ROMANIAN ECONOMIC AND BUSINESS REVIEW

EDITOR
Bogdan Glăvan
Romanian American University

ASISTANT EDITOR
Evelyne-Sara Stănescu
Romanian-American University

ASSOCIATE EDITORS
Lucian Botea
Flavia Anghel
Tudor Edu
Iuliu Ivănescu
Romanian American University

EDITORIAL BOARD
Carmen Tamas, *University of Hyogo*
Florin Bonciu, *Romanian American University*
Barry Eichengreen, *University of California, Berkeley*
Soner Baskaya, *University of Glasgow*
Mohamed Latib, *DeSales University*
Vasa László, *Széchenyi István University*
Anthony Evans, *European Business School*
Nina Linde, *Institute of Economics of the Latvian Academy of Sciences*
Teodora Peneva, *Economic Research Institute Bulgarian Academy of Sciences*
Walter Block, *Loyola University New Orleans*
George Ionescu, *Romanian American University*
Nikolay Gertchev, *European Commission*
Alex Sharland, *Barry University*
Samir Trabelsi, *Brock University*
Theodor Purcărea, *Romanian American University*
Mihaela Gruiescu, *Romanian American University*
Cosmin Marinescu, *Academy of Economic Studies*
Ovidiu Folcuţ, *Romanian American University*
Josef Sima, *Anglo-American University in Prague*
Gregor Pfajfar, *Ljubljana University*
Andrei Rădulescu, *Institute of World Economy, Romanian Academy of Sciences*
Klodiana Gorica, *University of Tirana*
Pacha Malyadri, *Osmania University*
Andreea Budacia, *Romanian American University*
Kong Tianping, *University of Ningbo*
Daniela Firoiu, *Romanian American University*
Bogdan Wlodarczyk, *University of Warmia and Mazury*

Statement of Purpose

The *Romanian Economic and Business Review* (ISSN 1842-2497) intends to provide a forum for academic analysis of the economic phenomena and institutions affecting the world economy in general, and Romania, in particular. *REBE* examines a wide variety of phenomena related to economic growth and business development and attempts to publish high quality research focusing on the role of institutions and public policy, within both a national and international context. *REBE* encourages cross-disciplinary research work of Romanian and foreign scholars.

Indexed and/or *Abstracted* in:
EBSCO; EconLit; ProQuest; Index Copernicus; RePec

Author Information

The ROMANIAN ECONOMIC AND BUSINESS REVIEW (REBE) is a refereed journal published four times annually by the Romanian-American University. The editors invite submissions of articles that deal with important issues in economy and business. Papers that focus on specific phenomena and events affecting Romanian economy are particularly encouraged. Because REBE seeks a broad audience, papers should be comprehensible beyond narrow disciplinary bounds.

Manuscripts should not exceed 8,000 words and must conform to the REBE's style requirements, which are guided by The Chicago Manual of Style (14th edition). All submissions must include a cover sheet explaining the scope of the article, and including the authors' names and affiliations, telephone and e-mail address. The text should be single-spaced. References are cited with parentheses using the author/date/page style. *Example*: (Marcus, 2005, p. 74). Authors should use footnotes, not endnotes to add only short comments. Bibliography should include only references cited in the text, in the alphabetical order of authors. An abstract of no more than 200 words should be included.

Submission of a paper implies that the paper will not be submitted for publication to another journal unless rejected by the REBE editor or withdrawn by the author, and that it is an original work. All submissions should be sent to the journal Editor:

Dr. Bogdan Glăvan
Romanian-American University
Bulevardul Expoziţiei nr. 1B
Bucureşti
E-mail: bogdan.nicolae.glavan@rau.ro

ROMANIAN ECONOMIC AND BUSINESS REVIEW

FALL 2026 **VOLUME 21** **NUMBER 3**

PRO UNIVERSITARIA 2026
BUCUREŞTI

ROMANIAN ECONOMIC AND BUSINESS REVIEW

CONTENTS

DORU NEGRICEA	*ECCLESIAL ADMINISTRATION AND LEADERSHIP OF CHURCH COMMUNITIES IN A CONTEMPORARY CONTEXT: A THEOLOGICAL AND ORGANIZATIONAL APPROACH*	*7*
HILDA-HEDVIG VARGA, CRISTINA COCULESCU, ANA MARIA MIHAELA IORDACHE	*FROM EMIGRATION TO IMMIGRATION: AN INTERDISCIPLINARY STUDY OF MIGRATION AND THE INTEGRATION OF THE INDIAN COMMUNITY IN ROMANIA*	*24*
YUKI YASAKU, NOBUMICHI WATAHIKI, CRISTIAN VLAD	*THE SPATIAL LAYOUT OF BANK LOCATIONS AND INDUSTRIAL CLUSTERS IN THE KANTO REGION IN 1905: A QUANTITATIVE ANALYSIS USING VORONOI DIAGRAMS AND MS-SSIM*	*43*
MĂDĂLINA ANA BURDUJA, DOREL MIHAI PARASCHIV	*POLICY STABILITY AND RENEWABLE ELECTRICITY DEPLOYMENT: ROMANIA IN COMPARATIVE PERSPECTIVE, 2010–2025*	*57*

HIROTOSHI SATO, CRISTIAN VLAD	*CAN PUBLISHED DIGITAL TRANSFORMATION CASES TEST A CONFIGURATIONAL THEORY? A THREE-VALUED TESTABILITY DIAGNOSIS OF PLUS–D*	*79*
SACHINDRA KUMAR, DEEPA KUMARI, SATISH KUMAR CHAUDHARY	*BEYOND SEAMLESSNESS: AN EFFORT–REWARD IMBALANCE AND PSYCHOLOGICAL REACTANCE PERSPECTIVE ON THE VALUE OF FRICTION IN AI-ENABLED PHYGITAL RETAIL*	*105*

ECCLESIAL ADMINISTRATION AND LEADERSHIP OF CHURCH COMMUNITIES IN A CONTEMPORARY CONTEXT: A THEOLOGICAL AND ORGANIZATIONAL APPROACH

Doru Negricea[1]

Abstract

The study analyzes church administration in the context of contemporary society, characterized by institutional complexity, accelerated social transformations, and cultural pluralism. Starting from the theological foundation of ecclesial communion, the research explores how the principles of Orthodox theology can be put in dialogue with modern concepts in the field of organizational management and leadership. In the first part, the theological dimensions of ecclesial organization are highlighted, with reference to the theology of the person and communion, as articulated in the thought of Orthodox theologians such as Dumitru Stăniloae, Kallistos Ware or Christos Yannaras. In the second part, concepts from the contemporary management literature are analyzed, such as strategic leadership, organizational culture, critical thinking and value innovation, highlighting their relevance for the administration of ecclesial communities. The study argues that the integration of these perspectives does not imply a secularization of church life, but offers useful analytical and organizational tools for the fulfillment of the pastoral mission in contemporary society. In this sense, ecclesial administration is understood as a dynamic process that combines fidelity to the theological tradition of the Church with the responsible use of modern principles of organization and leadership. Through this transdisciplinary approach, the study proposes a reflection on how pastoral leadership, community culture and strategic discernment can contribute to strengthening ecclesial life and developing the Church's mission in the contemporary world.

Keywords: *ecclesial administration, pastoral leadership, organizational culture, strategic discernment, theology of communion, ecclesial management, mission of the Church*

JEL Classification: Z12, M10, M12, L31

Church Administration in the Contemporary Context: Academic Introduction

In the context of contemporary society, characterized by institutional complexity, cultural pluralism and accelerated social transformations, religious institutions are called to reflect on the way in which they organize their community life and carry out their pastoral mission. Church administration cannot be reduced to a mere organizational or bureaucratic dimension, but must be understood in close connection with the theological foundation of ecclesial life and with the pastoral responsibility of community leadership.

[1] Rev. Lect. Univ. Dr. Doru Negricea, Ovidius University of Constanța Faculty of Theology.

In this context, contemporary reflection on institutional leadership offers a number of useful concepts for understanding how religious communities can coordinate their activities and resources. The specialized literature in the field of organizational management and leadership emphasizes the importance of elements such as organizational culture, strategic communication, critical thinking and participatory leadership in the effective functioning of institutions.

The purpose of this study is to analyze the relationship between the theological foundations of ecclesial organization and certain concepts from the contemporary literature of management and leadership. The study aims to highlight how theological reflection on the person, communion and mission of the Church can enter into a fertile dialogue with the conceptual tools of organizational management, without compromising the theological identity of the ecclesial institution.

Through this transdisciplinary approach, the research aims to contribute to a broader understanding of contemporary church administration, highlighting that the institutional organization of the Church must combine fidelity to the theological tradition with the ability to respond to the social and cultural challenges of the contemporary world.

Research methodology

The study uses a qualitative and transdisciplinary approach, based on theological analysis and conceptual examination of the contemporary literature on management and organizational leadership. The research method consists in the comparative analysis of some theological sources from the Orthodox tradition and of some representative works in the field of organizational management, in order to identify points of conceptual convergence between the two fields.

The research analyzes theological works that reflect on the nature of ecclesial communion and on the personal dimension of Christian existence, such as those of Dumitru Stăniloae, Kallistos Ware or Christos Yannaras. In parallel, contributions from the management and leadership literature that address topics such as organizational culture, strategic leadership, institutional communication and critical thinking in decision-making are examined.

Through this analytical and transdisciplinary method, the study aims to highlight how certain concepts in organizational theory can offer useful interpretative tools for understanding the administrative and institutional dimensions of ecclesial life, without reducing the reality of the Church to a simple social organization.

Literature review

Contemporary Orthodox theological reflection has paid particular attention to the community dimension of ecclesial existence. In the theological

thought of Dumitru Stăniloae, the Church is fundamentally understood as a space of communion between persons, based on the participation of the faithful in liturgical and sacramental life. This perspective emphasizes that the organization of ecclesial life cannot be separated from the spiritual reality of communion in Christ.

Similarly, Kallistos Ware's ecclesiological reflections highlight the organic and communitarian character of the Church, which cannot be reduced to a juridical or administrative institution. From this perspective, ecclesial structures must be understood as instruments at the service of communion and the spiritual mission of the Church.

Contemporary theology inspired by the thought of Christos Yannaras emphasizes the personal and relational dimension of ecclesial existence, emphasizing that the identity of the person is realized within the framework of relationships of communion. This perspective provides a relevant anthropological framework for reflection on the leadership of ecclesial communities.

In parallel, the contemporary management and leadership literature has developed a number of useful concepts for analyzing how organizations coordinate their activities and resources. Studies such as those by Mary Crossan, Peter Lorange or Jo Owen emphasize the importance of strategic leadership, organizational culture and communication in institutional development.

The dialogue between these theological and organizational perspectives can contribute to a more nuanced understanding of contemporary ecclesial administration, highlighting the fact that the spiritual dimension of the life of the Church does not exclude the use of conceptual tools derived from organizational theory.

Church Administration in a Contemporary Context

In the context of contemporary society, characterized by institutional complexity, rapid change and the multiplication of social challenges, church administration is called to combine fidelity to ecclesial tradition with the responsible use of modern principles of organization and leadership. In this sense, contemporary approaches to organizational management provide a useful conceptual framework for understanding how institutions can effectively coordinate their resources and activities.

Management is defined as the process by which the resources and activities of an organization are coordinated in order to achieve its objectives. In this regard, Robert D. Stueart and Barbara B. Moran emphasize that: ,,Management is essential for the efficient functioning of organizations and for the coordination of resources in order to achieve institutional objectives."[2]

[2] Robert D. Stueart, Barbara B. Moran, *Library and Information Center Management*, Santa Barbara, CA: Libraries Unlimited, 2007, p. 3.

Applied in an ecclesial context, this perspective highlights the need for an administration that ensures the proper organization of pastoral, missionary and educational activities. At the same time, the management of institutions must be able to respond to the social and cultural changes of the contemporary world. In this sense, Peter Lorange states that: ,,Organizations must adapt their leadership structures and practices to the ever-changing environments."[3]

Institutional adaptability is closely related to the ability of leaders to guide the organization in a context of uncertainty. In this sense, the same author points out that: ,,Strategic leadership involves the ability to respond to uncertainty while maintaining a clear direction for the organization."[4]

In church administration, this dimension translates into the need for leadership that is both faithful to tradition and capable of identifying appropriate solutions to contemporary challenges. Similarly, the management literature emphasizes the role of cooperation and coordination of human activities within organizations. Jo Owen observes that: ,,Management involves coordinating people, resources, and processes to achieve organizational goals."[5]

At the same time, effective leadership is not just about exercising authority, but about mobilizing the community around a common mission: ,,Effective leadership is less about authority and more about the ability to get people to work together for common goals."[6]

In this sense, communication becomes a central element of the leadership process. Harrison and Mühlberg point out that: ,,The quality of leadership in an organization is amplified or limited by the quality of communication."[7]

Strategic communication also plays an essential role in articulating the institutional vision and in mobilizing the members of the organization: ,,Strategic communication defines and creates value for the organization and for those it serves."[8]

At the strategic level, the management of institutions requires the ability to analyze the context and formulate coherent directions of action. In this sense, Crossan and collaborators state that: ,,Strategic analysis provides leaders with

[3] Peter Lorange, *Leading in Turbulent Times:Lessons Learnt and Implications for the Future*, Bingley: Emerald Publishing, 2010, p. 1.
[4] *Ibidem*, p. 43.
[5] Jo Owen, *How to Manage. The definitive guide to effective management*, Harlow: Pearson Education, 2009, p. 13-14.
[6] *Ibidem*, p. 35.
[7] E. Bruce Harrison, Judith Mühlberg, *Leadership Communication. How Leaders Communicate and How Communicators Lead in Today's Global Enterprise*, New York: Business Expert Press, 2015, p. 1.
[8] *Ibidem*, p. 1.

the necessary tools to understand the organizational environment and develop effective responses."[9]

At the same time, organizational success depends on the ability to integrate vision, structure, and action into a coherent strategy: „Organizations succeed when leadership integrates vision, structure, and execution into a coherent strategy."[10]

From this perspective, contemporary church administration must be understood not as a mere bureaucratic structure, but as a dynamic process of coordinating community life and the Church's mission in the world.

The Theological Foundation: Person and Communion

Church administration cannot be adequately understood without considering its theological foundation. In the Orthodox tradition, the organization of the Church's life is not determined exclusively by institutional or juridical criteria, but finds its foundation in the theology of the person and of communion. This perspective starts from the fundamental reality of the Church as the Body of Christ and as a space of Eucharistic communion.

Contemporary Orthodox theology has consistently insisted that Christian spirituality is inseparable from the experience of communion. In this sense, Dumitru Stăniloae emphasizes: „In general, a true spirituality is the spirituality of a real communion in prayer and in life."[11]

For Father Stăniloae, the liturgical life of the Church constitutes the environment in which this communion is concretely realized. The participation of the faithful in the Divine Liturgy is not only a religious practice, but the experience of a real unity in Christ. Thus, he states, „Believers unite with one another by participating in the same Body and Blood of Christ."[12]

This Eucharistic dimension of the unity of the Church is essential for understanding how ecclesial structures are configured. The organization of community is not the result of a mere social convention, but the sacramental expression of communion in Christ. In the same sense, Cristian Sonea shows that the unity of the Church has its origin in the Trinitarian reality itself: „The unity of the Church has its foundation in the unity of God. (of the Holy Trinity)."[13]

---

[9] Mary M. Crossan, Michael J. Rouse, W. Glenn Rowe, Cara C. Maurer, *Strategic Analysis and Action*, Toronto: Pearson Education Canada, 2015, p. 17.

[10] *Ibidem*, p. 48

[11] Priest Professor Dumitru Stăniloae, *Spirituality and Communion in the Orthodox Liturgy*, Publishing House of the Biblical and Mission Institute of the Romanian Orthodox Church, Bucharest, 2004, p. 5.

[12] *Ibidem*, p. 3.

[13] Cristian Sonea, *The Theology of Interchristian Dialogue. An introduction*, Cluj University Press Publishing House, Cluj-Napoca, 2017, p. 20.

