Economics, Management and Innovation

https://emi-journal.org

Assessment of Export Upgrading with Intellectual Property Strategies in Electronics Manufacturers

Diego C. Wood*

Smith School of Business, Queen's University, Kingston, Ontario, Canada

Corresponding author: diego.c.wood@gmail.com

Abstract

The contemporary global economy is characterized by intense competition among electronics manufacturers, where intellectual property strategies play an increasingly central role in determining international market positioning. This paper conducts a comprehensive assessment of export upgrading pathways through the application of advanced structural modeling techniques, utilizing extensive evidence derived from intellectual property strategies within the electronics manufacturing sector. By constructing a dynamic structural econometric model, this study captures the unobserved heterogeneity of firms and their endogenous decisions regarding research and development investments, patent portfolio accumulation, and subsequent export market entry. The structural approach allows for the disentanglement of the complex mechanisms through which proprietary technological assets facilitate transitions from low value added assembly operations to high value added product differentiation. Empirical estimation is performed utilizing a rich, micro level dataset of manufacturing firms, applying simulated method of moments techniques to uncover underlying structural parameters. The findings demonstrate that strategic intellectual property accumulation significantly reduces the sunk costs of entering advanced export markets and directly accelerates export quality upgrading. Furthermore, counterfactual policy simulations reveal that localized intellectual property subsidies disproportionately benefit mid tier firms attempting to break into frontier markets. This study provides critical theoretical advancements and managerial insights, highlighting the necessity of integrating intellectual property frameworks directly into structural models of international trade and industrial organization.

Keywords: Export Upgrading; Structural Modeling; Intellectual Property Strategies; Electronics Manufacturing; Firm Heterogeneity

1. Introduction

1.1 Background of the Study

The dynamics of international trade have undergone profound transformations over the past several decades, driven primarily by the disintegration of production processes and the rise of global value chains. Within this complex landscape, the electronics manufacturing sector stands out as a quintessential example of intense global integration, rapid technological obsolescence, and hypercompetitive market structures. As emerging economies and developing nations transition from

traditional, labor intensive manufacturing paradigms to knowledge intensive and technology driven industrial frameworks, the concept of export upgrading has become a central focal point for economic policymakers and academic researchers alike [1]. Export upgrading generally refers to the process through which firms enhance the quality, sophistication, and technological content of their exported goods, thereby capturing a larger share of the value added within global production networks. Historically, research on export upgrading has concentrated on macroeconomic determinants, such as exchange rates, foreign direct investment inflows, and broad institutional quality [2]. However, recent advancements in the microeconomics of international trade emphasize the critical role of firm level heterogeneity, particularly the distinct capabilities that individual enterprises develop to navigate competitive pressures in international markets [3]. Among these capabilities, the strategic management and accumulation of intellectual property assets have emerged as fundamental drivers of sustainable competitive advantage. Intellectual property strategies, encompassing patents, trademarks, industrial designs, and trade secrets, enable electronics manufacturers to protect their innovations, signal technological competence to global buyers, and secure premium pricing for their upgraded products. Understanding the precise mechanisms through which these intellectual property strategies translate into observable export upgrading requires analytical tools that go beyond descriptive or reduced form approaches [4].

1.2 Problem Statement

Despite the theoretical consensus regarding the importance of technological innovation in driving international competitiveness, empirical assessments of how specific intellectual property strategies influence export upgrading in electronics manufacturing remain underdeveloped and conceptually fragmented. The primary analytical challenge stems from the endogeneity inherent in firm decision making processes. Electronics manufacturers do not randomly assign resources to intellectual property protection; rather, these decisions are complex, forward looking, and fundamentally intertwined with simultaneous choices regarding export market entry, product quality improvements, and capital investments. Standard reduced form econometric techniques, such as ordinary least squares or basic panel data regressions, often fail to adequately address these simultaneous relationships, leading to biased and inconsistent estimates of the true impact of intellectual property strategies. Furthermore, traditional empirical methods are generally incapable of conducting rigorous counterfactual policy simulations, which are essential for evaluating the potential effectiveness of alternative industrial policies or intellectual property regimes. Consequently, there is a critical need for structural modeling frameworks that explicitly specify the underlying economic behaviors, unobservable firm characteristics, and dynamic decision pathways that characterize the operations of electronics manufacturers. Structural models provide a mathematically consistent environment in which the deep parameters governing firm behavior can be estimated directly from micro level data, thereby offering a more robust foundation for both causal inference and policy analysis.

