegovina-Neretva Cantons, which host some of the country's most competitive clusters, benefit from stronger public-private coordination mechanisms, donor engagement, and infrastructural investments. In contrast, Cantons like Posavina or Canton 10 suffer from administrative lethargy, political instability, and lack of absorptive capacity. This divergence institutionalized a geography of exclusion in which policy benefits disproportionately accrue to already successful regions.

Policy history plays a critical role in perpetuating this condition. Post-Dayton decentralization, while politically necessary, resulted in a fragmented governance architecture that lacks horizontal accountability. Sectoral strategies, if they exist, are rarely coordinated across ministries or cantons. Budgetary allocations for industrial development are erratic and often linked to political cycles rather than evidence-based planning. In some cantons, industrial

zoning regulations remain unchanged since the 1980s, reflecting institutional inertia rather than adaptive policy learning.

To redress these failures, BiH must adopt a systemic governance reform strategy tailored to the unique challenges of its wood processing sector. First, establish a national-level Sectoral Development Council for wood processing, bringing together representatives from ministries, chambers, universities, and private firms. This council should draft and oversee a unified strategy aligning certification, innovation, and market access initiatives.

Second, institutional capacity-building at the cantonal level is paramount. This includes the creation of specialized cluster managers, training programs for municipal economic officers, and performance-based funding mechanisms that reward cantonal institutions for achieving targets in firm formalization, export growth, or skills alignment.

Third, implement a national registry of industrial support services—mapping labs, incubators, and training centers across the country—and develop inter-cantonal access protocols to mitigate regional disparities. Support mobile certification units and digital platforms that allow remote firms to access quality assurance tools and apply for international tenders.

Finally, donor coordination mechanisms must be institutionalized to prevent duplication and ensure strategic alignment. A centralized donor alignment dashboard managed by the Ministry of Foreign Trade and Economic Relations could track ongoing programs, identify synergies, and assess cumulative impacts across the sector.

In conclusion, governance and institutional voids represent not only obstacles to policy execution but also determinants of firm behavior and sectoral trajectory. Without deliberate, systemic reform, BiH's wood processing industry risks entrenching inequality, stagnation, and missed opportunities in EU and global markets. Policy failure in this context is not merely a technical flaw—it is a structural condition requiring coordinated, multi-scalar responses.

**Citations:** Rodrik, D. (2008). Industrial policy: Don't ask whether, ask how. *Middle East Development Journal*, 1(1), 1–29. The findings reflect significant governance gaps in sectoral coordination. Rodrik (2008) highlights that successful industrial policy requires embedded autonomy—where the state is both informed by, and autonomous from, special interest capture. In BiH, fragmented administrative structures and inconsistent enforcement dilute the effectiveness of policy instruments. Institutional voids—especially in certification, innovation infrastructure, and vocational training—undermine cluster-based upgrading and SME formalization.

## **Beyond SCP: Toward a Multi-Theoretical Model of Competitiveness in BiH**

This study advocates a pluralistic analytical model combining SCP, RBV, and cluster theory. While SCP offers insight into structural concentration and firm conduct, RBV elucidates internal capabilities, and cluster theory emphasizes the role of regional networks. The triangulation of these frameworks enables a more nuanced understanding of how firm behavior, institutional context, and geography jointly shape competitive outcomes in transitional resource-based industries.

## **Comparative Reflections from Southeast Europe: Serbia, Croatia, and Slovenia**

When benchmarked against peers, the FBiH wood sector reveals both parallels and deficits. Slovenia exhibits strong integration into EU value chains, supported by robust design ecosystems and trade facilitation. Croatia's export competitiveness in wood furniture has risen through aggressive branding and product diversification. Serbia, like BiH, struggles with informality and fragmented support systems (World Bank, 2023). These comparisons suggest that export competitiveness correlates with both horizontal collaboration and institutional coherence.

## **Sectoral Digitalization and Sustainability: Future Vectors of Competitive Differentiation**

In the evolving landscape of industrial competitiveness, the dual forces of digitalization and sustainability increasingly define firm trajectories, especially in resource-based sectors. Within the Federation of Bosnia and Herzegovina (FBiH), the wood processing industry faces both an opportunity and a challenge in leveraging these transformational vectors. Despite their recognized importance for accessing high-margin markets, particularly in the European Union (EU), the level of integration of digital and green practices remains limited across the sector.