Ecclesial communion, therefore, reflects divine communion on a historical level. From this perspective, the Church is not a purely juridical institution, but a sacramental and communitarian reality. This idea is also highlighted in the ecclesiological reflections of Kallistos Ware: „Orthodoxy sees the Church not as a purely juridical institution, but as a living organism of communion."[14]

The administrative structure of the Church must therefore be understood as an instrument at the service of this communion. The hierarchical organization, liturgical life and pastoral mission are expressions of a deeper theological reality, which has its origin in the very life of the Holy Trinity.

Palamite theology also offers a relevant perspective on the personal dimension of ecclesial experience. Within the hesychastic tradition, the knowledge of God is not conceived as a purely intellectual process, but as a personal participation in divine grace. In this regard, a study dedicated to the thought of Gregory Palamas shows that: „Palamite theology emphasizes the personal experience of divine grace in the life of the believer."[15]

This perspective highlights the fact that the life of the Church is founded on the personal encounter between God and man. Hence the community dimension of ecclesial existence, since the experience of grace leads to the integration of the person into the community of believers.

In contemporary theological reflection, Christos Yannaras insisted on the relationship between the person and communion, considering that human identity is fully realized only in relationship. Studies devoted to his thought emphasize that Orthodox theology attaches great importance to this relational dimension: „Contemporary Orthodox thought emphasizes the connection between the person, freedom and communion."[16]

Consequently, ecclesial administration cannot be adequately conceived without taking into account this relational anthropology. Leadership in the Church is not oriented towards the exercise of authority in a purely institutional sense, but towards the cultivation of communion and mutual responsibility within the community of believers.

The theological foundation of ecclesial administration, therefore, is to be found in the very reality of Trinitarian and Eucharistic communion. The organization of the community, hierarchical structures and pastoral activities are concrete expressions of this spiritual reality, which defines the identity and mission of the Church in the world.

---

[14] Bishop Kallistos Ware, *The Orthodox Church*, translated by Francisc Garcia, Editorial Angela, Buenos Aires, Argentina, 2006, p. 18.

[15] Constantinos Athanasopoulos (ed.), *Orthodox Mysticism and Asceticism. Philosophy and Theology in St Gregory Palamas' Work*, Cambridge Scholars Publishing, 2020, p. 2-200.

[16] Andreas Andreopoulos, Demetrios Harper (eds.), *Christos Yannaras: Philosophy, Theology, Culture*, 2019, p. 2.

Pastoral leadership and leadership of the ecclesial community

Within the Church, community leadership cannot be reduced to an administrative or organizational function. Pastoral leadership presupposes a particular form of service, oriented towards building up the community and cultivating communion among the faithful. In this sense, ecclesial leadership is inseparable from pastoral responsibility and the spiritual dimension of community life.

In the contemporary literature on leadership, leadership is often described as the ability to mobilize people around a common goal. Thus, Robert Mellor observes that: ,,Leadership is the ability to bring out the best in others and unite them around a common goal."[17]

This perspective is particularly relevant in a pastoral context, where the role of the leader is not to impose authority, but to inspire and guide the community towards the fulfillment of its spiritual mission. In the same vein, Jo Owen points out that: ,,Effective leadership is less about exercising authority and more about the ability to get people to work together for common goals."[18]

In the context of the Church, these common objectives are defined by the pastoral, liturgical and missionary mission of the community. Pastoral leadership, therefore, presupposes the ability to cultivate cooperation and common responsibility within the ecclesial community.

Another essential element of leadership is communication. The relationship between the leader and the community is mediated by the ability to convey the vision and create trust. In this sense, Harrison and Mühlberg state that: ,,The quality of leadership in an organization is amplified or limited by the quality of communication."[19]

Pastoral communication is not limited to the transmission of information, but involves the creation of a space for dialogue and participation. Through it, the leader of the community can articulate the pastoral vision and mobilize the faithful in its realization. In the same sense, the mentioned authors emphasize that: ,,Strategic communication defines and creates value for the organization and for those it serves."[20]

In the ecclesial context, this "value" is linked to the strengthening of the community and the deepening of the spiritual life of the faithful.

Pastoral leadership also involves the ability to guide the community in an ever-changing social context. In this sense, Peter Lorange observes that leaders must be able to respond to the uncertainty and challenges of the contemporary

[17] Robert B. Mellor with Gary Coulton, Anne Chich, Antonia Bifulco, Noha Mellor and Alan Fisher, *Entrepreneurship for Everyone*, London: SAGE Publications, 2009, p. 12.
[18] Jo Owen, *How to Manage...*, p. 35.
[19] E. Bruce Harrison, Judith Mühlberg, *Leadership Communication...*, p. 1.
[20] *Ibidem*, p. 2.

environment: „Strategic leadership involves the ability to respond to uncertainty while maintaining a clear direction for the organization."[21]

For pastoral leadership, this direction is determined by fidelity to the Gospel and to the tradition of the Church, but also by the ability to identify appropriate ways to respond to the needs of the contemporary community.

At the same time, effective leadership involves the training and development of community members. Dave Kerpen points out that authentic leaders don't just focus on organizational results, but also on developing people: „The most effective leaders focus on developing people, not just controlling them."[22]

In a pastoral context, this perspective highlights the role of the leader as a spiritual formator and as an animator of community life. Pastoral leadership thus presupposes a form of ministry aimed at the spiritual growth of the faithful and the strengthening of ecclesial communion.

In conclusion, the leadership of the ecclesial community must be understood as a synthesis between the spiritual dimension of pastoral ministry and the principles of an effective organization. Pastoral leadership is not based on institutional authority in the strict sense, but on the ability to inspire, communicate and guide the community towards the fulfillment of its mission in the world.

Organizational Culture in Ecclesial Communities

The community life of the Church develops within an ecclesial culture that shapes the behaviors, relationships, and participation of community members. Similarly to other organizations, ecclesial communities are also influenced by values, norms, and patterns of interaction that define what the literature calls organizational culture. In the context of the Church, however, this culture is profoundly linked to the spiritual dimension and the experience of ecclesial communion.

The culture of an organization is formed through the interaction of the values and practices shared by its members. In this regard, Don Warrick and Jens Mueller note that: „Creating a culture of excellence is not an easy task; It involves understanding the importance of culture, setting a personal example, and taking dedicated action to bring out the best in others."[23]

This perspective highlights the fundamental role of leaders in shaping organizational culture. In the context of the Church, community leaders

[21] Peter Lorange, *Leading in Turbulent Times...*, p. 43.

[22] Dave Kerpen, *Likeable Leadership, a collection of 65+ inspirational stories on marketing, your career, social media @ more*, New York: McGraw-Hill Education, 2019, p. 10-14.

[23] D. D. Warrick, Jens Mueller, *Lessons in Changing Cultures*, RossiSmith Academic Publications Ltd., Oxford, UK, 2015, p. 3.

contribute to shaping community life through personal example, spiritual guidance, and the promotion of evangelical values.

Organizational culture also influences how members of a community perceive and interpret institutional reality. Warrick and Mueller point out that: ,,Organizational culture influences the way people think, act, and interact within the organization."[24]

In the case of ecclesial communities, this influence is manifested in the formation of a common identity and in the cultivation of a specific way of relating among the faithful. The community culture of the Church is thus oriented towards solidarity, cooperation and mutual responsibility.

The management literature emphasizes that common values and a shared sense of mission contribute to strengthening the organizational culture. Mary Crossan and collaborators show that: ,,Organizations with a strong culture are characterized by shared values and a clear sense of common purpose."[25]

This idea can also be applied in the ecclesial context, where the common goal is determined by the mission of the Church and by the participation of the faithful in liturgical and sacramental life. Community culture thus becomes the framework in which the experience of communion and active participation in the life of the Church is realized.

At the same time, organizational culture influences the way strategies and decisions are implemented within the institution. Crossan and collaborators point out that: ,,Culture shapes how strategies are interpreted and implemented within organizations."[26]

In the life of ecclesial communities, this means that the success of pastoral initiatives depends not only on planning or organization, but also on the way in which they are assumed by the community. Community culture thus becomes a determining factor in the vitality and dynamism of church life.

Another important element of organizational culture is mutual trust between community members. Open communication and dialogue help to strengthen relationships and develop an atmosphere of collaboration. Harrison and Mühlberg emphasize in this regard that: ,,Leaders must cultivate an environment of trust and openness to enable collaboration."[27]

In the context of the Church, this culture of dialogue and trust fosters the active participation of the faithful in the life of the community and in the fulfilment of the ecclesial mission.

---

[24] *Ibidem*, p. 7.

[25] Mary M. Crossan, Michael J. Rouse, W. Glenn Rowe, Cara C. Maurer, *Strategic Analysis and Action...*, p. 112.

[26] *Ibidem*, p. 118.

[27] E. Bruce Harrison, Judith Mühlberg, *Leadership Communication...*, p. 65.

Also, developing a strong community culture helps empower community members. Peter Lorange points out that: ,,Successful organizations develop cultures in which individuals feel responsible for collective results."[28]

In the case of ecclesial communities, this collective responsibility is manifested in the involvement of the faithful in the liturgical life, pastoral activities and missionary projects of the Church.

Community culture is therefore an essential element for the vitality of ecclesial life. It creates the framework in which spiritual values are transmitted, relationships between believers are strengthened, and the Church's mission is concretely realized.

Critical Thinking and Discernment in Ecclesial Leadership

In the current context, marked by the complexity of social phenomena and the multiplication of sources of information, the leadership of ecclesial communities presupposes not only pastoral competences, but also the capacity for analysis and discernment. Critical thinking thus becomes an essential tool for evaluating situations, for correctly interpreting contemporary realities and for formulating responsible decisions.

The literature emphasizes that critical thinking is a fundamental element of the decision-making process. Katherine Hibbs Pherson and Randolph H. Pherson state that: ,,Critical thinking is essential for making sound decisions in complex contexts."[29]

This statement highlights the role of analytical thinking in evaluating information and identifying the most appropriate directions of action. In the context of ecclesial leadership, discernment presupposes the ability to interpret social and cultural realities in the light of Gospel values.

A central element of critical thinking is the ability to analyze hypotheses and evaluate arguments. In this regard, Katherine and Randolph emphasize that: ,,Rigorous analysis involves examining assumptions and carefully evaluating the evidence before drawing conclusions."[30]

For the leadership of ecclesial communities, this perspective is particularly important, since pastoral decisions must take into account both the concrete social context and fidelity to the Church's tradition.

Critical thinking also involves the ability to structure the analysis process and organize information in a coherent manner. The mentioned authors show that: ,,Effective analysis requires structured thinking and careful evaluation of information sources."[31]

---

[28] Peter Lorange, *Leading in Turbulent Times...*, p. 101.

[29]Katherine Hibbs Pherson, Randolph H. Pherson, *Critical Thinking for Strategic Intelligence*, by CQ Press, an Imprint of SAGE Publications, 2021, p. 3.

[30] *Ibidem*, p. 3.

[31] *Ibidem*

In ecclesial life, this intellectual discipline contributes to the formulation of appropriate pastoral strategies and to the avoidance of decisions based on superficial perceptions or incomplete interpretations.

Critical thinking also contributes to navigating situations of uncertainty and managing the complexity of the social environment. In this sense, Pherson and Pherson state that: ,,Critical thinking allows decision-makers to manage the uncertainty and complexity of contemporary environments."[32]

This capacity is essential for the leadership of ecclesial communities in a context in which cultural and social changes directly influence religious life.

At the same time, critical thinking is closely linked to strategic reflection. Mary Crossan and collaborators point out that the strategic process begins by asking relevant questions: ,,Strategic thinking involves asking the right questions before looking for the answers."[33]

This perspective highlights the role of critical questions in the discernment process. In ecclesial leadership, the formulation of appropriate questions can help to identify the real challenges of the community and to the correct orientation of pastoral initiatives.

At the same time, critical reflection helps leaders avoid certain limits of perception and interpretation. Crossan and collaborators point out that: ,,Leaders need to examine their own assumptions to avoid strategic blind spots."[34]

În context eclesial, această dimensiune a reflecției critice contribuie la menținerea unei atitudini de discernământ și responsabilitate în procesul decizional.

Also, the discipline of analysis contributes to improving the quality of decisions. Katherine Pherson and Randolph Pherson point out that: ,,The discipline of analysis improves the quality of decisions and reduces the risk of errors."[35]

In the case of ecclesial communities, this perspective can contribute to the development of more transparent and accountable decision-making processes.

In conclusion, critical thinking and discernment are essential components of ecclesial leadership in the contemporary context. By cultivating analytical reflection and carefully evaluating concrete situations, the leaders of church communities can formulate more responsible pastoral decisions and guide the community towards the fulfilment of its spiritual mission.

---

[32] *Ibidem*, p. 58.
[33] Mary M. Crossan, Michael J. Rouse, W. Glenn Rowe, Cara C. Maurer, *Strategic Analysis and Action...*, p. 62.
[34] *Ibidem*, p. 88.
[35] Katherine Hibbs Pherson, Randolph H. Pherson, *Critical Thinking for Strategic Intelligence...*, p. 75.

Value innovation in the mission of the Church

The cultural and social transformations of the contemporary world require ecclesial communities to reflect constantly on how they carry out their mission. This reflection does not imply abandoning tradition, but creatively reinterpreting the fundamental values of faith in the context of new social realities. In the management and entrepreneurship literature, this capacity for reinterpretation is often described by the concept of innovation.

Innovation is not just about introducing completely new elements, but often involves reconsidering existing practices and models. In this sense, Robert Mellor points out that the innovation process frequently occurs when organizations are willing to reevaluate traditional assumptions and explore new possibilities: ,,Innovation often occurs when organizations reconsider traditional assumptions and explore new possibilities."[36]

Applied in an ecclesial context, this perspective suggests that the development of pastoral mission can involve finding new ways of communication and community involvement, without compromising the theological identity of the Church.

Another important aspect of innovation is the ability to identify opportunities for value creation. Mellor points out that: ,,Entrepreneurial thinking encourages individuals to identify opportunities for new value creation."[37]

In the life of ecclesial communities, this "value" is not an economic one, but a spiritual and community one. It is manifested in the strengthening of relations between the members of the community, in the development of pastoral activities and in the extension of the Church's mission in society.

The strategic literature also emphasizes that innovation is closely related to leaders' ability to critically analyze existing models. Mary Crossan and collaborators state that: ,,Strategic innovation requires leaders to question the organization's existing models."[38]

In the context of ecclesial leadership, this approach can contribute to the development of new forms of community involvement, educational activity or social mission.

At the same time, the innovation process implies the willingness to experiment and learn from experience. Peter Lorange points out that: ,,Innovation depends on the willingness of organizations to experiment and learn from their own failures."[39]

---

[36] Robert B. Mellor with Gary Coulton, Anne Chich, Antonia Bifulco, Noha Mellor and Alan Fisher, *Entrepreneurship for Everyone....*

[37] *Ibidem*, p. 18.

[38] Mary M. Crossan, Michael J. Rouse, W. Glenn Rowe, Cara C. Maurer, *Strategic Analysis and Action...*, p. 137.

[39] Peter Lorange, *Leading in Turbulent Times...*, p. 75.

This perspective is also relevant for the life of ecclesial communities, where pastoral initiatives may require adaptations and adjustments according to the concrete context of the community.

Another important factor of innovation is the organizational culture that fosters creativity and initiative. Warrick and Mueller show that: ,,Organizations that encourage creativity are more likely to develop sustainable advantages."[40]

In ecclesial life, this creativity is manifested in the diversity of forms of pastoral ministry and in the ability of communities to respond to the spiritual and social needs of the faithful.

Leaders also play a decisive role in stimulating the innovative process. Harrison and Mühlberg emphasize that: ,,Leaders need to create an environment in which new ideas can be explored without fear."[41]

In the pastoral context, this openness favors the involvement of the faithful and the development of community initiatives.

In conclusion, the concept of value innovation can be interpreted in the ecclesial context as a capacity for creative reinterpretation of tradition, aimed at strengthening community life and developing the Church's mission in society.