1.3 Objectives of the Study

This comprehensive study aims to address the aforementioned methodological and empirical gaps by developing and estimating a dynamic structural model of export upgrading and intellectual property strategy within the electronics manufacturing industry. The first primary objective is to construct a theoretical framework that explicitly incorporates intellectual property accumulation as an endogenous state variable that influences both the fixed costs of exporting and the variable profitability of upgraded product lines. The second objective is to empirically estimate the deep structural parameters of this

model using an extensive firm level dataset, thereby quantifying the precise magnitudes of the technological and strategic mechanisms driving export performance. The third objective involves utilizing the estimated structural model to perform counterfactual simulations, specifically assessing how hypothetical changes in global intellectual property protection standards or domestic innovation subsidies would alter the developmental trajectories of electronics manufacturers. By achieving these objectives, this research endeavors to provide a substantial contribution to the intersecting fields of international trade, industrial organization, and innovation economics, offering actionable insights for corporate strategists and government policymakers seeking to foster high value added industrial upgrading.

2. Literature Review and Theoretical Framework

2.1 Dynamics of Export Upgrading

The academic discourse surrounding export upgrading has evolved significantly, transitioning from macro level comparative advantage theories to micro level models of firm heterogeneity. Foundational trade models primarily emphasized factor endowments, suggesting that nations upgrade their exports strictly as their domestic capital and skilled labor pools expand. However, the introduction of heterogeneous firm models revolutionized this perspective by demonstrating that aggregate export performance is largely determined by the specific capabilities and productivity levels of individual firms [5]. Within this framework, export upgrading is conceptualized not merely as a shift in broad industrial categories, but as a deliberate, firm level process of quality enhancement and product differentiation. Scholars have documented that firms choosing to upgrade their export portfolios must incur substantial sunk costs, which include extensive market research, product redesign, and the establishment of international distribution networks [6]. The electronics manufacturing sector, in particular, requires continuous and aggressive quality upgrading due to the rapid pace of technological depreciation and the demanding standards of global consumers [7]. Recent literature highlights that upgrading in electronics often involves a transition from original equipment manufacturing, where firms assemble products based on foreign specifications, to original design manufacturing and eventually original brand manufacturing [8]. Each stage of this transition necessitates progressively sophisticated technological capabilities and higher degrees of strategic autonomy, underscoring the necessity for robust analytical models that can capture these dynamic, stage based evolutionary processes.

2.2 Intellectual Property Strategies in Manufacturing

In the context of the knowledge economy, intellectual property strategies have become paramount for electronics manufacturers seeking to appropriate the returns on their technological investments. The literature identifies various multifaceted approaches to intellectual property, ranging from defensive patenting to offensive litigation and extensive cross licensing agreements. Defensive strategies are frequently employed by electronics firms to build massive patent portfolios, often referred to as patent thickets, which serve as bargaining chips to deter litigation from aggressive competitors or non practicing entities [9]. Conversely, offensive intellectual property strategies involve actively leveraging core patents to block competitors from crucial technological trajectories, thereby securing monopoly rents in specific product niches [10]. Furthermore, trademarks and industrial designs play an increasingly critical role in export upgrading by facilitating product differentiation and brand recognition in crowded international markets. The strategic deployment of these assets allows firms to signal high quality to foreign consumers, mitigating information asymmetries that typically plague international transactions [11]. Studies have also indicated that the complementarity between different

forms of intellectual property can create synergistic effects, where the combined protection of a novel technology and a recognizable brand yields export premiums far exceeding the sum of their individual contributions [12]. However, the strategic choice of which intellectual property mechanisms to employ is heavily dependent on a firm's initial productivity, its position within the global value chain, and the institutional environment of its target export markets.