The digital transformation of manufacturing industries refers to the adoption of advanced information technologies such as Computer Numerical Control (CNC) systems, Enterprise Resource Planning (ERP) platforms, cloud-based design and procurement systems, Internet of Things (IoT) devices for smart production monitoring, and Artificial Intelligence (AI) for predictive maintenance and inventory management. In FBiH, only a fraction of wood-processing firms report the use of ERP or automated systems. According to a 2022 survey by UNDP, fewer than 18% of surveyed SMEs in the sector employed integrated digital tools to manage production or logistics, while over 60% still rely on manual tracking of operations.

This lag in digital readiness is attributable to several factors. First, many SMEs perceive digitalization as a high-cost, low-return investment due to uncertain demand cycles and short planning horizons. Second, there exists a considerable digital skills gap among the labor force.

Unlike in Slovenia or Austria, where vocational training curricula include modules on industrial automation and digital manufacturing, technical schools in FBiH rarely offer such exposure. Third, institutional support is fragmented. Digital innovation grants offered by donor organizations are sporadic, non-recurring, and often accompanied by bureaucratic procedures that deter SME participation.

Nevertheless, the policy relevance of digitalization is increasing. The European Green Deal and Digital Decade targets underscore the need for integration of smart technologies across all levels of production. In FBiH, pilot initiatives in Central Bosnia Canton—including digital auditing platforms and shared e-commerce portals—demonstrate the feasibility of collective action models. These initiatives are supported by cantonal development agencies and EU-funded programs such as COSME and Horizon Europe. The existence of digitally capable anchor firms in certain clusters also creates demonstration effects that gradually reduce adoption barriers among surrounding SMEs.

Parallel to digitalization, the sustainability agenda is gaining traction. EU regulations—particularly under the European Union Timber Regulation (EUTR) and upcoming Corporate Sustainability Reporting Directive (CSRD)—require stringent compliance in terms of sourcing, emissions, and labor standards. Certification schemes such as the Forest Stewardship Council (FSC) and Programme for the Endorsement of Forest Certification (PEFC) offer both access to EU markets and a reputational edge. However, in FBiH, only a limited subset of firms—primarily medium and large exporters—have acquired such certifications.

Barriers to sustainability adoption mirror those of digitalization. Firms cite high audit costs, lack of consulting support, and regulatory ambiguity. Additionally, informal practices in raw material procurement—common in more rural cantons—conflict with chain-of-custody requirements embedded in most green certification schemes. This creates a systemic mismatch between the normative goals of environmental compliance and the economic realities of smaller firms operating with constrained margins and opaque supply chains.

Yet, there are success stories. A notable case is a medium-sized firm in Herzegovina-Neretva that has implemented a circular production system: offcuts from furniture production are redirected into biomass heating, reducing waste and operating costs. This firm combines ISO 14001 certification with digital energy tracking tools and exports 80% of its output to Germany.

The intersection of digitalization and sustainability also presents opportunities for integrated upgrading. Smart energy management systems, blockchain-based sourcing verification, and AI-enhanced environmental impact assessments are already in pilot phases globally. BiH's wood sector could benefit by passing from traditional and adopting such modular, scalable innovations through consortia or donor-backed challenge funds.

Policy recommendations are clear. First, create a national digital and green transformation roadmap for the wood sector, embedded within the country's broader industrial strategy. Second, establish digital maturity assessment centers in cooperation with technical universities and chambers of commerce. Third, incentivize sustainability compliance through tiered subsidies that reward progressive achievement of green benchmarks. Fourth, promote shared digital infrastructure such as cluster-based ERP systems and open-access design libraries. Finally, donor programs must coordinate to avoid redundancy and ensure continuity in support services.

In sum, digitalization and sustainability are not mere buzzwords but foundational vectors of competitive differentiation in a post-carbon, data-intensive global economy. For the FBiH wood processing industry, embracing these pathways is not only a strategic imperative for EU integration but also a mechanism for enhancing productivity, reducing resource dependency, and achieving inclusive growth.

### **Limitations, Biases, and Data Gaps in Sectoral Competitiveness Research**

While this study represents one of the most comprehensive empirical investigations into the competitiveness of the FBiH wood processing industry, it is essential to recognize its limitations. First, the analysis primarily relies on secondary quantitative data—particularly financial statements from the Financial Intelligence Agency (FIA) and export records from the Foreign Trade Chamber. While these sources offer longitudinal consistency and objectivity, they lack granular insight into qualitative drivers of firm behavior such as managerial practices, organizational culture, innovation orientation, or supply chain governance.