Strategy and strategic analysis

In contemporary management and strategy literature, the concept of "blue ocean" is used to describe those spaces of action where organizations can create value through innovative initiatives, avoiding direct competition and developing new areas of activity. Although this concept derives from the strategic theory of economic organizations, its principles can also be interpreted in the context of ecclesial mission, especially with regard to the identification of new forms of pastoral and social involvement.

A central element of strategic thinking is the ability of leaders to make coherent choices based on the organizational context. In this regard, Mary Crossan and collaborators emphasize that: ,,Strategy involves making choices that position the organization for long-term success."[42]

Applied in the context of the Church, this perspective suggests that the development of pastoral mission requires discernment in identifying the priorities and areas of action that best respond to the needs of the community.

The strategic process also involves a careful assessment of the resources and the environment in which the organization operates. Crossan and collaborators point out that: ,,Strategic leaders must assess both the internal

[40] D. D. Warrick, Jens Mueller, *Lessons in Changing Cultures...*, p. 39.
[41] E. Bruce Harrison, Judith Mühlberg, *Leadership Communication...*, p. 97.
[42] Mary M. Crossan, Michael J. Rouse, W. Glenn Rowe, Cara C. Maurer, *Strategic Analysis and Action...*, p. 17

capabilities of the organization and the conditions of the external environment."[43]

For ecclesial communities, this analysis involves understanding the social and cultural context in which they carry out their activity, as well as identifying the spiritual and community resources available.

Another key aspect of strategic thinking is the balance between opportunities and resources. In this sense, Crossan and collaborators state that: ,,Strategic thinking involves balancing opportunities with available resources."[44]

In ecclesial life, this balance is reflected in the way in which communities develop pastoral and social initiatives adapted to their real possibilities.

The leadership literature also emphasizes the importance of clarity of strategic priorities. Peter Lorange observes that: ,,Organizations that develop clear strategic priorities are better prepared to adapt to change."[45]

This perspective is particularly relevant for ecclesial communities facing the challenges of a pluralistic and secularized society.

Another important element of strategic leadership is the ability to integrate people and organizational processes around a common goal. Jo Owen points out that: ,,Strategic leadership involves aligning the people, processes and objectives of the organization."[46]

In a pastoral context, this alignment is achieved by articulating a missionary vision that mobilizes the community around the values of the Gospel.

The strategic process also involves the ability to analyze the environment in which the organization operates. Crossan and collaborators point out that: ,,Strategic analysis provides a framework for understanding competitive and organizational environments."[47]

In the case of ecclesial communities, this analysis can help to identify areas of activity in which the Church can make a significant contribution to the life of society.

At the same time, the success of a strategy depends on the ability to implement. Peter Lorange points out that: ,,Successful strategies result from careful analysis and disciplined execution."[48]

In conclusion, the application of the principles of strategic reflection in the context of ecclesial leadership can contribute to the development of a pastoral mission that is more effective and adapted to the contemporary context.

---

[43] *Ibidem*, p. 48.
[44] *Ibidem*, p. 112.
[45] Peter Lorange, *Leading in Turbulent Times...*, p. 67.
[46] Jo Owen, *How to Manage. The definitive guide to effective management...*, p. 201.
[47] Mary M. Crossan, Michael J. Rouse, W. Glenn Rowe, Cara C. Maurer, *Strategic Analysis and Action...*, p. 62.
[48] Peter Lorange, *Leading in Turbulent Times...*, p. 92.

Through discernment, analysis and strategic orientation, church communities can identify new ways of social and spiritual involvement, thus contributing to the fulfillment of the Church's mission in the world.

Administrative reform and the ERSC matrix

Administrative reform of institutions often involves reassessing existing processes, practices and structures. In strategic management theory, a frequently used tool for analyzing and improving organizational performance is the E.R.S.C. matrix, which aims to identify the activities that need to be eliminated, reduced, developed or created. Although this model comes from the field of organizational management, its principles can also be applied in the context of the administration of ecclesial communities.

In the literature, improving organizational performance is associated with the ability of institutions to critically evaluate their own processes. Darryl D. Enos points out that: ,,Improving performance involves identifying inefficiencies and redesigning organizational processes."[49]

This perspective highlights the importance of regular assessment of how institutional structures function. In the case of ecclesial administration, such an assessment can help to identify practices that no longer adequately respond to the needs of the community.

The administrative reform process also involves the permanent monitoring of the efficiency of organizational processes. Enos states in this regard that: ,,Organizations must continuously evaluate their processes to ensure their efficiency."[50]

In the life of ecclesial communities, this evaluation can concern the administrative structures, the way in which pastoral activities are organized or the mechanisms of communication between the leadership and the community.

Reform initiatives must also be guided by clear objectives. Enos points out that: ,,Performance improvement initiatives are successful when leaders clearly define objectives and evaluation criteria."[51]

In the context of the Church, these objectives must be fundamentally oriented towards strengthening community life and making pastoral activities more effective.

Administrative reform also involves aligning institutional structures with organizational processes and available resources. In this regard, Robert D. Stueart and Barbara B. Moran point out that: ,,Change management involves aligning organizational structures, processes and resources."[52]

---

[49] Darryl D. Enos, *Performance Improvement*, 2007, p. 11.
[50] *Ibidem*, p. 26.
[51] *Ibidem*, p. 46.
[52] Robert D. Stueart, Barbara B. Moran, *Library and Information Center Management...*, p. 123.

Within ecclesial communities, this alignment contributes to the creation of a coherent organizational framework that supports pastoral activity.

Another important principle of administrative reform is the elimination of activities that do not bring value to the organization. Enos points out that: ,,Organizations improve their performance by eliminating unnecessary processes."[53]

Applied in an ecclesial context, this principle can lead to the simplification of certain administrative procedures and to the directing of resources towards activities with a real pastoral impact.

At the same time, the reform process involves identifying the activities that bring value to the community and their development. Enos observes that: ,,Leaders need to identify those activities that create value and develop them."[54]

In the life of the Church, these activities may include pastoral initiatives, educational programs, or social projects dedicated to the community.

Another key aspect of administrative reform is the ongoing process of organisational improvement. Enos states that: ,,Performance improvement is an ongoing process, not a singular intervention."[55]

This perspective highlights the fact that ecclesial administration must be open to constant reflection on its own practices and structures.

At the same time, administrative reform is closely linked to the organisational culture of the community. Warrick and Mueller emphasize that institutional changes only become sustainable when they are supported by cultural transformations: ,,Organizational reform requires both structural and cultural transformations."[56]

Therefore, the processes of administrative reform within ecclesial communities must be oriented not only towards organizational efficiency, but also towards strengthening the community culture and the spiritual values that define the identity of the Church.

Conclusions

The analysis highlights the fact that contemporary church administration must be understood as a complex process that combines the theological dimension of communion with the modern principles of institutional leadership and organization. The theology of the person and communion provides the spiritual foundation of ecclesial organization, while reflection on leadership, organizational culture, and strategic thinking contributes to the development of effective forms of pastoral leadership.

---

[53] Darryl D. Enos, *Performance Improvement...*, p. 58.
[54] *Ibidem*, pp. 72-73.
[55] *Ibidem*, p. 146.
[56] D. D. Warrick, Jens Mueller, *Lessons in Changing Cultures...*, p. 88.

The integration of concepts from management theory – such as strategic thinking, value innovation or the analysis of organizational processes – does not imply the secularization of ecclesial life, but offers useful tools for the more effective fulfilment of the Church's mission in contemporary society. In this regard, ecclesial administration is called to develop structures and practices that support community life, facilitate the participation of the faithful and contribute to the concrete manifestation of communion within the Church.

Bibliography

Andreopoulos, Andreas, și Demetrios Harper (eds.). *Christos Yannaras: Philosophy, Theology, Culture*. London: Bloomsbury Academic, 2019.

Athanasopoulos, Constantinos (ed.). *Orthodox Mysticism and Asceticism: Philosophy and Theology in St Gregory Palamas' Work*. Newcastle upon Tyne: Cambridge Scholars Publishing, 2020.

Crossan, Mary M., Michael J. Rouse, W. Glenn Rowe și Cara C. Maurer. *Strategic Analysis and Action*. Toronto: Pearson Education Canada, 2015.

Enos, Darryl D. *Performance Improvement*. San Francisco: Pfeiffer, 2007.

Harrison, E. Bruce, și Judith Mühlberg. *Leadership Communication: How Leaders Communicate and How Communicators Lead in Today's Global Enterprise*. New York: Business Expert Press, 2015.

Kerpen, Dave. *Likeable Leadership: A Collection of 65+ Inspirational Stories on Marketing, Your Career, Social Media & More*. New York: McGraw-Hill Education, 2019.

Lorange, Peter. *Leading in Turbulent Times: Lessons Learned and Implications for the Future*. Bingley: Emerald Publishing, 2010.

Mellor, Robert B., cu Gary Coulton, Anne Chick, Antonia Bifulco, Noha Mellor și Alan Fisher. *Entrepreneurship for Everyone*. London: SAGE Publications, 2009.

Owen, Jo. *How to Manage: The Definitive Guide to Effective Management*. Harlow: Pearson Education, 2009.

Pherson, Katherine Hibbs, și Randolph H. Pherson. *Critical Thinking for Strategic Intelligence*. Washington, DC: CQ Press / SAGE Publications, 2021.

Sonea, Cristian. *The Theology of Interchristian Dialogue. An introduction*. Cluj-Napoca: Cluj University Press, 2017.

Stăniloae, Dumitru. *Spirituality and communion in the Orthodox Liturgy*. Bucharest: Publishing House of the Biblical and Mission Institute of the Romanian Orthodox Church, 2004.

Stueart, Robert D., și Barbara B. Moran. *Library and Information Center Management*. Santa Barbara, CA: Libraries Unlimited, 2007.

Ware, Kallistos (Timothy Ware). *The Orthodox Church*. Traducere by Francisco García. Buenos Aires: Editorial Angela, 2006.

Warrick, D. D., și Jens Mueller. *Lessons in Changing Cultures*. Oxford: RossiSmith Academic Publications, 2015.

FROM EMIGRATION TO IMMIGRATION: AN INTERDISCIPLINARY STUDY OF MIGRATION AND THE INTEGRATION OF THE INDIAN COMMUNITY IN ROMANIA

Hilda-Hedvig Varga[1],
Cristina Coculescu[2]
Ana Maria Mihaela Iordache[3*]

Abstract

This paper aims to analyze the phenomenon of migration in Romania from an interdisciplinary perspective, integrating legal, sociological, and econometric dimensions. The qualitative component is based on an analysis of international, European, and national legislation in the field of migration, as well as on the specialized literature regarding the social integration of migrants. The quantitative component consists of applying a multiple linear regression model estimated using the ordinary least squares (OLS) method, utilizing immigration data to identify the relationships between the explanatory variables and the phenomenon under analysis. The analysis highlights Romania's transformation from a predominantly emigration-oriented country into a major destination for non-EU workers. The Indian community represents a relevant example of new migration flows and the challenges associated with social and professional integration. The results of the econometric model show that it explains approximately 85.8% of the variation in the analyzed phenomenon and is statistically significant overall, but only one of the explanatory variables has a significant individual impact. This study contributes to the academic literature by integrating legal, sociological, and econometric perspectives into a unified framework for analyzing migration and the integration of migrants in Romania.

Keywords: immigration, Romania, India, regression, discrimination, rights

JEL Classification: J15, J61, J71, K38, C21

1. Introduction

International migration is one of the major issues in contemporary law and international relations, as it brings into interaction the principles of freedom of movement, states' security needs, labour protection, and the social integration of individuals residing outside their country of origin. According to the International Organization for Migration, approximately 281 million people were living in a country other than that of their birth in 2020, confirming the global nature of this phenomenon (IOM, 2024).

[1] PhD at the Romanian - American University, Bucharest, hilda.hedvig.varga@rau.ro
[2] Professor at the Romanian - American University, Bucharest, cristina.coculescu@rau.ro
[3] Associate Professor at the Romanian - American University, Bucharest, mihaela.iordache@rau.ro
[*] Corresponding author

For Romania, this topic is particularly relevant, as the country has long been analysed almost exclusively through the lens of Romanian emigration, while over the past decade it has also become a destination for workers originating from outside the European Union (Breaz et al., 2024).

Romania is mainly a transit country in the context of migrant smuggling. According to the Council of Europe, Romanian prosecution offices registered 1,488 migrant smuggling cases in 2022. The number of DIICOT cases involving both migrant smuggling and organised criminal groups also increased, from 65 in 2019 to 152 in 2022 and 186 by the end of September 2023 (Council of Europe, 2024). Similarly, the Global Organized Crime Index notes that groups operating along Romania's western border have facilitated the movement of migrants from Asian countries, including India, Pakistan and Bangladesh, towards Western Europe. These groups are generally composed of both Romanian and foreign nationals, although most land-based facilitators are Romanian (Global Initiative Against Transnational Organized Crime, 2023).

The aim of this paper is to examine the evolution of migration in Romania by combining three perspectives: human rights and the applicable legal framework, the sociology of migration, and the integration of the Indian community. Given the marked diversity that characterizes India, the term Indian community will be used to avoid undermining the distinct socio-cultural, linguistic, and religious identities that coexist within this population (Bori, 2023). The heterogeneity of the Indian state cannot be adequately captured by expressions such as Hindi community, a common misconception arising from the frequent confusion between the terms Hindi, Hindu, and Hinduism. Hindi refers primarily to a language and a cultural reference point, rather than to a unified legal, ethnic, or national category (Chakravarty, 2020).

The research questions that this study seeks to address are:

RQ1. How has the phenomenon of migration evolved in Romania?

RQ2. Does Romania possess a sufficiently developed legal and institutional framework to protect the rights of migrants and to facilitate the integration of newly arrived communities?

The answers to these questions cannot be formulated solely through the enumeration of legal provisions, as the existence of legislation does not automatically guarantee its effective implementation. For this reason, the present research incorporates both international and European legal instruments, as well as recent institutional data concerning work authorization, legal residence, and the economic demand for foreign workers. The study adopts an interdisciplinary approach, combining qualitative and quantitative methods of analysis, as migration is not merely an administrative matter, but also a social process that reshapes the relationships among the majority, minority, employers, and public institutions.

2. Methodology

The research methodology employed in this study comprises the following stages:

Stage 1. Qualitative research based on the analysis of the legal framework and the relevant scholarly literature on migration.

Stage 2. Identification of the indicators considered most suitable for the quantitative analysis.

Stage 3. Quantitative research conducted through the statistical and econometric analysis of immigration-related data.

Stage 4. A case study examining the integration of the Indian community in Romania.

The indicators used in the empirical analysis, which, in the authors' view, most accurately characterize the migration phenomenon, are presented in Table 1.

Table no.1 Indicators Used in the Analysis

Indicator Code	Description of the Indicator
Y	Total number of immigrants
X_1	Total number of temporary male immigrants
X_2	Total number of temporary female immigrants
X_3	Total number of immigrants from other countries

The empirical analysis employs a multiple linear regression model to examine the relationship between the dependent variable (Y) and the three explanatory variables (X_1, X_2 and X_3) presented in Table 1. The model specification is given in Equation (1).

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \varepsilon_t \quad (1)$$

where:

Y_t – the value of the dependent variable Y observed at time t;

β_0 – the intercept (constant term) of the regression model;

β_1, β_2, β_3 – the regression coefficients associated with the explanatory variables;

ε_t – the random error term at time t;

X_{1t}, X_{2t}, X_{3t} – the values of the explanatory variables X_1, X_2, X_3 observed at time t;

t – the time considered in the analysis, taking values from 1 to 15.

3. Literature review

Migration may be broadly defined as the movement of an individual or a group from one territory to another, whether temporary or permanent, voluntary or forced. The definitions employed by the International Organization for Migration encompass both international and internal migration and do not

reduce the phenomenon to the legal status of the individual (IOM, 2024). This approach is particularly important for the analysis of human rights, as the protection of human dignity does not depend exclusively on the administrative form of residence. Nevertheless, from a legal perspective, the status of a migrant influences access to employment, social services, long-term residence, family reunification, and protection against removal (Arowolo, 2021).