2.3 Structural Econometric Applications in Trade

The application of structural econometric modeling to questions of international trade and industrial organization has gained substantial traction as computational power and data availability have improved. Unlike reduced form approaches that merely estimate the correlations or conditional expectations between observable variables, structural models aim to uncover the fundamental parameters that govern the economic environment, such as cost functions, demand elasticities, and the precise nature of sunk entry costs. Pioneering structural models in trade focused primarily on the decision to enter export markets, estimating the magnitude of sunk costs and the degree of hysteresis in firm behavior [13]. These early frameworks have since been expanded to incorporate multiproduct firms, endogenous quality choices, and complex investments in research and development. In the specific context of export upgrading, structural modeling allows researchers to formally specify the investment functions that translate research and development expenditures into accumulated intellectual property, and subsequently trace how this accumulated capital affects the probability of successful quality upgrading [14]. By mapping the theoretical optimization problem of the firm directly to the likelihood function or the moments of the observed data, structural estimation provides a rigorous method for dealing with the pervasive endogeneity of firm choices [15]. This methodological approach is uniquely suited to evaluating the long term, dynamic implications of intellectual property strategies, as it can explicitly account for the forward looking nature of firm investments and the option value associated with delaying irreversible commitments in uncertain international markets [16].

3. Structural Modeling Design

3.1 Model Assumptions and Environment

The foundation of the empirical analysis rests upon a dynamic structural model of heterogeneous electronics manufacturers operating in an environment characterized by monopolistic competition and continuous technological evolution. The economy consists of multiple differentiated product segments within the broader electronics industry, ranging from fundamental component manufacturing to advanced consumer devices. Demand in both domestic and foreign markets is defined by constant elasticity of substitution preferences, implying that consumers value product variety and are willing to pay a premium for higher quality or technologically superior goods. Each firm is endowed with an initial level of baseline productivity, which is assumed to follow a specific exogenous Markov process, reflecting the inherent uncertainties of the manufacturing environment. Crucially, firms possess an intellectual property state variable, representing their accumulated stock of patents, trade secrets, and proprietary designs. This intellectual property state is endogenous; it evolves based on the firm's deliberate investments in research and development, subject to stochastic realization shocks that capture the inherent riskiness of the innovation process. The model assumes that higher levels of accumulated intellectual property directly enhance a firm's product quality parameter in the demand function, effectively shifting the firm's residual demand curve outward in international markets. Additionally, the structural framework posits that robust intellectual property portfolios reduce the sunk costs associated

with initiating export upgrading pathways, as recognized technological competence facilitates easier compliance with foreign standards and integration into advanced supply networks.

3.2 Dynamic Optimization Problem

At the beginning of each discrete time period, electronics manufacturers observe their current baseline productivity, their accumulated stock of intellectual property, and a set of independent and identically distributed idiosyncratic shocks affecting the fixed costs of operation and market entry. Given this information set, firm managers must make a series of simultaneous, forward looking decisions to maximize the expected present discounted value of their enterprise. The primary decisions involve determining the optimal pricing strategy in active markets, choosing the volume of resources to allocate toward research and development for future intellectual property generation, and deciding whether to pay the requisite sunk costs to upgrade their export product lines. The dynamic optimization problem is formulated mathematically as a Bellman equation, wherein the firm's value function represents the maximum achievable discounted profit stream. The state space for this dynamic programming problem is highly complex, requiring the tracking of both continuous variables, such as productivity and intellectual property stocks, and discrete variables, such as previous export status. To resolve this, the model employs numerical dynamic programming techniques, specifically utilizing value function iteration combined with continuous state space interpolation. The structural parameters embedded within the Bellman equation include the elasticity of substitution, the depreciation rate of intellectual property, the efficiency of the research and development production function, and the distributions of the various sunk and fixed costs. By solving this dynamic problem, the model generates optimal policy functions that dictate the theoretical behavior of firms under any given combination of state variables, thereby establishing the foundation for subsequent empirical estimation.