Second, the regression model, though statistically robust, is inherently correlational and does not permit causal inference. The observed negative relationship between capital intensity and profitability, for instance, may be influenced by unobserved variables such as market volatility, firm age, or customer concentration. Future studies should consider structural equation modeling or longitudinal fixed-effects models to better disentangle these dynamics.

Third, the informal sector remains underrepresented. Many micro-firms in rural cantons operate without full tax registration or maintain parallel records. Their exclusion from official databases not only skews market concentration measures like HHI but also biases conclusions regarding competitiveness gaps and regional disparities. Ethnographic fieldwork and snowball sampling could enhance representation in future research.

Fourth, the cluster analysis is based on firm headquarters, not operational geography. This is problematic in cases where production facilities are located in different cantons or regions from the firm's registration address. Consequently, spatial patterns of productivity,

export behavior, and infrastructure access may be mischaracterized. Integrating geospatial data from industrial zones and energy consumption records could refine future cluster mapping.

Fifth, the study excludes gender-based or minority-owned enterprise analyses due to data unavailability. In a post-conflict society such as BiH, where gender and ethnic disparities intersect with economic outcomes, future research must adopt inclusive frameworks. Similarly, the effects of diaspora investment and remittances—both significant for the BiH economy—are not captured in this model but warrant dedicated exploration.

Finally, while the mixed-methods design adds analytical depth, its qualitative component is limited. Semi-structured interviews were used to contextualize quantitative findings but not formally coded or analyzed using rigorous qualitative techniques such as thematic analysis or grounded theory. Embedding these methods would enhance validity and reveal latent constructs not captured by numeric indicators.

Despite these constraints, the study offers actionable insights and a replicable methodological framework. Future researchers are encouraged to build on this foundation by employing more granular firm-level surveys, incorporating behavioral economics experiments, or applying digital ethnography. Cross-country comparative studies would also illuminate systemic differences in competitiveness trajectories across the Western Balkans.

In sum, the limitations highlighted here do not detract from the study's core contributions but rather signal areas for methodological refinement and theoretical extension. Recognizing and addressing these gaps is essential for advancing a truly inclusive and empirically grounded understanding of industrial development in BiH and beyond.

### **Policy Implications and Strategic Recommendations for Sectoral Competitiveness**

Building on the empirical and theoretical findings of this study, several strategic recommendations emerge for enhancing the competitiveness of the wood processing industry in the Federation of Bosnia and Herzegovina (FBiH). The analysis presented in preceding chapters confirms that sectoral dynamism is not a linear function of firm size or market dominance, but rather hinges upon institutional coordination, innovation ecosystems, and targeted policy support that addresses firm-level heterogeneity and regional disparities. In this context, the design and execution of industrial policy must be informed by empirical evidence and grounded in a multidimensional framework of competitiveness.

### ***Toward a National Wood Sector Development Strategy***

The absence of a cohesive national strategy for the wood sector has resulted in fragmented interventions, with overlapping mandates and limited scalability. To address this,

a comprehensive Wood Sector Development Strategy (WSDS) should be formulated through a participatory process involving cantonal ministries, chambers of commerce, leading firms, labor unions, and academic institutions. This strategy must articulate measurable targets in terms of value-added exports, green certification rates, SME formalization, and productivity growth. Moreover, it should synchronize sectoral initiatives with broader economic goals such as regional development, digital transformation, and green transition (World Bank, 2023).

### ***Clusters as Engines of Innovation and Resilience***

Clusters should be elevated from informal agglomerations to formalized institutional arrangements with governance structures, performance benchmarks, and budgetary allocations. Drawing inspiration from European cluster excellence frameworks, FBiH could pilot a "Cluster Accelerator Program" (CAP) that provides seed funding, innovation vouchers, and co-working facilities for firms within designated clusters. These clusters would also host cluster managers trained in value chain coordination, export compliance, and EU funding application procedures (Ketels & Protsiv, 2021).

### ***Investment in Vocational and Dual Education***

Human capital is a binding constraint in FBiH's wood sector. The current education-to-employment pipeline fails to equip workers with skills in digital fabrication, product design, or sustainable sourcing. The strategy should thus include a dual education initiative modeled on the German-Austrian system, with strong linkages between firms and vocational institutions. Pilot programs in Zenica-Doboj and Una-Sana Cantons have already demonstrated the feasibility of such partnerships (GIZ, 2022).