The sociology of migration explains mobility through the interaction of structural causes and individual decision-making. The Push–pull theory suggests that migration is driven by both push factors, such as poverty, unemployment, and insecurity, and pull factors, including higher wages, political stability, and access to services (Urbański, 2022). While useful, this theory is incomplete when considered in isolation from its social context, as migration decisions are often shaped by family networks, informally transmitted information, and the experiences of previous migrants. In the case of Indian nationals migrating to Romania, income differentials, employment contracts, and the presence of recruitment agencies constitute key elements influencing migration decisions.

Castles and Miller described the contemporary period as the "age of migration," emphasizing that human mobility has become a permanent feature of the global economy rather than an exceptional phenomenon (Castles & Miller, 2009). This perspective is particularly relevant to Romania, where the importation of labour should not be viewed merely as a temporary solution to workforce shortages, but rather as part of a broader transformation of the European labour market. As the economically active population declines and sectors such as construction, transportation, and hospitality face increasing labour shortages, economic migration becomes an important mechanism for balancing labour supply and demand (Fayzullayev & Khalid, 2024).

Migrants' rights derive from the broader framework of universal human rights, which recognizes that fundamental protections belong to all people irrespective of nationality. The Universal Declaration of Human Rights enshrines core values, including dignity, liberty, equality, and the right to work, without restricting their application to citizens alone (United Nations, 1948). However, states maintain sovereign authority over immigration matters, including the admission and residence of foreign nationals. This dual reality gives rise to an ongoing legal and political tension between the sovereign interests of states and the imperative to ensure the protection of individual rights. Contemporary law seeks to balance these competing considerations through regulations governing visas, residence permits, working conditions, and safeguards against discriminatory or degrading treatment (Mattila, 2001).

The European Convention on Human Rights does not establish a general right for foreign nationals to enter a particular state; however, it imposes clear limitations regarding treatment, private life, family life, and non-discrimination

(Council of Europe, 1950). For migrants, these guarantees become particularly significant in cases involving expulsion, administrative detention, family separation, or arbitrary denial of services. The jurisprudence of the European Court of Human Rights has progressively shaped an indirect mechanism for the protection of foreign nationals, whereby states must examine both the proportionality of any restrictive action and its tangible consequences for the persons concerned (Sainato & Jewell, 2015).

The Charter of Fundamental Rights of the European Union prohibits discrimination on grounds such as race, colour, ethnic or social origin, language, religion, beliefs, membership of a national minority, and citizenship, within the framework established by the Treaties (De Witte, 2025; FRA, n.d.). This provision is directly relevant to workers from third countries, as discrimination may occur during recruitment, within employment relationships, in access to housing, or in interactions with public authorities. From a legal perspective, the issue extends beyond the mere existence of prejudice to include the victim's ability to demonstrate differential treatment and obtain effective redress.

The European Union has developed a regulatory framework that distinguishes yet interconnects legal migration, asylum, border management, and social integration. The Single Permit Directive (2011/98/EU) was adopted to create a more efficient procedure for granting residence and work authorization to third-country nationals and to ensure that legally employed non-EU nationals benefit from a common core of rights across EU Member States (European Union, 2011).

The significance of this Directive lies in its recognition of migrant workers not only as economic resources, but also as holders of minimum social rights. In practice, the effectiveness of its implementation must be assessed through the duration of administrative procedures, the transparency of requirements, and the actual accessibility of protection mechanisms in cases of abuse.

The European Commission's Action Plan on Integration and Inclusion 2021–2027 is based on the principle of "inclusion for all" and places particular emphasis on education, employment, healthcare, and housing (European Commission, 2020). Although the Plan does not replace the competences of Member States, it provides a policy framework for the integration of migrants and persons with a migrant background. For Romania, its relevance is twofold: it offers a European benchmark for policy development, while simultaneously demonstrating that integration cannot be reduced to the mere issuance of a work permit.

Eurostat data reveal that around 3.5 million initial residence permits were issued across the European Union to third-country nationals in 2024. Furthermore, statistics relating to residence and employment authorization schemes suggest that more than 4.6 million individuals secured legal access to

residence and labour markets through single-permit arrangements during the same period (Eurostat, 2025a; Eurostat, 2025b). These figures demonstrate that legal migration is not a marginal phenomenon, but rather a major administrative mechanism within the European Union. At the same time, the data reveal significant differences among Member States, reflecting variations in economic needs, administrative procedures, and institutional capacities.

Following 1990, Romania became primarily associated with the large-scale emigration of its own citizens. Romanian sociological research has shown that international migration evolved into a family strategy aimed at increasing income, acquiring housing, and improving social status (Sandu, 2010). This collective experience is relevant to understanding how Romanian society perceives newly arrived migrants. Although many Romanians are familiar, through their own families, with the challenges of working abroad, such familiarity does not automatically translate into solidarity with Asian or African workers arriving in Romania.

Romania's transformation into a destination country is closely linked to labour shortages and demographic change. In 2025, Government Decision No. 10/2025 established a quota of 100,000 newly admitted foreign workers for the Romanian labour market (Government of Romania, 2025). This quota does not represent the total number of foreign nationals residing in Romania, but rather the administrative threshold applicable to a specific category of newly admitted workers. This distinction is important because public debates often conflate legally employed foreign workers, asylum seekers, international students, and individuals residing under other legal statuses.

4. Results

The indicators used in the empirical analysis were obtained from the TEMPO database maintained by the Romanian National Institute of Statistics and cover the period 2010–2024 (Table 2).

Table no.2 The values of the indicators used in the empirical analysis

year	Y	X_1	X_2	X_3
2010	7059	85486	64399	2551
2011	15538	83931	63754	3862
2012	21684	94047	73219	3077
2013	23897	84790	68856	1467
2014	36644	70841	65194	13687
2015	23093	73670	59125	4895
2016	27863	79387	58068	6187
2017	50199	101036	76399	12013
2018	65678	98271	74307	16989

2019	64479	117643	84779	16887
2020	32250	83727	61792	7807
2021	49769	113914	80728	10947
2022	54839	168215	124809	22437
2023	29830	213594	110497	15569
2024	28431	184932	101606	16592

A preliminary analysis of Table 2 indicates that the total number of immigrants increased from 7,059 in 2010 to a peak of 65,678 in 2018. Following this peak, the figures remained relatively high in 2019 (64,479) before declining sharply in 2020 (32,250), largely because of the COVID-19 pandemic. After a temporary rebound in immigration observed in 2021 and 2022, when the number of incoming migrants increased to 49,769 and 54,839, respectively, a renewed downward trend emerged. Consequently, immigration levels fell below 30,000 in both 2023 and 2024.

A substantial increase in the temporary immigrant population was observed during the study period, from 149,885 individuals (85,486 men and 64,399 women) in 2010 to 286,538 individuals (184,932 men and 101,606 women) in 2024. Regarding the gender distribution of temporary immigrants, men constituted the majority throughout the entire period under analysis. The gender gap widened after 2021, suggesting a significant increase in labour migration directed toward sectors traditionally characterized by a predominantly male workforce.

As for immigrants originating from other countries, their number rose from 2,551 in 2010 to a peak of 22,437 in 2022. Although the figures declined slightly after 2022, they remained substantially higher than those recorded during the 2010–2017 period.

The multiple regression analysis was conducted using SAS Enterprise Guide. The results reveal a coefficient of determination (R^2) of 0.7505, indicating that approximately 75.05% of the variability in the dependent variable can be attributed to the combined influence of the explanatory variables included in the model. Furthermore, the adjusted coefficient of determination (Adjusted $R^2 = 0.6825$) remains relatively high, demonstrating that the model maintains substantial explanatory capacity even after adjusting for the number of predictors.

The modest gap between R^2 and Adjusted R^2 suggests that the independent variables contribute meaningfully to the explanation of the dependent variable and that the model is not excessively complex. There is limited evidence of overfitting, supporting the robustness and adequacy of the specified regression model. Consequently, the model can be considered to possess a satisfactory level of explanatory capacity for the phenomenon under investigation.

The overall significance of the model was assessed using the Fisher F-test. The value of the F-statistic is 11.03, with an associated probability of p = 0.0012, which is substantially lower than the conventional significance threshold of 5%. Therefore, the null hypothesis that all regression coefficients are simultaneously equal to zero is rejected.

These results indicate that the model is statistically significant and that at least one of the explanatory variables exerts a statistically significant influence on the dependent variable. Equation (2) presents the estimated regression model

$$Y = 22648 - 0.26563X_1 + 0.15963X_2 + 2.86757X_3 \quad (2)$$

The estimated coefficient for variable X_1 is negative (−0.26563), suggesting the existence of an inverse relationship between X_1 and Y. Thus, holding all other explanatory variables constant, a one-unit increase in X_1 leads, on average, to a decrease of approximately 0.266 units in the estimated value of Y. The associated t-test yields the p-value was 0.1266, which is greater than the commonly accepted significance level of 0.05. So, there is insufficient statistical evidence to conclude that the effect of X_1 on the dependent variable is statistically significant.

The estimated coefficient for X_2 is positive (0.15963), indicating a direct relationship between this variable and Y. However, the associated p-value is 0.7069, which is substantially higher than the 5% significance level. Therefore, the influence of X_2 on the dependent variable is not statistically significant, and the results do not support the existence of a systematic relationship between X_2 and Y.

The estimated coefficient for X_3 is positive and relatively large (2.86757), indicating that a one-unit increase in X_3 is associated, on average, with an increase of approximately 2.87 units in Y, ceteris paribus. The associated p-value is 0.0010, well below the 5% significance threshold, demonstrating that the effect of X_3 is both strong and statistically significant. Therefore, X_3 represents the principal explanatory factor of the dependent variable within the regression model.

To assess the relative contribution of the explanatory variables, the standardized Beta coefficients were examined. The results indicate the following values: β(x1) = −0.655, β(X_2) = 0.180, and β(x3) = 1.062. The largest standardized coefficient corresponds to X_3, confirming that this variable exerts the strongest influence on Y. By contrast, X_2 makes only a limited contribution, and its effect is practically negligible when compared with that of X_3.

To identify potential multicollinearity issues among the explanatory variables, Variance Inflation Factor (VIF) values were calculated for each independent variable: VIF(X_1) = 6.93, VIF(X_2) = 9.54, and VIF(x3) = 2.52. VIF values greater than 5 indicate potential multicollinearity concerns, while values close to or exceeding 10 suggest severe multicollinearity. The results indicate

that X_1 and X_2 exhibit relatively high levels of multicollinearity, which may lead to instability in the estimated coefficients and reduce the individual statistical significance of the predictors. In contrast, X_3 does not raise concerns from this perspective. This conclusion is further supported by the Condition Index, whose maximum value is 29.94, very close to the threshold of 30 commonly associated with severe multicollinearity.

The assumption of homoscedasticity was tested using a Chi-square test, which produced a statistic of 8.37 with an associated p-value of 0.4973. Since the p-value is substantially greater than 0.05, the null hypothesis of constant variance cannot be rejected. Therefore, there is no statistical evidence of heteroscedasticity in the model.

The independence of residuals was assessed using the Durbin–Watson statistic, which has a value of 1.807, very close to the ideal value of 2, while the first-order autocorrelation coefficient is only 0.010. These results indicate the absence of serial autocorrelation among the residuals and confirm that the assumption of error independence is satisfied.

The examination of standardized residuals revealed a maximum value of approximately −2.39. In statistical literature, observations are generally considered potential outliers when studentized residuals exceed the threshold of ±3 in absolute value. Accordingly, none of the observations exceeds this threshold, suggesting the absence of extreme observations that could significantly influence the estimation results.

In conclusion, the estimated multiple linear regression model is statistically valid and exhibits substantial explanatory power, accounting for approximately 75% of the variation in the dependent variable. The Fisher test confirms the overall significance of the model, while the diagnostic tests indicate no evidence of heteroscedasticity or autocorrelation. The analysis of the individual coefficients shows that only X_3 exerts a statistically significant influence on the dependent variable. Variables X_1 and X_2 are not statistically significant, and the relatively high VIF values suggest the presence of potential multicollinearity issues between these predictors.

The legal status of foreign nationals in Romania is primarily governed by Emergency Ordinance No. 194/2002, which establishes the conditions for entry, residence, and departure, as well as the rights and obligations of foreign citizens residing in the country (Government of Romania, 2002). This legislative act is of fundamental importance because it translates migration policy into concrete administrative procedures, including visa issuance, residence permits, extensions of residence rights, termination of lawful stay, and removal measures.

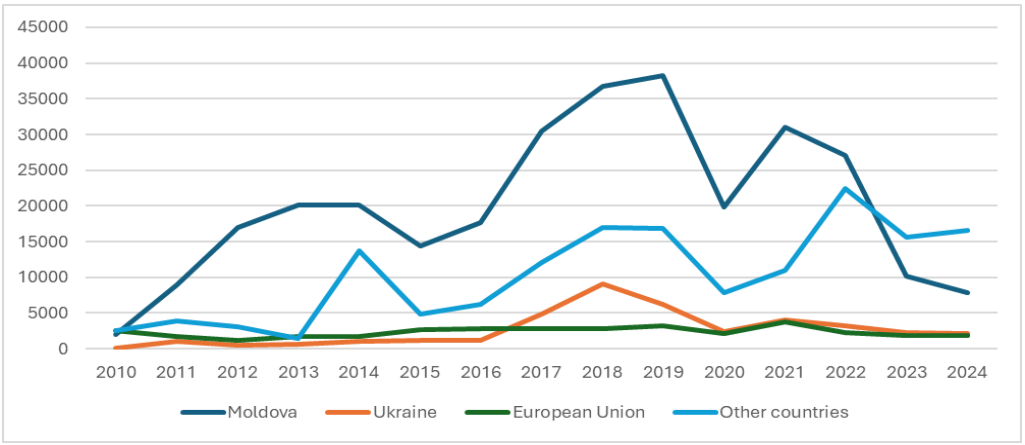


Figure 1. Evolution of the Number of Immigrants in Romania, 2010–2024.

Source: Authors' elaboration based on data from the Romanian National Institute of Statistics.

During the period 2010–2024, migration to Romania (Figure 1) exhibited distinct patterns depending on the migrants' region of origin. The Republic of Moldova emerged as the leading source country of immigrants for most of the study period. The volume of immigrants originating from Moldova exhibited a marked upward trend, growing from 1,973 persons in 2010 to 20,125 persons in 2014. This increase was followed by a downward adjustment, with the number of immigrants decreasing to 14,340 in 2015. Subsequently, the migration flow resumed an upward trajectory, reaching a peak of 38,205 individuals in 2019. Thereafter, significant fluctuations were observed, with the number decreasing to 19,912 in 2020, increasing to 31,041 in 2021, and then declining continuously to 7,891 individuals in 2024.

About immigration from Ukraine, the figures remained relatively low between 2010 and 2016, ranging from 39 to 1,221 individuals. Beginning in 2017, the number of immigrants increased substantially, reaching 4,850 persons, while the highest value of the analysed period was recorded in 2018, with 9,040 immigrants. Following this peak, the number of Ukrainian immigrants gradually declined, reaching 2,154 individuals in 2024.

Immigration originating from Member States of the European Union was characterized by a relatively stable pattern throughout the period under review. The number of immigrants remained within a relatively narrow range, varying from 1,184 to 3,775 individuals and displaying considerably less volatility than the other categories examined. A peak was observed in 2021, when immigration from European Union Member States reached 3,775 persons. Subsequently, this figure declined, falling to 1,794 individuals by 2024.

The category of "other countries" exhibited the highest degree of variability after the Republic of Moldova. Following a decline to 1,467 immigrants in 2013, a substantial increase was recorded in 2014, when the number reached 13,687 individuals. In the following years, the figures continued to fluctuate, reaching 16,989 immigrants in 2018 and 16,887 in 2019. After declining to 7,807 individuals in 2020, the number of immigrants from other countries increased to a peak of 22,437 in 2022. During the final two years of the analysed period, this category accounted for 15,569 individuals in 2023 and 16,592 in 2024.