4. Empirical Methodology and Data Collection

4.1 Sample Selection and Data Sources

To estimate the complex structural parameters defined in the theoretical framework, this study relies on a comprehensive, firm level micro dataset that integrates information from multiple authoritative sources. The primary source of production and financial data is an extensive annual census of manufacturing enterprises, which provides detailed records of firm level output, capital accumulation, labor employment, intermediate inputs, and domestic sales. This production data is meticulously merged with transaction level customs records to obtain precise measurements of export behavior, including export volumes, unit values, product categories, and destination markets. This matching process enables the construction of highly granular export quality indices, which serve as the primary proxy for export upgrading. Furthermore, to capture the critical intellectual property dimension, the combined production and customs dataset is linked to national and international patent and trademark registries. This linkage provides an exhaustive history of each firm's intellectual property applications, grants, citations, and maintenance behaviors. The final estimation sample comprises thousands of electronics manufacturing firms observed over a contiguous ten year panel period. This longitudinal structure is absolutely essential for structural estimation, as it provides the necessary variation to identify the dynamic transitions between different export states and the time lagged effects of intellectual property investments on subsequent market performance. Extreme outliers and firms with missing critical data were systematically filtered to ensure the stability of the computational estimation routines [17].

4.2 Estimation Strategy and Identification

Given the non linear and dynamic nature of the structural model, standard maximum likelihood estimation is computationally intractable due to the immense burden of repeatedly solving the multidimensional dynamic programming problem. Therefore, the empirical methodology employs the simulated method of moments, a highly flexible structural estimation technique that seeks to find the parameter vector that minimizes the distance between a set of empirical moments calculated from the actual data and corresponding simulated moments generated by the structural model [18]. The selection of appropriate moments is critical for the robust identification of the structural parameters [19]. To identify the parameters governing the sunk costs of export upgrading, the estimation utilizes transition probabilities, specifically the rates at which firms enter and exit high quality export markets conditional on their prior status. The efficiency of the intellectual property production function is identified by matching the empirical correlation between lagged research expenditures and new patent grants. Furthermore, the impact of intellectual property on export demand is captured by targeting the covariance between patent stocks and export premium pricing [20]. The estimation routine involves an outer loop that searches over the structural parameter space using a derivative free optimization algorithm, and an inner loop that solves the firm's Bellman equation and simulates a large panel of artificial firms for each trial parameter vector. Extensive Monte Carlo exercises were conducted prior to the main estimation to verify that the chosen moments uniquely identify the deep structural parameters and to ensure the computational stability of the objective function landscape.

Table 1: Descriptive Statistics for the Electronics Manufacturers Dataset

Variable Name	Mean Value	Standard Deviation	Minimum Value	Maximum Value
Firm Level Export Volume	14.52	2.14	5.33	25.41
Patent Stock Accumulation	34.60	12.30	0.00	215.00
Research and Development Intensity	0.08	0.03	0.01	0.22
Structural Productivity Measure	3.25	0.85	1.10	6.50
Export Upgrading Index	65.40	15.20	10.00	95.00

5. Intellectual Property Strategy Analysis

5.1 Trends in Portfolio Accumulation

An essential prerequisite for analyzing the structural impact of intellectual property is a detailed examination of the strategic accumulation patterns exhibited by the electronics manufacturers within the sample. The descriptive analysis reveals a profound shift in the orientation of intellectual property strategies over the observation period. Initially, the majority of the firms in the dataset engaged primarily in process innovations designed to reduce marginal manufacturing costs, relying heavily on trade secrets and informal know how rather than formal patent protection [21]. However, as the sector became increasingly integrated into sophisticated global supply chains, there was a pronounced structural break characterized by exponential growth in formal patent applications, particularly in utility models and high technology invention patents. This surge in formal intellectual property accumulation was not uniform across all enterprises. A distinct bifurcation emerged, wherein highly productive firms at the technological frontier built massive, interlocking patent portfolios covering critical design architectures and communication protocols, while mid tier firms focused on specialized niche patents designed to protect specific component innovations. Trademark registrations also exhibited significant

growth, aligning closely with efforts by original design manufacturers to establish independent global identities. The structural model implicitly captures these divergent strategies by allowing the return on intellectual property investments to vary based on the firm's contemporaneous state variables, thereby reflecting the reality that aggressive patenting is only optimal for firms possessing sufficient baseline productivity to absorb the high fixed costs of legal protection and international enforcement [22].