### ***Formalization, Finance, and SME Upgrading***

Given the informal nature of many micro firms, formalization incentives should be expanded beyond compliance and include access to state-supported microfinance, technical assistance, and tax holidays. A tiered support system—wherein firms graduate from startup incubators to SME development funds and export readiness programs—can enhance scalability and sustainability. Donor harmonization is also crucial; a central portal tracking firm-level engagement across multiple donor initiatives would prevent redundancy and facilitate impact evaluation (OECD, 2022).

### ***Digital and Green Transformation Funds***

To unlock competitive differentiation, a dedicated Transformation Fund should be launched with co-financing from international development institutions (e.g., EBRD, KfW, World Bank). This fund would provide grants for ERP implementation, CNC equipment, ISO certification, energy efficiency upgrades, and carbon accounting systems. Eligibility criteria should emphasize sectoral spillovers, SME consortia, and geographic equity.

### ***Intergovernmental Coordination Platforms***

The fragmented governance structure of BiH necessitates the creation of an Inter-Governmental Coordination Platform (IGCP) for industrial development. This body, chaired by the Ministry of Foreign Trade and Economic Relations, should facilitate data sharing, policy harmonization, and joint investment programming across entities and cantons. The IGCP could also coordinate EU accession-linked reforms in public procurement, state aid, and customs facilitation—critical enablers of wood sector integration into the EU Single Market.

### ***Monitoring and Evaluation (M&E) Mechanisms***

Finally, all sectoral initiatives must be accompanied by robust M&E frameworks with real-time dashboards, citizen feedback tools, and third-party audits. The availability of disaggregated data on firm performance, skill acquisition, and export behavior is crucial for adaptive policy learning and public accountability.

In sum, a new generation of industrial policy in FBiH must transition from reactive, fragmented interventions to proactive, integrated strategies rooted in institutional collaboration, evidence-based planning, and global competitiveness benchmarks.

### ***Broader Theoretical and Regional Implications***

The empirical results and methodological innovations presented in this study offer significant contributions beyond the case of the FBiH wood processing industry. At a theoretical level, the findings challenge the sufficiency of the classical Structure-Conduct-Performance (SCP) paradigm in explaining firm profitability within transitional, resource-based economies. Despite a persistently high Herfindahl-Hirschman Index (HHI), profitability is not significantly associated with market share or firm size, but rather with internal efficiencies—particularly capital productivity and export orientation. This supports the Efficient Structure Hypothesis (ESH) and aligns more closely with the Resource-Based View (RBV), which emphasizes firm capabilities, routines, and intangible assets as key performance determinants (Barney, 1991).

Moreover, the study integrates cluster theory and regional development frameworks, revealing that spatially concentrated industrial ecosystems exhibit higher performance levels, innovation uptake, and export penetration. These findings echo Porter's (1998) work on the competitive advantage of clusters and underscore the need for place-based industrial strategies in economies marked by regional disparity and administrative decentralization.

From a regional policy perspective, the study offers insights into the challenges of economic integration in the Western Balkans. Shared structural features—such as legacy infrastructure, institutional fragmentation, and SME dominance—mean that the lessons from FBiH are applicable to wood sectors in Serbia, Montenegro, and North Macedonia. In particular, the methodological approach combining econometric modeling, cluster analysis, and diagnostic testing presents a replicable template for industry diagnostics across the region (Jelovac & Vujanovic, 2021).

The study also contributes to debates in development economics regarding the sequencing of policy reforms in low- and middle-income countries (LMICs). It suggests that competitiveness upgrading does not necessarily follow liberalization or privatization but requires targeted public investment, market coordination, and institutional scaffolding. This calls for a return to strategic industrial policy—not as state control, but as smart governance aimed at correcting market and coordination failures.

Additionally, the study demonstrates the utility of combining secondary financial data with cluster-based spatial analysis in data-scarce environments. This hybrid methodology may be especially valuable for sectors where firm-level survey data is costly or politically sensitive. It enables policymakers and researchers to generate actionable insights even in the absence of perfect data.

In conclusion, this study contributes to the broader fields of industrial organization, regional development, and transitional economics by proposing and operationalizing a multidimensional framework for understanding competitiveness. It underscores the importance of context-specific diagnostics, hybrid theoretical integration, and evidence-based policy design in advancing inclusive and sustainable industrial transformation.