An examination of immigration patterns over the 2010–2024 period highlights the Republic of Moldova as the leading country of origin for migrants arriving in Romania during most of the years analysed. Nevertheless, a notable shift occurred in 2023 and 2024, when the aggregated category of "other countries" exceeded the number of immigrants originating from the Republic of Moldova and became the most significant source of immigration. The findings further suggest that migration flows from EU Member States remained relatively consistent throughout the period, exhibiting only limited variation. In contrast, immigration from the Republic of Moldova and from the group classified as "other countries" experienced considerably greater volatility, with substantial year-to-year changes.

From a cumulative perspective, the data for the entire 2010–2024 interval confirm the dominant contribution of the Republic of Moldova to Romania's immigration inflows. The second-largest share was represented by immigrants from other countries, whereas migrants arriving from Ukraine and EU Member States constituted comparatively smaller proportions of the overall immigrant population.

From an employment perspective, an important feature of the Romanian legal framework is that the work authorization is generally obtained by the employer rather than by the foreign worker. Euraxess Romania specifies that the work permit application is submitted by the employer, while the foreign worker is required to retain a certified copy of either the employment authorization or the residence permit issued for employment purposes (Euraxess Romania, n.d.). This procedural structure may create a degree of dependency on the employer, particularly when the worker lacks proficiency in the Romanian language, has limited understanding of administrative procedures, or does not have access to independent legal assistance (Gavriș, 2024; Hlaciuc & Rata, 2018).

Legal protection extends beyond the right of residence. The Labour Code, occupational health and safety regulations, anti-discrimination legislation, and wage protection rules apply equally to foreign workers who are legally employed in Romania. Vulnerability arises when migrants are unable to distinguish between the promises made by recruitment agencies, the contractual

obligations agreed upon in Romania, and the rights guaranteed under labour legislation. Consequently, effective protection requires the provision of multilingual information, labour inspections, and close cooperation among immigration authorities, territorial labour inspectorates, and civil society organizations (Toshpo‘Latov, 2024).

5. Discussion

The Indian community in Romania is highly diverse and cannot be reduced to a single religious, linguistic, or professional identity. Indian nationals residing in Romania come from different social backgrounds and are engaged in a wide range of economic activities, including construction, manufacturing, hospitality, information technology, entrepreneurship, and higher education. This diversity demands avoiding generalizations and distinguishing between citizenship, language, religion, regional identity, and professional status (Kaur, 2024).

The presence of Indian workers in Romania should be understood within the broader context of South Asian migration to Central and Eastern Europe. The increasing number of workers from India and other South Asian countries is closely associated with labour shortages resulting from the emigration of Romanian citizens and the ageing of the population. Journalistic accounts provide valuable insights into migrants’ living conditions, recruitment processes, and adaptation experiences (Crețulescu, 2024).

Social integration is a multidimensional process encompassing housing, employment, education, healthcare, civic participation, and cultural recognition. The European Action Plan on Integration and Inclusion 2021–2027 emphasizes the importance of access to education, employment, healthcare services, and housing (European Commission, 2020). In Romania, economic integration is often achieved more rapidly than social integration. While an employment contract may provide financial stability, it does not automatically ensure awareness of rights, community participation, or the development of stable social relationships. Integration also has a cultural dimension, reflected in the establishment of restaurants, retail businesses, cultural and religious events, and informal support networks. These mechanisms contribute to preserving cultural identity and reducing the psychological costs associated with relocation.

Language constitutes one of the principal barriers to integration. Limited proficiency in Romanian restricts access to public services and may increase migrants’ dependence on intermediaries. Although English facilitates certain interactions, it does not fully address communication challenges related to public administration, healthcare services, or the housing market. Romanian language courses, translated informative materials, and culturally sensitive legal counselling therefore represent important instruments for promoting successful integration.

Discrimination may take either direct or indirect forms. Direct discrimination involves less favourable treatment because of origin, religion, language, or skin colour. Indirect discrimination may arise from seemingly neutral rules that disproportionately affect certain groups. The Charter of Fundamental Rights of the European Union and Romanian anti-discrimination legislation provide mechanisms of protection; however, their effectiveness depends largely on awareness and accessibility (FRA, n.d.; Gherghina, 2020).

Labor exploitation constitutes one of the principal vulnerabilities associated with economic migration. The risk increases when workers incur substantial recruitment costs, reside in employer-controlled accommodation, or lack knowledge of local institutions and legal protections. International standards on decent work seek to prevent such situations (ILO, 2014). The prevention of labour exploitation depends on comprehensive regulatory monitoring of contractual employment conditions, wage compliance, accommodation quality, and working-hour practices, complemented by effective and accessible mechanisms for reporting abuses.

From a strictly organised crime perspective, cases in which Indian nationals are explicitly mentioned as suspects or organisers remain relatively limited. In 2008, the Romanian Border Police announced the dismantling of an illegal migration network operating on the India–Russia–Romania–Italy route, whose leader was identified as an Indian national and was supported by two Romanian citizens (Romanian Border Police, 2008). Another significant case occurred in 2021, when Romanian authorities reported the taking down of an organised criminal group composed of Romanian and Indian nationals, suspected of facilitating the movement of Indian migrants to Portugal, Italy and Germany. Europol referred to the same case, noting that migrants allegedly paid between EUR 5,000 and 6,000 for transportation (Europol, 2021; Romanian Border Police, 2021). In 2022, the Timișoara Border Police reported another case in which two Indian nationals, K.A. and S.J., were suspected of sheltering fellow nationals and assisting them in illegally crossing the border (Romanian Border Police, 2022).

From an economic perspective, migration plays a vital role in alleviating workforce shortages, promoting economic productivity, and increasing fiscal revenues through tax contributions. For the Indian community, contributions are evident through the occupation of positions experiencing labour deficits, the transfer of skills in sectors such as information technology and engineering, and the development of commercial activities with a cultural profile (Varma, 2020). At the social level, migration may generate exclusionary reactions in societies with limited experience of ethnic diversity; however, intercultural education and effective institutional communication can contribute to mitigating such attitudes.

Migration is also an important subject within the field of international relations. The recruitment of Indian workers in Romania is the outcome of transnational economic and political processes. The International Organization for Migration promotes safe, orderly, and regular migration through cooperation among states (IOM, 2024). The existence of an active Indian community can facilitate economic, academic, and cultural exchanges between Romania and India, while migrants' experiences contribute to shaping perceptions of the host country (Boangiu, 2024).

Public policies may pursue three principal objectives: informing migrants, supporting local integration, and monitoring recruitment and employment conditions. Information regarding rights, obligations, and working conditions should be accessible, including for individuals with limited literacy skills. Local integration may be supported through Romanian language courses, orientation centres, and partnerships with non-governmental organizations. Furthermore, monitoring employment and accommodation conditions can play an important role in preventing abuse and exploitation.

A responsible policy approach requires recognition of the diversity within the Indian community. Not all Indian nationals share the same language, religion, or migration objectives. Consequently, both public policies and academic research should avoid simplistic categorizations and consider the socio-cultural, linguistic, and religious diversity of this population (Debbarma, 2025; Zieliński, 2021).

The right to health is particularly important for migrants, both in relation to the physical risks associated with certain occupations and regarding mental well-being. Cultural, linguistic, and social adjustment challenges may intensify feelings of alienation and emotional distress (Martin et al., 1999). Access to healthcare services depends not only on legal entitlement, but also on an individual's understanding of administrative procedures and ability to communicate effectively with healthcare professionals (Section & (Eupha-MH), 2025; Sangaramoorthy & Carney, 2021). Family separation represents another major challenge for migrant workers, as prolonged distance from relatives may have significant emotional and psychological consequences (Knipe et al., 2019).

6. Conclusion

Migration in Romania can no longer be analysed exclusively through the lens of emigration; it must also be understood as a process of legal immigration involving workers from third countries. The increasing quotas for foreign workers and the growing presence of Asian communities indicate a structural transformation in Romania's migration profile. The Indian community exemplifies the relationship between economic migration, social rights, and integration. From a legal perspective, Indian nationals lawfully residing in

Romania benefit from fundamental and social rights, while their successful integration depends on access to language acquisition, housing, public institutions, and non-discriminatory treatment.

Existing legislative instruments, including Government Emergency Ordinance No. 194/2002, Directive 2011/98/EU, and the Charter of Fundamental Rights of the European Union, establish a solid legal basis for the protection of rights. Nevertheless, the effectiveness of these norms depends largely on their implementation at the national and local levels. Where information dissemination is inadequate, labour inspections are insufficient, or integration support services are underdeveloped, the practical enjoyment of these rights may be significantly constrained despite their formal legal recognition. Workplace integration constitutes the first stage of broader social integration, and measures such as anti-discrimination training and accessible communication strategies can help reduce migrants' vulnerabilities.

The institutional sources examined do not support the view that the Indian community in Romania can be treated as a collective actor in organized crime. The available data point only to isolated cases in which Indian nationals appear either as suspects, migrants, or beneficiaries of smuggling networks. Therefore, a rigorous formulation should distinguish between the individual involvement of persons of Indian nationality and the unjustified attribution of criminal behavior to an entire community.

The limitations of this research stem primarily from the lack of detailed public data concerning integration outcomes by nationality, economic sector, locality, and type of vulnerability. Data relating to work authorizations do not provide sufficient information regarding housing conditions, wages, access to healthcare, or experiences of discrimination. Future research should therefore employ aggregated and regularly updated datasets to assess both integration processes and the effectiveness of public policies. Furthermore, greater attention should be devoted to analysing institutional coordination among authorities responsible for immigration, employment, social services, and anti-discrimination measures.

References

Arowolo, G. 2021. Protecting the Rights of Migrants: The Challenges and the Prospects. Journal of Law, Policy and Globalization, 105. https://doi.org/10.7176/jlpg/105-12

Boangiu, G. 2024. International Migration of Romanians – Typologies and Social Development. Case Studies. Anuarul Institutului de Cercetări Socio-Umane „C.S. Nicolăescu-Plopșor", 2024, 175–187. https://doi.org/10.59277/csnpissh.2024.13

Bori, J. P. 2023. (Re) conceptualizing and Contextualizing 'Community' in Tribal/Indigenous Cultures and Development in India. The International

Journal of Community and Social Development, 5(1), 30–46. https://doi.org/10.1177/25166026221142696

Breaz, T. O., Trif, G., Ciolomic, I. A., Jaradat, M., & Cilan, T. F. 2024. Proceedings Of The 18th International Management Conference "Management in the Algorithmic Era: Harmonizing AI Mastery and Human Collaboration". The Socio-Economic Effects of Labor Migration in Romania. https://doi.org/10.24818/imc/2024/01.05

Castles, S., & Miller, M. J. 2009. The age of migration: International population movements in the modern world (4th ed.). Guilford Press.

Chakravarty, A. 2020. A Study on Migratory Population in India: Some Selected States. International Journal of Research - Granthaalayah, 8(6), 163–168. https://doi.org/10.29121/ granthaalayah.v8.i6.2020.444

Crețulescu, A. 2024. Long-Term Labor Force Projections in Romania: An Analysis Based on Data on the Economic Impact of Population Aging. Proceedings of the International Conference on Business Excellence, 18(1), 533–543. https://doi.org/10.2478/picbe-2024-0046

Council of Europe. 1950. Convention for the Protection of Human Rights and Fundamental Freedoms (European Convention on Human Rights). https://www.echr.coe.int/documents/d/echr/convention_ENG

Council of Europe, Committee on Crime Problems. 2024. Country factsheet – Smuggling of migrants: Legal and judicial information on migrant smuggling: Romania. Council of Europe.

De Witte, B. 2025. The EU Charter and anti-discrimination law (pp. 64–80). Edward Elgar. https://doi.org/10.4337/9781789906318.00011

Debbarma, M. 2025. Many Languages, One Nation: Navigating Linguistic Diversity in India. Journal of Research in Humanities and Social Science, 13(1), 228–245. https://doi.org/10.35629/9467-1301228245

Euraxess Romania. Work permit. Government of Romania. https://www.euraxess.gov.ro/romania/information-assistance/work-permit.

European Commission. 2020. *Action plan on integration and inclusion 2021–2027* (COM(2020) 758 final). Publications Office of the European Union. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0758

European Parliament & Council of the European Union. 2011. *Directive 2011/98/EU on a single application procedure for a single permit for third-country nationals to reside and work in the territory of a Member State and on a common set of rights for third-country workers legally residing in a Member State*. *Official Journal of the European Union, L 343*, 1–9. Retrieved from https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32011L0098

Europol. 2021. Gang smuggling Indian nationals busted in Romania. https://www.europol.europa.eu/media-press/newsroom/news/gang-smuggling-indian-nationals-busted-in-romania

Eurostat. 2025a. *Residence permits - statistics on first permits issued during the year*. European Commission. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Residence_permits_-_statistics_on_first_permits_issued_during_the_year

Eurostat. 2025. Residence permits – statistics on authorisations to reside and work. Statistics Explained. European Commission. https://ec.europa.eu/eurostat/statistics-explained/index.php/Residence_permits_%E2%80%93_statistics_on_authorisations_to_reside_and_work

European Union Agency for Fundamental Rights. *Charter of Fundamental Rights of the European Union, Article 21 – Non-discrimination*. FRA. https://fra.europa.eu/en/eu-charter/article/21-non-discrimination.

Fayzullayev, B. Z., & Khalid, D. S. 2024. Migration Dynamics: A Scientific Exploration of Modern Trends in International Labor Mobility. International Journal of Business, Law and Political Science, 1(9), 35–41. https://doi.org/10.61796/ijblps.v1i9.193

Gavriș, A. E. 2024. Labor through a Romanian temporary employment agent in opposition to illegal migration. Analele Universității Din Oradea. Seria: Relații Internaționale Și Studii Europene. https://doi.org/10.58603/dicm4497

Gherghina, S. 2020. Work and Stay: Explaining Perceived Discrimination Among Romanian Labor Migrants. Journal of International Migration and Integration, 22(3), 887–905. https://doi.org/10.1007/s12134-020-00777-y

Global Initiative Against Transnational Organized Crime. 2023. Global Organized Crime Index 2023: Romania. https://ocindex.net/assets/downloads/2023/english/ocindex_profile_romania_2023.pdf

Government of Romania. 2002. *Emergency Ordinance No. 194/2002 on the regime of foreigners in Romania* (republished and subsequently amended). Official Gazette of Romania. https://legislatie.just.ro/Public/DetaliiDocumentAfis/93712

Hlaciuc, E., & Rata, D. 2018. Comparative Analisys of Romanian and Eu Legislative Framework Regarding European Mobility of Workers. European Journal of Accounting Finance & Business, 6(1). https://doi.org/10.4316/ejafb.2018.613

General Inspectorate for Immigration. 2025. *Quota for the employment of foreign workers used at over 80%*. Ministry of Internal Affairs of Romania. https://igi.mai.gov.ro/contingentul-pentru-angajarea-strainilor-utilizat-in-proportie-de-peste-80/

International Labour Organization. 2014. *Fair migration: Setting an ILO agenda* (Report I(B), International Labour Conference, 103rd Session).

International Labour Office. https://www.ilo.org/resource/conference-paper/ilc/103/fair-migration-setting-ilo-agenda.

International Organization for Migration. 2024. *World migration report 2024*. International Organization for Migration. https://publications.iom.int/books/world-migration-report-2024.