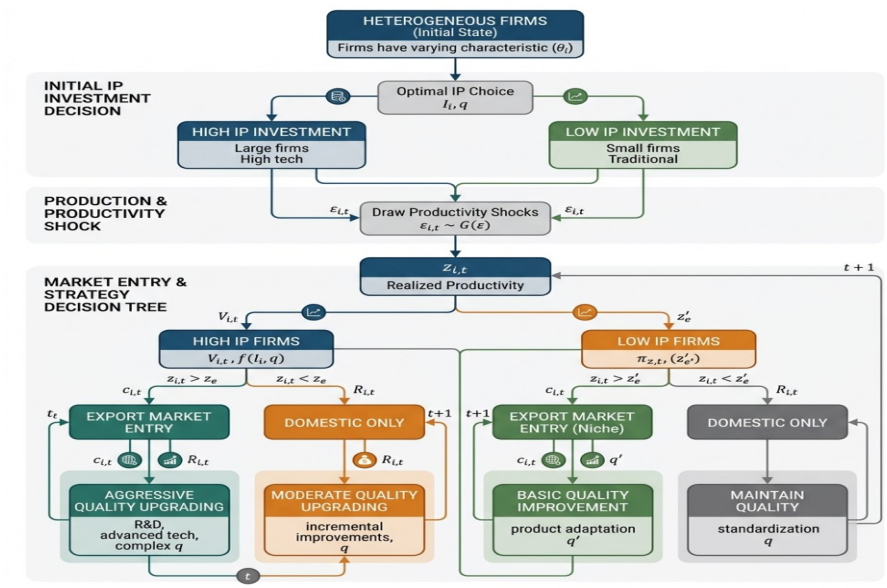

Figure 1: Comprehensive Schematic of Structural Decision Modeling Framework for Electronics Manufacturers

5.2 Strategic Complementarities

A critical dimension of intellectual property strategy in the electronics industry is the presence of strategic complementarities, where the value of one type of intellectual asset is significantly enhanced by the presence of another. The structural analysis specifically investigates the interaction between technological patents and market oriented trademarks. Firms attempting to upgrade their exports from standardized intermediate components to fully assembled consumer electronics face severe informational frictions in foreign markets. Foreign buyers are often unable to perfectly observe the ununderlying quality and durability of the electronics products prior to purchase. In this environment, a robust patent portfolio signals fundamental technological competence, while an established trademark provides a reputational guarantee that mitigates the risk of catastrophic product failure [23]. The structural model's demand system, which incorporates both technological quality parameters and consumer brand preference parameters, demonstrates that simultaneous investment in both domains yields exponentially higher returns in terms of export volume and price premiums compared to isolated investments. Furthermore, the analysis uncovers complex strategic complementarities between firm level innovation and external network effects. Electronics manufacturers that strategically cross license their proprietary technologies to allied firms within standard setting organizations frequently achieve more rapid and sustained export upgrading. The structural methodology accurately quantifies these complex interdependencies, highlighting that modern intellectual property strategy is less about establishing impenetrable monopolies and more about optimizing strategic positioning within highly interdependent global value networks.