## **Conclusion and Strategic Recommendations**

The objective of this study was to assess the market structure and competitiveness of the wood processing industry in the Federation of Bosnia and Herzegovina (FBiH), using a mixed-method approach grounded in econometric analysis, market concentration metrics, and spatial cluster mapping. Firm-level profitability served as the primary performance indicator, with

attention to how market share, firm size, capital intensity, and regional clustering influence competitive outcomes. The study integrates t...

The research hypothesis posited that market concentration would positively influence profitability. However, empirical findings contradicted this classical assumption. Regression results revealed that neither firm size nor market share significantly impacted profitability, while capital intensity exhibited a consistent negative effect, indicating inefficiencies in asset utilization. These outcomes underscore that internal operational efficiency, not market dominance, drives competitiveness.

The Herfindahl-Hirschman Index (HHI) confirmed a highly concentrated market structure (HHI > 2,500), dominated by a few large firms. Yet, this concentration has not translated into widespread innovation for inclusive growth. Instead, the Efficient Structure Hypothesis finds greater support, suggesting firm-level capabilities matter more than oligopolistic power. Cluster analysis revealed that firms in Central Bosnia and Herzegovina-Neretva Cantons outperformed those in peripheral regions, benefiting fro...

A SWOT analysis highlighted opportunities in design-driven exports and sustainable practices, while also identifying threats such as inflationary labor costs and international competition. Based on the empirical and theoretical insights of this study, the following strategic recommendations are proposed:

- Promote Capital Efficiency and Smart Investment: Shift from volume-based to performance-based support schemes, tying incentives to return on assets, innovation, and asset productivity.
- Foster Cluster-Based Development: Invest in shared infrastructure, design labs, logistics centers, and PPP-based service models. Launch digital platforms for intra-cluster coordination and promote cross-cluster networking.
- Strengthen SME Competitiveness: Facilitate certification access (FSC, CE), support branding and packaging innovation, and launch SME–large firm mentorship programs.
- Upgrade Human Capital and Innovation Systems: Reform vocational curricula, embed dual education models, and incentivize industry–academia collaboration through regional innovation funds.
- Institutional and Regulatory Reform: Streamline permitting processes, harmonize regulations, and use procurement to support domestic certified production.
- Encourage Environmental and Digital Transition: Promote circular economy practices, ERP/CRM adoption, and launch climate-smart forestry strategies to ensure long-term material availability.
- Monitor and Evaluate Policy Impact: Establish an inter-ministerial competitiveness council and annual benchmarking reports to guide adaptive policymaking.

This study empirically assessed the market structure and competitiveness of the wood processing industry in the Federation of Bosnia and Herzegovina (FBiH) through an integrated framework that combines the Structure-Conduct-Performance (SCP) paradigm, the Resource-Based View (RBV), and spatial cluster analysis. The results indicate that internal efficiency metrics—particularly capital utilization—and regional agglomeration effects are more predictive of firm-level profitability than traditional indicators such as market share or firm size. This finding challenges classical industrial organization assumptions and underscores the need for a paradigm shift in industrial policy formulation.

The way forward for the sector involves a transition from scale-based support mechanisms to capability-oriented and regionally anchored development strategies. Policymakers should prioritize investments in lean manufacturing, digital inventory systems, workforce training, and export-readiness programs, particularly for SMEs located outside established industrial clusters. Enhancing the functionality of cluster ecosystems—through shared design facilities, certification bodies, and inter-firm collaboration platforms—can serve as a catalyst for productivity gains and technological upgrading.

Regarding the scope for further research, several promising avenues emerge. First, the inclusion of governance-related variables, such as ownership structure, board composition, and managerial tenure, could yield deeper insights into the micro-foundations of competitiveness. Second, future studies could apply causal inference techniques, such as difference-in-differences or propensity score matching, to isolate the impact of specific policy interventions (e.g., export incentives or cluster support programs). Third, cross-entity comparative studies involving the Republika Srpska or other Western Balkan economies would enhance the generalizability of findings and facilitate benchmarking across institutional regimes.

Moreover, integrating environmental performance metrics—such as carbon intensity, sustainable forest certification (FSC/PEFC), and circular economy practices—would provide a more holistic view of competitiveness in the context of EU Green Deal compliance. Finally, qualitative research methodologies, including firm-level case studies and stakeholder interviews, could complement the quantitative findings by unpacking the institutional and behavioral drivers of superior performance in niche segments of the industry.

In sum, this study lays the groundwork for a richer, multidimensional understanding of industrial competitiveness in resource-based sectors of post-transition economies, and it highlights critical pathways for future scholarly inquiry and policy innovation.

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