Kaur, D. H. 2024. Diversity in India- A Challenge for Unity. Journal of Research in Humanities and Social Science, 12(10), 234–238. https://doi.org/10.35629/9467-1210234238

Knipe, D., Lambert, H., Pearson, M., Eddleston, M., Jayamanne, S., Wickramage, K., Hawton, K., Konradsen, F., Metcalfe, C., & Gunnell, D. 2019. Are left-behind families of migrant workers at increased risk of attempted suicide? \\u2013 a cohort study of 178,000+ individuals in Sri Lanka. BMC Psychiatry, 19(1), 25. https://doi.org/10.1186/s12888-018-2000-8

Martin, P., Ugalde, A., & Cardenas, G. 1999. Health and Social Services among International Labor Migrants: A Comparative Perspective. International Migration Review, 33(1), 208. https://doi.org/10.2307/2547335

Mattila, H. S. 2001. Protection of Migrants' Human Rights: Principles and Practice. International Migration, 38(6), 53–71. https://doi.org/10.1111/1468-2435.00142

Parija, S. 2021. A journey through the realms of the Great Indian Diaspora and India's diaspora engagement policy. Research Journal of Humanities and Social Sciences, 71–85. https://doi.org/10.52711/2321-5828.2021.00012

Romanian Border Police. 2008. Illegal migration network dismantled by Bihor border police officers. https://www.politiadefrontiera.ro/ro/main/i-retea-de-migratie-ilegala-destructurata-de-politistii-de-frontiera-bihoreni-1951.html

Romanian Border Police. 2021. Organized criminal group made up of Romanian and Indian citizens dismantled. https://www.politiadefrontiera.ro/ro/main/i-grup-infractional-organizat-format-din-cetateni-romani-si-indieni-destructurat-22739.html

Romanian Border Police. 2022. Indian citizens involved in migrant smuggling detected by Timișoara border police officers. https://www.politiadefrontiera.ro/ro/timisoara/i-cetateni-indieni-implicati-in-traficul-de-migranti-depistati-de-politistii-de-frontiera-timiseni-28385.html

Sainato, V. A., & Jewell, P. 2015. European Court of Human Rights. The Encyclopedia of Crime and Punishment, 1–6. https://doi.org/10.1002/9781118519639.wbecpx279

Sandu, D. 2010. *The social worlds of Romanian migration abroad* (*Lumile sociale ale migrației românești în străinătate*). Iași, Romania: Polirom

Sangaramoorthy, T., & Carney, M. A. 2021. Immigration, Mental Health and Psychosocial Well-being. Medical Anthropology, 40(7), 591–597. https://doi.org/10.1080/01459740.2021.1931174

Section, O., & (Eupha-Pmh), C. 2025. 1.N. Scientific session: Mental health among migrant communities: challenges, community responses and innovative pathways. The European Journal of Public Health, 35(Suppl 4). https://doi.org/10.1093/eurpub/ckaf161.068

Toshpo‘Latov, D. 2024. The Role of International Organizations in Protecting the Rights of International Labor Migrants. International Journal of Law and Criminology, 4(11), 17–22. https://doi.org/10.37547/ijlc/volume04issue11-03

United Nations. 1948. *Universal Declaration of Human Rights*. United Nations. https://www.un.org/en/about-us/universal-declaration-of-human-rights

Urbański, M. 2022. Comparing Push and Pull Factors Affecting Migration. Economies, 10(1), 21. https://doi.org/10.3390/economies10010021

Varma, N. S. 2020. Indian Diaspora: Analysis Of Its Advantage to The Home Country and To the World. International Review of Business and Economics, 4(2), 433–439. https://doi.org/10.56902/irbe.2020.4.2.2

Zieliński, J. 2021. Language as an Interstate Migration Barrier – The Interesting Case of India. Eastern European Journal of Transnational Relations, 5(1), 29–38. https://doi.org/10.15290/eejtr.2021.05.01.03

THE SPATIAL LAYOUT OF BANK LOCATIONS AND INDUSTRIAL CLUSTERS IN THE KANTO REGION IN 1905: A QUANTITATIVE ANALYSIS USING VORONOI DIAGRAMS AND MS-SSIM

Yuki Yasaku,
Nobumichi Watahiki,
Cristian Vlad[*]

Abstract

This study aims to elucidate the spatial relationships between banks—which functioned as financial pumps circulating capital into various industries—and administrative boundaries or natural geographic features, and to examine how their distribution related to the spatial structure of industrial clusters. The authors analysed the development of industrial clusters in Japan at the beginning of the 20th century, indicating that the locations of early financial institutions served as important indicators reflecting the realities of regional economic activities and their networks.

Keywords: clusters, industrial, space, development, banking, urban, talent, governance, management, Japan, innovation, emotion, transformation

JEL classification: L60, L63, M14

1. Introduction

In 1905, Japan was undergoing a significant historical transition, as the conclusion of the Russo-Japanese War marked the acceleration of industrialization and urbanization alongside the development of the modern nation-state system. During this period, the establishment of small and medium-sized banks proliferated even in regional areas, gradually expanding the financial infrastructure across the country (Okazaki, 2005). Simultaneously, as transportation methods shifted from river shipping to railways, natural geographic conditions such as terrain and waterways played a major role in shaping the economic networks that connected cities and rural regions.

Against this backdrop, the locations of banks serve as important indicators that reflect the realities of regional economic activities and their networks. In particular, local banks established during the Meiji period were often founded by local merchants and entrepreneurs, demonstrating strong ties with the local economy. These banks are thus valuable for understanding the initial conditions

[*] Yuki Yasaku is at Nagaoka University of Technology.
Nobumichi Watahiki Professor at Nagaoka University of Technology
Cristian Vlad is a Ph.D. Candidate at Babes Bolyai University Globis University Partner Faculty.

of economic agglomeration. Accordingly, this study seeks to clarify the spatial distribution of banks in relation to institutional and geographic structures.

Examining the spatial correspondence between bank locations, administrative divisions, and natural geography is essential for interpreting the formation of regional economies during this period. Banks were not merely financial infrastructures; they were central to economic activities closely connected with commerce, logistics, and administration. Their placement thus serves as a key to visualizing the spatial structure and developmental stage of local economies. This study analyzes how natural geographic factors—such as major river basins and the boundaries between mountainous and flatlands—and institutional factors—such as cities and counties—influenced the placement of banks, testing the hypothesis that their locations were shaped by these institutional and geographic structures.

Previous studies have primarily focused on qualitative analyses of modern clusters, such as Silicon Valley (Porter, 1998), or spatial economic theories based on mathematical models (e.g., Krugman, 1991). Few studies have empirically examined the relationship between geographic conditions and industrial agglomeration using historical data. However, Yoshizu (1978) demonstrated that bank locations during the Meiji period were concentrated in commercial centers and strategic points of transportation and administration, suggesting spatial consistency between bank distribution and the regional central place hierarchy. Building on this discussion, the present study reexamines the spatial characteristics of bank locations through quantitative analysis.

Specifically, Voronoi diagrams are generated based on the locations of banks in 1905 and are overlaid with contemporary administrative boundaries and natural geographic features (such as water systems and elevation). The structural consistency between these layers is then quantified using the Multi-Scale Structural Similarity Index (MS-SSIM), a metric for image similarity. This approach enables the study to uncover the spatial order of bank locations based on quantitative evidence, rather than relying on visual impressions alone.

Ultimately, this research aims to clarify the mechanisms of economic formation grounded in institutional and geographic structures from a historical perspective.

2. Study Scope and Period

2.1. Target Region

This study focuses on the Kanto region of Japan as it existed in 1905. The Kanto region encompasses the largest plain in Japan—the Kanto Plain—and is characterized by a complex interplay of plains, hills, and mountainous terrain. Even during the Meiji era, the region had a well-developed network of railways and river transport routes, with Tokyo emerging as the nation's political and economic center.

The analysis covers seven prefectures: Tokyo, Kanagawa, Chiba, Saitama, Ibaraki, Tochigi, and Gunma. These areas include the Tone River, which has the largest watershed in Japan, along with other major Class A rivers, and the massive consumer market of Tokyo. In the Meiji period, these prefectures served as critical hubs of industry and distribution. In northern Kanto—specifically Gunma, Tochigi, and Ibaraki—textile and warehousing industries flourished. Meanwhile, Kanagawa Prefecture conducted outward-facing trade through Yokohama Port, and Tokyo experienced rapid urbanization and the concentration of banking institutions.

2.2. Target Period of Analysis

Under these circumstances, the location of banks was not merely a matter of establishing financial infrastructure, but became a crucial factor in driving regional economic growth. Yoshino & Taghizadeh-Hesary (2018) demonstrated that the density of banks is a decisive factor influencing economic growth, suggesting that clarifying the spatial arrangement of banks is essential for understanding the structural foundations of economic development at the time.

Yoshizu (1978) showed that the establishment of banks during the Meiji era tended to concentrate in commercial centers and strategic nodes of transportation and administration—locations that correspond to upper hierarchical levels in central place theory. In the Kanto region, these "central places" often overlapped with junctions of railway and river transportation networks, indicating that institutional and logistical factors played a significant role in shaping bank locations.

Furthermore, during this period, Japan was transitioning from river to rail transport, and the spatial overlap between transport and financial infrastructure became increasingly evident. In particular, the year 1905 marked a turning point in industrial policy following the end of the Russo-Japanese War. The number of banks nationwide was increasing, and local financial networks led by small institutions were actively forming.

According to Okazaki (2005), even before the financial panic of 1907, regional banks were undergoing mergers aimed at rationalizing management and increasing capital, especially in northern Kanto. Around the same time, a boom in company formation occurred, and local financial institutions played a vital role as providers of startup capital.

Taken together, these observations suggest that bank locations were not merely the result of economic activity, but may have functioned as a "precondition" that shaped the structure of regional economies.

In this study, bank locations in the seven prefectures as of 1905 are identified, and their distribution is analyzed in relation to geographical features (e.g., mountainous and flat areas) and hydrological systems. In addition, the degree of spatial alignment with administrative boundaries is measured to elucidate the relationship between bank distribution and industrial clustering from a spatial perspective.

3. Methodology

3.1. Data Sources

To clarify the spatial distribution of banks in the Kanto region and their relationships with topography and administrative boundaries, this study utilized a range of official documents and geospatial datasets. The location data for banks were extracted from the *Directory of Executives of Companies Nationwide in Japan (1905)*. Bank names and addresses listed therein were converted into latitude and longitude coordinates and geocoded using GIS software.

For topographic data, elevation information provided by the Geospatial Information Authority of Japan was used. Areas were classified into plains and mountainous zones using an elevation threshold of 500 meters. This classification follows criteria adopted by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and previous studies in geography. Regarding river systems, spatial data for Class A rivers were obtained from the National Land Numerical Information database (MLIT) to visualize waterborne transportation routes at the time.

In addition, historical administrative boundaries at the county (郡) level during the Meiji period were reconstructed and digitized within a GIS environment. This allowed the study to capture structural characteristics that would be overlooked by relying solely on modern administrative units.

For the reconstruction of administrative divisions, the "Historical Administrative Boundary Dataset (Beta Version)" was employed. This dataset provides map-based information reflecting the city, town, and village system established in 1889, enabling precise GIS-based recreation of county-level administrative structures of the period.

3.2 Analytical Procedure

The analytical procedure in this study is composed of two stages. First, Voronoi diagrams were generated using bank coordinates as seed points. A Voronoi diagram partitions a space into regions where each region corresponds to the area closest to a given point, making it an appropriate method for visually analyzing the service coverage or spheres of influence of banks. The generated Voronoi regions were overlaid with geographic layers—such as the plains and mountainous classification, hydrological networks, and administrative boundaries—to examine the spatial relationships between bank locations and natural or institutional features. The generation of diagrams followed the method described by Matoschek (2002).

Second, to quantitatively evaluate the spatial similarity between the Voronoi diagrams and administrative boundaries, the Multi-Scale Structural Similarity Index (MS-SSIM) was employed. Originally proposed by Wang et al. (2003), MS-SSIM compares the structural, luminance, and contrast features of images across multiple scales, offering human-perception-aligned assessments of structural consistency.

The appropriateness of MS-SSIM for this study was confirmed from several perspectives. First, map data inevitably involve scaling, rotation, or distortion. MS-SSIM is robust against such transformations. In contrast, traditional metrics such as Intersection over Union (IoU), pixel matching rate, or Dice coefficient are primarily designed for comparing binary images and are less suitable for quantifying structural consistency when dealing with subtle boundary shifts or continuous gradations. Particularly in this study—where complex shapes based on Meiji-era bank locations and administrative boundaries are analyzed—comprehending overall structural integrity is more important than exact pixel-level matches. MS-SSIM excels in this regard due to its multi-level structural evaluation capability.

To demonstrate the superiority of MS-SSIM over conventional similarity metrics, a comparative table is presented below (Table 1).

Table 1: Comparison of Spatial Similarity Metrics – Characteristics of MS-SSIM vs. Traditional Methods

Metric	**Characteristics**	**Advantages**	**Disadvantages**	**Suitability for Spatial Structure Comparison**
MS-SSIM	Multi-scale comparison of structure, luminance, and contrast	Strong for hierarchical structure analysis; robust to scale/rotation	Requires specialized understanding; interpretation is context-dependent	Very High
IoU	Measures area overlap (Intersection over Union)	Simple and intuitive; suited for binary mask comparisons	Sensitive to minor boundary shifts; cannot handle gradations	Rather Low
Dice Coefficient	Symmetric area overlap index similar to IoU	Effective in medical imaging; good for small objects	Weak at capturing geometric differences	Rather Low
PSNR	Pixel-value-based image quality metric	Extremely fast and simple	Ignores structure/luminance; misaligned with visual relevance	Low
Pixel Match Rate	Ratio of matching pixel values	Simplest to compute	Extremely fragile to translation or deformation	Low

As shown in Table 1, each metric has its strengths and weaknesses depending on the nature of the image and the evaluation goal. MS-SSIM stands out in its ability to evaluate structural features across scales. While IoU and Dice coefficients are useful for comparing binary regions, they are limited in addressing subtle structural discrepancies. Simpler metrics like PSNR and pixel match rate are particularly vulnerable to distortions common in map data, such as scaling, rotation, or warping. In contrast, MS-SSIM offers high robustness

and reliability for real-world spatial comparisons, establishing its superiority in terms of accuracy, applicability, and resilience.

Furthermore, MS-SSIM has been increasingly applied in urban growth modeling (Zhang & Du, 2016) and regional spatial comparisons (Hagenauer & Helbich, 2012), confirming its relevance in urban planning and GIS-based research. Incorporating such precedent strengthens both the methodological rigor and empirical foundation of this study.

Practically, the Voronoi and administrative maps were standardized to a resolution of 224×224 pixels and converted into grayscale using OpenCV. This resolution was chosen as a common standard in image recognition and geospatial analysis, balancing structural detail retention and computational efficiency. Bicubic interpolation was used to maintain aspect ratios and minimize structural distortion during conversion. Furthermore, consistency across resolutions was verified by executing MS-SSIM at multiple resolutions, with no significant variation in scores observed.

Pixel values were normalized to the [0,1] range, and the ms_ssim() function from the PyTorch library was used to compute scores for each region. These scores ranged from 0 to 1, with scores above 0.8 interpreted as indicating high structural similarity.

To rule out the possibility that high MS-SSIM scores were due to chance, a Monte Carlo test was conducted. In this procedure, for each prefecture, Voronoi-administrative map pairs were randomly sampled from other prefectures to generate 1,000 synthetic pairs. MS-SSIM scores were then calculated for each pair. The probability of obtaining a score equal to or greater than the observed value was taken as the p-value.

Statistical significance was set at $p < 0.05$. Score generation and random sampling were conducted using consistent parameters within the PyTorch ms_ssim() function. The choice of 1,000 iterations follows precedent in prior studies such as Zhang & Du (2016), ensuring reproducibility and computational efficiency.

Through the introduction of the Monte Carlo test, the study provides quantitative evidence that the structural similarity between bank Voronoi regions and administrative boundaries is not a result of visual impression or random coincidence, but reflects a statistically significant spatial correspondence.

4 Results

4.1 Spatial Consistency between Bank Locations and Administrative Boundaries

4.1.1 Visual Correspondence

A Voronoi diagram was created based on bank locations in the Kanto region as of 1905, and this was overlaid with county-level administrative boundaries of the same period for visual examination of their spatial correspondence (see Figure 1). Additionally, topographic features were considered by classifying the region into mountainous and plain areas using an elevation threshold of 500 meters.