6. Results and Export Upgrading Assessment

6.1 Baseline Structural Estimates

The simulated method of moments estimation successfully convergence, yielding a set of structural parameter estimates that provide profound insights into the mechanics of export upgrading. The estimated elasticity of substitution is firmly within the expected theoretical bounds, confirming that the international electronics market is characterized by high levels of product substitutability and intense price competition [24]. Crucially, the parameter governing the impact of intellectual property on the sunk costs of export upgrading is highly significant and negative. This indicates that possessing a substantial and well managed patent portfolio dramatically reduces the frictional costs associated with entering high quality, premium export tiers. The results suggest that foreign buyers and lead firms in global value chains utilize a supplier's intellectual property stock as a primary screening mechanism, thereby accelerating the contracting and certification processes that typically constitute massive sunk costs for aspiring exporters. Furthermore, the structural estimates regarding the intellectual property production function reveal substantial uncertainties and temporal lags. The translation of research and development expenditures into valuable technological assets is modeled as a highly stochastic process, demonstrating that export upgrading is inherently risky and requires sustained, long term financial commitment [25]. The model also uncovers strong evidence of state dependence in quality upgrading; firms that successfully transition to higher value added export categories exhibit a high probability of remaining in those lucrative segments, provided they continue to maintain and modernize their intellectual property portfolios to offset rapid technological depreciation.

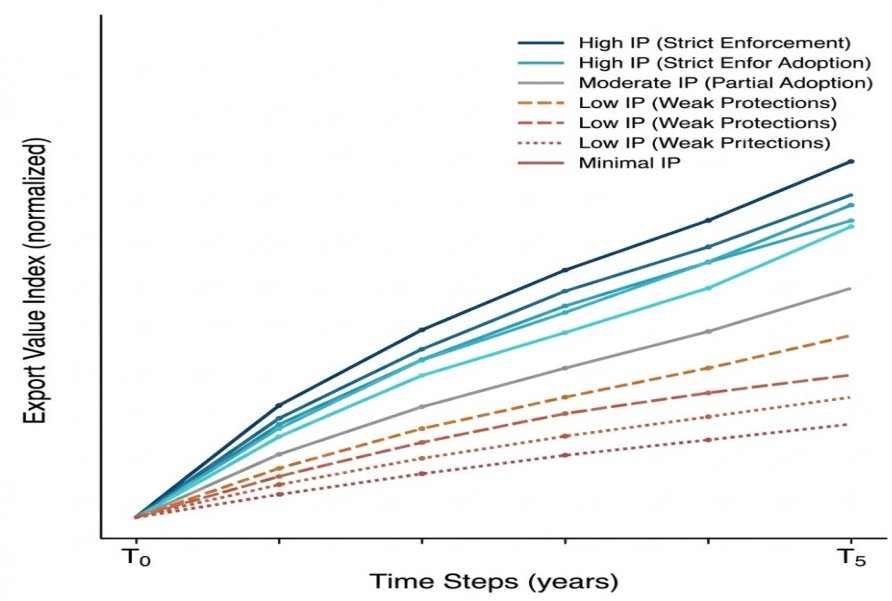

Figure 2: Counterfactual Simulation Pathways for Export Upgrading

6.2 Counterfactual Policy Simulations

One of the paramount advantages of employing a fully specified structural model is the ability to conduct rigorous counterfactual simulations that evaluate the potential impacts of alternative economic environments. The first major counterfactual scenario simulates a significant reduction in the global institutional enforcement of intellectual property rights, effectively increasing the rate at which proprietary technological knowledge spills over to competitors without compensation. The simulation results demonstrate that such an environment leads to a catastrophic collapse in voluntary research and development investments among electronics manufacturers. Consequently, the aggregate rate of export

upgrading stagnates, as firms revert to competing solely on marginal cost reductions in low quality market segments rather than undertaking the risky investments required for product differentiation. The second counterfactual exercise investigates the implementation of targeted government subsidies designed to reduce the marginal cost of patent applications for mid tier manufacturing firms [26]. The structural simulations reveal that these subsidies act as a powerful catalyst for industrial transformation. By lowering the financial barriers to intellectual property accumulation, the policy enables a massive cohort of moderately productive firms to cross the threshold required to offset the sunk costs of export upgrading. This leads to a substantial densification of the high quality export sector and a significant increase in the aggregate technological sophistication of the nation's electronics exports. These findings underscore the critical non linearities in firm behavior; minor alterations to the institutional or incentive structures surrounding intellectual property can precipitate massive structural shifts in international trade performance.

7. Conclusion and Policy Implications

7.1 Summary of Methodological Advancements

This comprehensive study has successfully elucidated the complex, dynamic relationships between intellectual property strategies and export upgrading within the highly competitive electronics manufacturing industry. By departing from traditional reduced form econometric approaches and developing a sophisticated dynamic structural model, this research has provided a mathematically rigorous framework for understanding how heterogeneous firms make simultaneous decisions regarding technological innovation and international market positioning. The structural estimation routine, utilizing extensive micro level datasets merging production, customs, and patent registry information, allowed for the precise quantification of deep economic parameters that are typically unobservable. The empirical results unequivocally demonstrate that the strategic accumulation of intellectual property assets is not merely a defensive legal maneuver, but a fundamental driver of international competitiveness that drastically reduces the sunk costs of export quality upgrading and enhances baseline product demand. Furthermore, the structural model successfully captured the significant strategic complementarities between different types of intellectual property, proving that modern electronics manufacturers must develop holistic strategies that integrate technological patents with market oriented trademarks to fully realize the benefits of export upgrading.

7.2 Managerial and Policy Directives

The findings derived from the structural modeling provide actionable directives for both corporate managers and public policymakers. For corporate strategists operating within the electronics manufacturing sector, the results highlight the imperative of viewing intellectual property not as an isolated legal expense, but as a core component of the firm's international expansion strategy. Managers must carefully calibrate their research and development investments, recognizing the stochastic nature of innovation and the necessity of building comprehensive portfolios that can reliably signal technological competence to global supply chain leaders. For policymakers aiming to foster national economic development through export upgrading, the structural counterfactual simulations offer clear guidance. Policies that merely subsidize raw production or general exports are likely to be highly inefficient. Instead, governments must focus on constructing robust intellectual property frameworks that lower the frictional costs of patenting while strictly enforcing technological protections [27]. Targeted support mechanisms that assist mid tier firms in formalizing their knowledge assets can trigger widespread structural transformations, enabling these enterprises to overcome the sunk costs of quality

upgrading and transition into high value added segments of the global economy. Ultimately, securing a sustainable position in the frontier of international trade requires a continuous, dynamically optimized commitment to intellectual property development.

References

1. Ovchynnykova, O.; Martinkiene, J.; Navickas, V. Enhancing Global Sustainability: The Role of the Blue Economy in Preserving Natural Capital. Chall. Sustain. 2024, 12, 65–79.

2. Mishra, D.R. Post-innovation CSR Performance and Firm Value. J. Bus. Ethics 2017, 140, 285–306.

3. Holúbek, J.; Durda, L.; Manák, R.; Rozsa, Z. Job crafting as a tool to support employee work assignment in the tourism sector: A systematic literature review. Equilib.-Q. J. Econ. Econ. Policy 2025, 20, 549–582.

4. Di Prima, C.; Ferraris, A. Rethinking the HR Role: How Digital Transformation is Changing HR Departments. In Research and Innovation Forum 2023; Springer International Publishing: Berlin/Heidelberg, Germany, 2024.

5. Ulpiani, G.; Vetters, N. On the risks associated with transitioning to climate neutrality in Europe: A city perspective. Renew. Sustain. Energy Rev. 2023, 183, 113448.

6. Triguero, Á.; Moreno-Mondéjar, L.; Córcoles, D. The Importance of the Eco-Innovation, Knowledge Network and the Geographical Dimension in the Adoption of Circular Economy Business Models. Bus. Strategy Environ. 2025, 34, 10903–10924.

7. Jeske, S. Applicant Tracking System Requirements—An Organizational Role Perspective. Bachelor's Thesis, FH Aachen, Aachen, Germany, 2024. Available online: https://opus.bibliothek.fh-aachen.de/opus4/frontdoor/deliver/index/docId/12053/file/Aachener_Online_Schriftenreihe_Band_02_2024.pdf#page=102 (accessed on 9 January 2026).