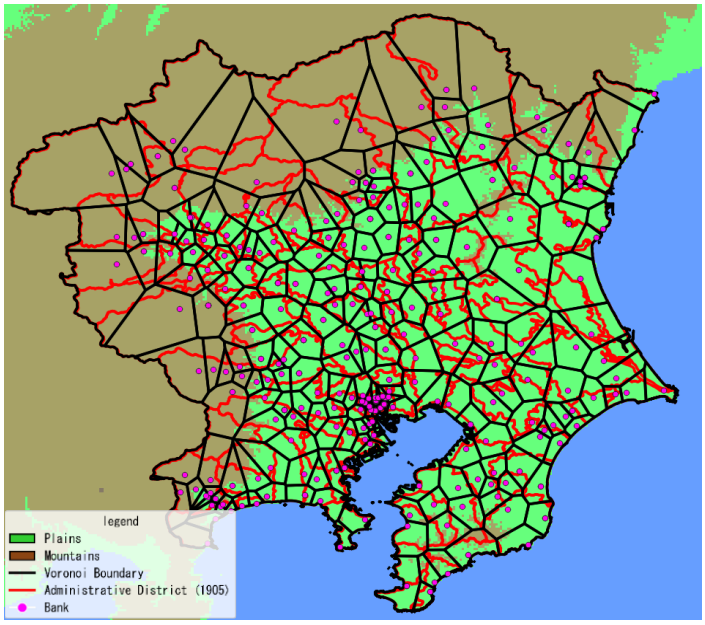


Figure 1: Administrative Boundaries and Voronoi Diagram of the Kanto Region in 1905

As shown in Figure 1, in Gunma, Tochigi, and Kanagawa prefectures, the boundaries of the Voronoi regions closely align with administrative boundaries, indicating a high degree of spatial consistency. While some deviations are observed in Tokyo, the overall alignment remains relatively strong. In contrast, Saitama and Chiba exhibit more noticeable mismatches between the Voronoi diagram and administrative divisions, suggesting relatively low spatial correspondence.

To quantify these visual impressions, the MS-SSIM index was used to evaluate the structural similarity between the Voronoi diagram and county images for each prefecture. Table 2 presents the MS-SSIM scores and the associated p-values obtained through Monte Carlo testing.

4.1.2 Quantitative Evaluation Using MS-SSIM

Table 2: MS-SSIM Scores and p-values for the Spatial Similarity between Administrative Boundaries and Voronoi Diagrams in the Kanto Region

Prefecture	MS-SSIM	p-value
Gunma	0.882	0.010**
Tochigi	0.868	0.032*
Kanagawa	0.865	0.035*
Ibaraki	0.831	0.047*
Tokyo	0.809	0.050*
Chiba	0.788	0.061
Saitama	0.785	0.073

Note: $p < 0.05$ was considered statistically significant.

Gunma, Tochigi, and Kanagawa recorded MS-SSIM scores above 0.86, indicating "high similarity." Ibaraki and Tokyo also exceeded 0.8 and were deemed structurally consistent. In contrast, Chiba and Saitama fell below 0.8, suggesting relatively weaker alignment compared to other prefectures.

To determine whether these scores could be due to random chance, Monte Carlo testing was conducted using MS-SSIM calculations via PyTorch. Specifically, MS-SSIM scores were computed for county and Voronoi image pairs in each prefecture, and 1,000 random pairs from other images in the same directory were generated for comparison. The probability of obtaining a score equal to or higher than the observed value was used as the p-value.

The results indicated statistically significant spatial alignment ($p < 0.05$) in Gunma, Tochigi, Kanagawa, Ibaraki, and Tokyo. This suggests that the structural match between the Voronoi diagram and administrative boundaries in these regions is unlikely to be coincidental. Although Chiba and Saitama showed relatively high scores, they did not reach statistical significance, implying that their structural resemblance is not distinct enough to reject the null hypothesis.

4.1.3 Summary: Structural Alignment between Bank Locations and Administrative Boundaries

Integrating visual observations, quantitative scores, and statistical testing reveals clear regional variation in the spatial alignment between bank locations and administrative boundaries in the Kanto region. In particular, the three northern prefectures—Gunma, Tochigi, and Ibaraki—along with Kanagawa and Tokyo, exhibit a strong structural alignment between bank locations and county boundaries, suggesting that bank distribution tends to conform to Voronoi-based spatial partitioning.

Importantly, these administrative units were not imposed top-down by central authorities but were often shaped by local private organizations and enterprises. This implies that the alignment between counties and bank locations may reflect autonomous decision-making within regional economies. In other words, counties were not merely administrative constructs but were shaped in mutual interaction with local economic functions and human networks. Thus, the observed spatial alignment can be interpreted as the product of dynamic interactions between institutional and economic structures.

Notably, in prefectures such as Gunma, Tochigi, and Kanagawa, it has been reported that network-based entrepreneurs consciously established banks in accordance with administrative boundaries (Suzuki & Kobayakawa, 2010). The spatial consistency confirmed in this analysis empirically demonstrates, through quantitative and statistical methods, the presence of historically rooted spatial structures. Hence, bank locations were not randomly distributed

independent of topography or institutions, but rather formed an orderly spatial pattern shaped by institutional and economic structures.

4.2 Relationship Between Bank Locations, Water Transport, and Topography

4.2.1 Rationale for Focusing on Water Transport Systems

To understand the relationship between bank locations and natural topography during the Meiji period, it is essential to first consider the role of water transport. Although Japan's railway network was expanding rapidly at the time, rivers remained a principal means of transporting goods—particularly heavy and voluminous cargo such as rice, coal, timber, and iron. The Class A rivers in the Kanto region, including the Tone River, spanned broad catchment areas from upstream zones to Tokyo Bay, serving as critical lifelines connecting regional industries to the capital region.

Consequently, logistical hubs emerged at strategic points along these waterways, creating concentrated demand for financial services. It is therefore reasonable to assume that banks tended to be located in areas where river-based logistics were concentrated.

4.2.2 Results: Bank Concentration in Class A River Basins, Centered on the Tone River

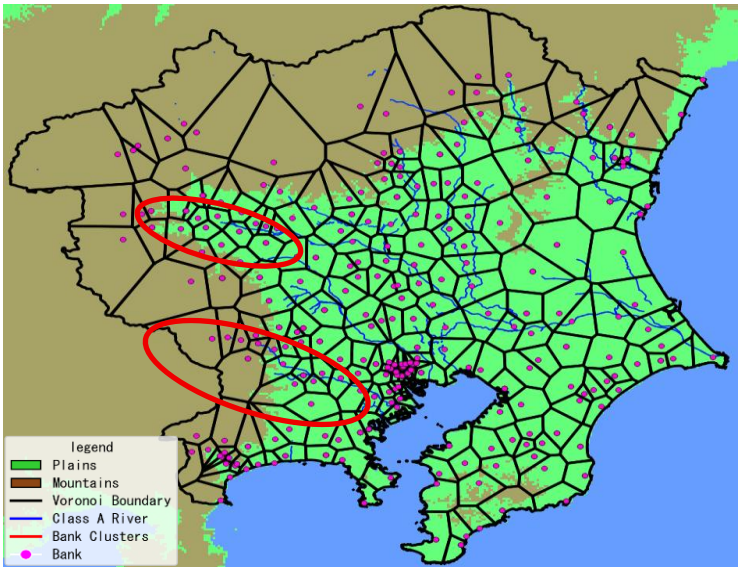


Figure 2: Water Transport Networks and Voronoi Diagram in 1905

As shown in Figure 2, bank locations in the Tone River basin—stretching from Gunma through Saitama to Chiba—are densely concentrated along riverbanks. This suggests that financial institutions were distributed in alignment with the water transport network. Similar trends were observed along other major rivers, including the Arakawa and Tama Rivers. In particular,

the downstream areas flowing into Tokyo Bay served as key logistical endpoints, where large volumes of cargo converged and economic activity intensified. As a result, Tokyo had already become a major banking center by 1905, serving as a vital hub for capital inflows and outflows within the greater metropolitan economy.

4.2.3 Structural Characteristics of River Mouths, Coastal Zones, and Plains

Bank locations were not limited to upstream and midstream zones; notable concentrations were also observed near river mouths. These areas served as intersections between inland and maritime transport. For example, Tokyo Bay's coastal zones—including Yokohama Port and Shinagawa Port—were hubs of commercial activity linked to foreign trade. In Kanagawa Prefecture, banks were densely distributed near these ports, reflecting high demand for financial transactions related to exports and shipping.

In addition, banks were often established in floodplains where river transport intersected with agricultural economies. This pattern was particularly noticeable in eastern parts of Saitama and Chiba. However, since these areas were primarily agricultural—dominated by fields and rice paddies—they had lower population densities compared to urban areas and more limited large-scale financial demand, which may have influenced the degree of bank concentration.

4.2.4 Limitations of Water Transport and Connections to Land Routes

Despite its importance, river transport had limitations. In areas with steep terrain or shallow water, boats could not pass easily, necessitating the transfer of goods to land routes. These intermodal transfer points—where waterborne goods were offloaded for land transport—often developed into warehouse hubs, post towns, and settlements, which were conducive to the establishment of banks.

In fact, in mountainous and hilly areas of Gunma and Tochigi, banks were found at the boundaries between mountain ranges and plains, suggesting their role as intermodal nodes for water and land transport.

4.2.5 Spatial Significance of "Warehouse-Banks"

The functional duality of banks as logistical and financial hubs was embodied in institutions known as "warehouse-banks." Examples include the Hokuetsu Warehouse Bank and the Tochigi Warehouse Bank, which combined financial and storage functions to support both regional distribution and liquidity management.

The location of such institutions along waterways and river basins supports the idea that bank placement was guided by both topographical and economic rationality.

5 Discussion

The results of this study reveal that the spatial distribution of banks in the Kanto region in 1905 exhibited a high degree of alignment with institutional administrative units (i.e., county boundaries) and natural geographic conditions such as rivers and elevation. In particular, in prefectures such as Gunma, Tochigi, and Kanagawa, bank locations closely matched county boundaries, suggesting that institutional regional units also functioned as economic network frameworks. This finding indicates that administrative boundaries were not merely units of governance, but also served as foundations for the formation of economic and spatial networks.

According to Yoshizu (1978), local banks during the Meiji period were often established in locations corresponding to the central-place hierarchy—such as county offices and transportation hubs—and were embedded in commercial centers within each region. This aligns with the results of this study, which confirmed the spatial consistency between Voronoi diagrams and administrative boundaries, indicating that the formation of bank locations followed an orderly pattern rooted in institutional and geographic context.

Furthermore, the concentration of banks along river basins and topographic boundaries suggests that they functioned as spatial nodes that mediated between logistics and finance. This is also consistent with the existence of multifunctional institutions such as “warehouse-banks” at the time. In other words, bank locations were not only determined by existing administrative and logistical structures, but also served as dependent variables that responded to these contexts. At the same time, they acted as mediating variables that influenced the formation and growth of local economic structures by serving as financial service hubs.

Thus, the spatial distribution of banks reflected the institutional and geographic conditions of their time, while also contributing to the reinforcement and stabilization of those very structures. Notably, in prefectures such as Gunma, Tochigi, and Kanagawa, network-oriented entrepreneurs reportedly established banks with a keen awareness of administrative boundaries (Suzuki & Kobayakawa, 2010). This study provides quantitative and statistical confirmation of such spatial coherence, rooted in historical and institutional background.

Therefore, bank locations were not randomly or uniformly distributed. Rather, they formed structured spatial patterns that were aligned with the institutional and economic systems of their time.

6 Conclusion

This study has demonstrated that the spatial distribution of banks in the Kanto region in 1905 showed a notable degree of alignment with natural geographic features—such as topography and river systems—as well as institutional boundaries, particularly administrative units at the county level. By

constructing Voronoi diagrams based on bank locations and comparing them with county boundaries and physical geographic features, the study employed the image similarity metric MS-SSIM to quantitatively evaluate the degree of structural correspondence. The results indicate a high level of spatial consistency between banking service areas and administrative units in Gunma, Tochigi, and Kanagawa, suggesting that the regional financial network was closely linked to institutional divisions.

In contrast, in Tokyo and Saitama, a certain degree of spatial discrepancy was observed. One explanation is that, by 1905, Tokyo had already developed a functional role as the nation's capital, transcending county-level administrative boundaries. As a center of national industrial policy and administrative authority, Tokyo was home to the headquarters of major banks strategically concentrated under state planning. Thus, bank locations in Tokyo were increasingly determined not by administrative boundaries but by policy objectives and central economic functions.

In southern Saitama, the cities of Kawagoe, Omiya, and Urawa were expanding across county lines, forming wider regional markets interconnected by railway networks. This likely enabled a more flexible deployment of bank branches in response to broader economic integration (Inoue, 1995; Sato, 2004).

Furthermore, the fact that many banks were concentrated near key nodes of river transport and topographic boundaries—particularly at the interface between mountainous and flatland zones—demonstrates their role not merely as financial service providers, but as spatial nodes mediating between logistics and economic activity. The existence of "warehouse-banks" in the Tone River basin provides compelling evidence that banks also functioned as distribution hubs. This finding highlights the geographic significance of bank locations as centers of economic activity embedded within the physical landscape.

Although statistical significance was not confirmed in Chiba Prefecture, this may be attributed to the region's relative lack of major Class A rivers, which limited water-based transport and reduced opportunities for economic centralization. Additionally, the peninsula-like shape of the Bōsō region may have restricted inland access, contributing to the fragmentation of economic zones and hindering the spatial expansion and coherence of bank locations.

These findings support Porter's (1998) theory that geographic proximity fosters concentrated networks and competitive advantage, suggesting that such dynamics were already at work during the Meiji era—embedded within both institutional frameworks and natural geography. Similarly, Krugman's (1991) proposition that spatial initial conditions exert lasting influence on the distribution and clustering of industries is empirically validated through the alignment between bank locations, river systems, and topographic boundaries.

Taken together, these results align with the view of Yoshino & Taghizadeh-Hesary (2018), who emphasized the decisive role of banking

density in shaping economic growth. The spatial configuration of financial networks, therefore, was not merely a passive outcome variable, but rather an active agent that shaped the skeletal structure of regional economies. Bank locations were simultaneously a **result** of institutional and geographic conditions and a **precondition** that contributed to the formation and reinforcement of regional economic structures and networks.

References

Asashima, A. (2009). Intra-group transactions of prewar zaibatsu-affiliated insurance companies and the role of subsidiaries. *Senshu University Economic Review, 44*(1), 35–59.

Hagenauer, J., & Helbich, M. (2012). Multi-scale spatial data modeling using structural similarity indices. *Computers, Environment and Urban Systems, 36*(6), 542–552.

Inoue, K. (1995). *Urban formation and urban issues: The modernization of Tokyo*. Yoshikawa Kōbunkan.

Krugman, P. (1991). Increasing returns and economic geography. *Journal of Political Economy, 99*(3), 483–499.

Matoušek, J. (2002). *Lectures on discrete geometry*. Springer-Verlag. (Okamoto, Y., Trans.). *Risan kikagaku kōgi* [離散幾何学講義]. Springer-Verlag Tokyo, 2005.

Naoki, Y. (1978). The locational process of banks in the Kanto region during the Meiji period: Especially in relation to the central place system. *Jinbun Chiri (Human Geography), 30*(5), 406–428.

National Institute of Informatics. (n.d.). *Historical administrative boundaries dataset* [歴史的行政区域データセット]. Retrieved May 22, 2025, from https://geoshape.ex.nii.ac.jp

Okazaki, T. (2005). Financial and corporate systems and economic development in prewar Japan. *The Economic Review, 56*(2), 117–129.

Porter, M. E. (1998). Clusters and the new economics of competition. *Harvard Business Review, 76*(6), 77–90.

Satō, S. (2004). *The formation of the Tokyo metropolitan area and the development of urban planning*. Kajima Publishing.

Suzuki, T., & Kobayakawa, T. (2010). Formation of network-based entrepreneur groups and the influence of administrative divisions. *Gakushuin University Economic Review, 43*(2), 112–128.

Tōyō Keizai Shinpōsha. (1905). *Nihon zenkoku shokaisha yakuinroku* [Directory of executives of companies nationwide, Meiji 38]. Tōyō Keizai Shinpōsha.

Wang, Z., Bovik, A. C., Sheikh, H. R., & Simoncelli, E. P. (2003). Multiscale structural similarity for image quality assessment. In *Proceedings

of the 37th Asilomar Conference on Signals, Systems & Computers* (Vol. 2, pp. 1398–1402). IEEE.