8. Hendrickson, A.R. Human resource information systems: Backbone technology of contemporary human resources. J. Labor. Res. 2003, 24, 381–394.

9. Baumgartner, R.J. Managing Corporate Sustainability and CSR: A Conceptual Framework Combining Values, Strategies and Instruments Contributing to Sustainable Development. Corp. Soc. Responsib. Environ. Manag. 2014, 21, 258–271.

10. Marsh, A.T.M.; Velenturf, A.P.M.; Bernal, S.A. Circular Economy strategies for concrete: Implementation and integration. J. Clean. Prod. 2022, 362, 132486.

11. Marshall, D.; O'Dochartaigh, A.; Prothero, A.; Reynolds, O. Are you ready for the sustainable, biocircular economy? Bus. Horiz. 2023, 66, 805–816.

12. Crossan, M.M.; Apaydin, M. A multi-dimensional framework of organizational innovation: A Systematic Review of the Literature. J. Manag. Stud. 2010, 47, 1154–1191.

13. Sullivan, K.; Thomas, S.; Rosano, M. Using industrial ecology and strategic management concepts to pursue the Sustainable Development Goals. J. Clean. Prod. 2018, 174, 237–246.

14. Afolabi, J.A. Advancing the circular economy in Europe: The role of eco-innovation, economic complexity, and digitalization. Technol. Soc. 2025, 83, 103027.

15. Macalik, J.; Sulich, A. External employer branding of sustainable organizations. In Proceedings of the International Scientific Conference Contemporary Issues in Business, Management and Economics Engineering' 2019, Vilnius, Lithuania, 9–10 May 2019.

16. Reed, M.I. Organization, trust and control: A realist analysis. Organ. Stud. 2001, 22, 201–228.

17. Chandratreya, A. AI in HR: A Comprehensive Analysis and Framework for Success. Int. J. Sci. Res. Eng. Manag. 2024, 8, 1–11.

18. West, J.; Mace, M. Browsing as the killer app: Explaining the rapid success of Apple's iPhone. Telecommun. Policy 2010, 34, 270–286.

19. Stanwick, P.A. The rise and fall of Eastman Kodak. Am. J. Humanit. Soc. Sci. Res. 2020, 4, 219–224.

20. Niño, A.G.M. A case study of KODAK: Failure to embrace digital innovation. Preprint 2024.

21. Ren, X.; Mia, M.A. The determinants of green innovations in manufacturing industries: A systematic literature review. Futur. Bus. J. 2025, 11, 42.

22. Sołoducho-Pelc, L.; Sulich, A. Sustainable development strategies of enterprises—Research perspectives. Studies Work. Coll. Manag. Financ. 2024, 197, 9–25.

23. Arvidsson, S.; Dumay, J. Corporate ESG reporting quantity, quality and performance: Where to now for environmental policy and practice? Bus. Strategy Environ. 2022, 31, 1091–1110.

24. Bertelli, B.; Kocollari, U.; Merzi, L.; Torricelli, C. The role of circular economy in reducing corporate default probability: Insights from recent research. Curr. Opin. Environ. Sustain. 2025, 75, 101555.

25. Sathiyaseelan, A.; Venkatagiri, S.; Sathiyaseelan, A. Using AI to Enhance Candidate Experience in High Volume Hiring: A Conceptual Review and Case Study. In Proceedings of the Replenish, Restructure & Reinvent: Technology Fueled Transformation for Sustainable Future 2022, New Delhi, India, 21–22 January 2022; Available online: https://www.researchgate.net/publication/359199987 (accessed on 14 January 2026).

26. Bansal, P.; Roth, K. Why companies go green: A Model of Ecological Responsiveness. Acad. Manag. J. 2000, 43, 717–736.

27. Le, T.T.; Tran, P.Q.; Lam, N.P.; Tra, M.N.L.; Uyen, P.H.P. Corporate social responsibility, green innovation, environment strategy and corporate sustainable development. Oper. Manag. Res. 2024, 17, 114–134.