Yoshino, N., & Taghizadeh-Hesary, F. (2018). Optimal credit guarantee ratio for small and medium-sized enterprises' financing: Evidence from Asia. *Economic Modelling, 74*, 127–137.

Zhang, Y., & Du, Q. (2016). MS-SSIM-based remote sensing image change detection. *IEEE Geoscience and Remote Sensing Letters, 13*(8), 1152–1156.

POLICY STABILITY AND RENEWABLE ELECTRICITY DEPLOYMENT: ROMANIA IN COMPARATIVE PERSPECTIVE, 2010–2025

Mădălina Ana Burduja
Dorel Mihai Paraschiv[*]

Abstract

Romania raised the renewable share of its electricity consumption by eleven percentage points between 2010 and 2014, then by one over the next seven years. This paper examines that interruption, comparing Romania with Poland, Germany and Spain, selected for their differing support instruments and policy disruptions, and with all twenty-seven European Union member states from 2010 to 2025. Stagnation periods are identified by a consistent rule and compared with the timing of support scheme revisions. Every case with a coded intervention date records prolonged stagnation beginning at or soon after intervention. Germany, which repeatedly revised its framework only for future installations, records the shortest interruption. Because stagnation is common, this association is suggestive rather than diagnostic. The Romanian case is reconstructed from legislation and exchange records, including a 2012–2020 price and volume series for green certificates compiled from the exchange's annual reports. Certificates owed to operating producers were withheld from trading between 2013 and 2020 and are being released between 2021 and 2030. None was cancelled, yet a substantial share of their value was lost. What appears to distinguish these trajectories is not how often governments revise support schemes, but whether revisions reach investors who have already committed capital.

Keywords: renewable energy policy, green certificates, policy credibility, retroactive regulation, Romania, European Union

JEL Classification: Q42, Q48, K23, O52.

1. Introduction

Between 2010 and 2014, Romania raised the renewable share of its electricity consumption by eleven percentage points. Over the next seven years it added one. This paper asks what happened in between.

The mechanism examined here is the credibility of policy commitments rather than their generosity. In 2013 Romania withheld from trading part of the certificates owed to producers already operating, promising release by 2020.

[*] Mădălina Ana Burduja is a PhD candidate at the Doctoral School of International Economic Relations, Bucharest University of Economic Studies, Bucharest, corresponding author. E-mail address: madalina@burduja.ro. Dorel Mihai Paraschiv is Professor of Economics and Prorector at the Bucharest University of Economic Studies, Bucharest. E-mail address: dorel.paraschiv@ase.ro

An earlier version of this study was presented at the BASIQ International Conference on New Trends in Sustainable Business and Consumption, Porto, 25-27 June 2026. The present paper extends that work substantially in indicator, period of observation, country sample and analysis.

Release for solar in fact began in 2021 and runs to 2030. No certificate was cancelled, yet about a fifth of the value of the support earned in those years disappeared.

Section 2 reviews the literature, Section 3 the data and method. Section 4 compares Romania with Poland, Germany and Spain, then with all member states, Section 5 examines the Romanian record, and Sections 6 and 7 discuss and conclude. The argument is that what matters is not how often schemes were revised, but whether revisions reached investors who had already committed.

2. Policy stability and renewable investment

2.1 Support instruments and investment outcomes

Renewable electricity in liberalised European markets is financed largely by private firms, whose investment decisions turn on expected profitability (Eyraud et al., 2011). Support schemes exist to close the gap between that expectation and the returns available from wholesale markets alone.

Three instruments predominate. Feed-in tariffs guarantee a fixed price over a project's life; feed-in premiums pay a supplement above the market price, leaving the producer exposed to it; quota obligations with tradable green certificates oblige suppliers to source a share of their electricity from renewable sources, with certificate prices set by supply and demand (Mitchell, Bauknecht and Connor, 2006). Comparative assessments generally find guaranteed-price instruments associated with higher deployment, and attribute the difference to lower revenue risk rather than greater generosity (Mitchell, Bauknecht and Connor, 2006; García-Álvarez, Cabeza-García and Soares, 2017; 2018). Boomsma, Meade and Fleten (2012) reach a compatible conclusion from a real options perspective, finding that the support scheme in force shapes both the timing and the scale of investment. What matters, on this reading, is not the level of support but its variance.

2.2 Policy uncertainty and the credibility of commitments

A second line of enquiry concerns not the design of a support scheme but the durability of the commitment behind it. Its foundation is the problem of time inconsistency identified by Kydland and Prescott (1977): a government that cannot bind its future self will find that rational agents anticipate its later incentives, so that policies optimal at announcement are not credible at the moment of investment.

The problem is acute where investment is irreversible and the asset cannot be moved. Blackman and Zeckhauser (1992) show that a utility becomes vulnerable to appropriation by the regulator once capital is committed. Laffont and Tirole (1996) demonstrate the parallel for environmental innovation: a government with discretion over pollution permits has an ex post incentive to devalue the technology it wished to encourage, and innovators anticipating this will not invest. Helm, Hepburn and Mash (2003) generalise the argument to

climate policy, concluding that the credibility of a commitment is a condition of its effectiveness.

Empirical work supports these propositions. In a choice experiment with European photovoltaic developers, Lüthi and Wüstenhagen (2012) find policy risk among the most important determinants of investment, with the number of policy changes ranking alongside the level of the tariff; Chassot, Hampl and Wüstenhagen (2014) report that high perceived regulatory risk reduces the probability of investment. Karneyeva and Wüstenhagen (2017) observe that the fall in photovoltaic module costs after 2009 did not produce a corresponding rise in European investment, because cost reductions were offset by increased exposure to policy and revenue risk.

The real options literature formalises the response. Boomsma and Linnerud (2015) distinguish anticipated reductions applying to new projects, which accelerate investment, from reductions with retroactive effect, which delay it; Ritzenhofen and Spinler (2016) find investment deferred or withdrawn when a regulatory shift exposing producers to price uncertainty is expected; Dalby et al. (2018) show that the investment threshold rises as the expected time to an adverse revision falls.

2.3 Retroactive intervention

The most direct empirical treatment of retroactive intervention is that of Sendstad et al. (2022), who construct a panel of European countries for 2000 to 2017 and estimate the effect of retroactive policy changes on subsequent investment using a difference-in-differences design. They find that a retroactive subsidy change reduces the investment rate by approximately 45 per cent for photovoltaics and 16 per cent for onshore wind, and conclude that once investor trust has been damaged the effect is durable. Their treated cases — Italy, Spain, Greece, Bulgaria, the Czech Republic and Portugal — fall between 2010 and 2012, and their analysis covers feed-in tariffs and feed-in premiums, the instruments then most widely used in Europe.

Three features of that study define the space this paper occupies. Its treated cases cluster in the period of the European debt crisis, so interventions occurring later fall outside its window. Its scope is confined to administered-tariff instruments, which means quota-and-certificate schemes, and the countries that relied on them, are not examined. And its treatment variable takes the value one from the year of intervention onward, a specification appropriate to estimating an average effect but one in which the persistence of that effect is assumed rather than measured.

Romania falls outside that scope on two counts at once. Its intervention occurred in 2013 and 2014, after the treated window, and it operated on a quota-and-certificate scheme rather than a tariff. The deferral described in Section 5 nonetheless affected installations already in operation, and Romanian deployment subsequently stalled for seven years.

The case has accordingly received little attention. Work on the Romanian scheme is limited and largely descriptive. Zamfir, Colesca and Corbos (2016) review a decade of Romanian renewable energy policy, noting that the national target of a 24 per cent renewable share by 2020 was more ambitious than the European average and had been reached by early 2014, and setting out the tradable green certificate system together with the successive changes made to it. Their review identifies the possible effects of those changes as a matter for subsequent research rather than settling it, and quantitative assessments remain scarce. Sector-specific reviews cover the development of Romanian photovoltaic and hydroelectric capacity (Năstase et al., 2018; Năstase et al., 2017), while Buzogány and Davidescu (2022) situate the country's energy governance in its wider institutional context.

This paper addresses that omission. In doing so it takes up two of the extensions that Sendstad et al. themselves propose: widening the range of countries examined and lengthening the period observed.

3. Data and method

3.1 Data

Deployment is measured using Eurostat's dataset on the share of energy from renewable sources (nrg_ind_ren), taking the electricity balance (REN_ELC) for all twenty-seven member states, annual, 2010 to 2025, extracted on 20 September 2026. The reason for using the electricity rather than the aggregate series is set out in Section 4.1. Figures for 2025 are provisional at the time of writing and are identified as such wherever they appear.

Evidence on the Romanian support scheme is drawn from primary sources. The design of the scheme, the number of certificates awarded by technology and accreditation year, and the successive amendments are taken from the legislation itself and from the Ministry of Energy's published account of the scheme. Operational detail on the deferral and its reversal is taken from the procedure issued by the transmission system operator, Transelectrica. Certificate prices and traded volumes are taken from the annual reports of the OPCOM exchange for the years 2012 to 2020, which publish weighted average prices, transaction values and volumes for each market segment. The series in Table 4 is compiled from the nine annual reports covering 2012 to 2020 and is reproduced in full there.

Three cautions attach to the OPCOM figures. First, the reports present some series on a calendar-year basis and others for a March-to-February trading period, and the two give materially different values for the same year; the figures used here are calendar-year unless otherwise stated. Second, the architecture of the certificate market changed during the period. The centralised market (PCCV) and the bilateral contracts market (PCBCV) operated until 31 August 2017 and were replaced from 1 September 2017 by an anonymous spot

market (PCSCV) and an anonymous forward market (PCTCV), with a further segment for renewable electricity sold together with certificates (PC-ESRE-CV) added in 2019. The series reported below follows the spot segment throughout, which is the continuous price reference, and the discontinuity in 2017 is marked. Third, prices are converted to euro using the exchange rate prescribed by Law 220/2008 — the average rate published by the National Bank of Romania for the final month of the preceding year — which is the rate the scheme itself applied rather than a contemporaneous market rate.

3.2 Case selection

Four member states are examined in detail before the analysis is extended to the Union as a whole. They were selected to vary along the two dimensions that bear on the argument: the class of support instrument in use, and the character of the disruption to producer revenues that each experienced.

Romania and Poland operated quota obligations with tradable green certificates, in which the producer's revenue depends on a market price. Germany and Spain operated administered-price instruments, in which it does not. Within each pair, one country experienced a disruption reaching installations already in operation and one did not. Romania deferred certificates owed to accredited producers. Poland's certificate revenues fell through market oversupply rather than legislative action. Spain reduced remuneration for existing installations. Germany revised its framework repeatedly but confined changes to installations not yet commissioned.

The four therefore span both instrument classes in widespread European use and the principal ways in which producer revenues can be impaired: by legislative act, by market failure, and not at all. They also span the range of starting positions, from Romania at 30.4 per cent of gross electricity consumption in 2010 to Poland at 6.5 per cent, and each is among the larger electricity markets in the Union.

Cases selected in this way are not a random sample, and a comparison of four countries chosen partly for the disruptions they experienced cannot establish how common those disruptions are or whether they are necessary for the outcome observed. Section 4.2 extends the analysis to all twenty-seven member states for that reason.

3.3 Identifying periods of stagnation

Section 4 refers to periods during which renewable electricity deployment stalled. To avoid identifying these by inspection, a single rule is applied uniformly to every member state: a period of stagnation is the longest run of consecutive years during which a country's renewable electricity share never rises more than two percentage points above its level in the first year of the run.

The threshold is a judgement rather than a derived quantity. Two percentage points over several years is small relative to the movement observed in countries deploying steadily. The ordering of countries by the length of their

stagnation periods is not greatly sensitive to modest changes in the threshold, though the number of countries meeting it is, as Section 4.2 reports. A stagnation period is treated as following an intervention where it begins in the year of the intervention or within three years of it. The rule is arbitrary in the sense that any such threshold is, and results should be read accordingly. Its purpose is consistency across cases rather than precision within them.

3.4 Valuing deferred certificates

Section 5.3 reports the present value of certificates withheld from trading under the deferral provisions. The certificates valued are those withheld from producers accredited by ANRE up to 31 December 2013: one certificate per megawatt-hour for onshore wind and for new small hydro below 10 MW, withheld between July 2013 and December 2017, and two certificates per megawatt-hour for solar, withheld between July 2013 and December 2020 under the successive provisions of Emergency Ordinance 57/2013 and Emergency Ordinance 24/2017 as amended by Law 184/2018. Wind and small hydro certificates are released in equal monthly instalments between January 2018 and December 2025; solar certificates between January 2021 and December 2030.

The counterfactual is sale at the moment of issue, which is what the twelve-month validity rule then in force required. For a certificate withheld in month t, the deferral replaces a single receipt at t with an equal share of each of the N monthly instalments paid across the release window. Its present value relative to immediate sale is therefore the mean of $(1 + i)^{-(s_k - t)}$ over the N release months s_k, at a constant real discount rate i. Because certificates accrue continuously with generation, this is computed for every month of the deferral window and averaged, weighting each month equally. Uniform weighting is a simplification, though a defensible one for this population: the capacity concerned was almost entirely commissioned before the end of 2013 and its output does not trend materially across the period.

Three assumptions are involved and none is estimated. The discount rate is imposed rather than measured, and results are reported at 6, 9 and 12 per cent so that the sensitivity of the conclusion to that choice is visible. The calculation assumes that certificates are released in full, on the legislated schedule, and at unchanged real value — the assumptions most favourable to the position that no support was withdrawn. And the loss is expressed as a share of the value of all certificates earned during the deferral period, not of lifetime support under the scheme: the deferral affected four and a half years of a wind producer's entitlement and seven and a half of a solar producer's, against a support period running to 2031.

The figures should therefore be read as an illustration of magnitude, not as an estimate of the returns realised by any Romanian producer. Their purpose is to establish that a measure which reduced no producer's entitlement nonetheless removed a substantial share of its value.

4. Renewable electricity deployment in comparative perspective, 2010–2025

4.1 Four countries

Comparisons of renewable energy performance commonly rely on the share of renewables in gross final energy consumption. That indicator aggregates electricity, heating and transport, and for the question addressed here it is the wrong one. Support schemes of the kind described in Section 5 operate on electricity. Romania's green certificates, Poland's certificate obligation, Germany's feed-in framework and Spain's tariff regime all rewarded electricity generation and none of them addressed household heating or transport fuel. The appropriate measure is therefore the renewable share of gross electricity consumption, reported by Eurostat as RES-E.

The distinction is not merely technical, and Romania illustrates why. Measured across all energy uses, Romania records one of the higher shares in the European Union: 23.9 per cent in 2018, rising to 25.4 per cent in 2024. On that basis the country appears to outperform Germany, which stood at 16.7 per cent in 2018, and Spain, at 17.0 per cent. Yet neither Romania's hydroelectric capacity, the bulk of which predates the period under examination (Năstase et al., 2017), nor the biomass burned for heating in rural households, is a product of the policies considered here. The aggregate indicator flatters Romania twice over, for two reasons that have nothing to do with policy.

Table 1 reports RES-E for the four countries at three-year intervals.

Table no.1 Renewable share of gross electricity consumption (%), selected years

Country	2010	2013	2016	2019	2022	2025
Romania	30.4	37.5	42.7	42.6	43.7	49.9
Spain	29.7	36.0	36.7	37.1	50.9	60.7
Germany	18.2	25.3	32.3	40.6	48.0	57.9
Poland	6.5	10.7	13.3	14.4	21.0	32.5

Source: Eurostat, nrg_ind_ren. Figures for 2025 are provisional.

In 2010 Romania led this group. Its share of renewable electricity exceeded Spain's and was more than ten percentage points above Germany's. By 2025 it ranks third, overtaken by both. The reason is visible in the full annual series rather than in the endpoints: between 2010 and 2014 Romania added 11.3 percentage points, then added one further point over the seven years to 2021, before resuming growth.

Spain and Poland display the same shape at different times. Spain rose to 36.0 per cent by 2013 and then declined, reaching 35.2 per cent in 2018 before accelerating to the highest share in the group. Poland reached 13.4 per cent in 2015 and remained within half a point of that level until 2019, after which it more than doubled in six years.

Germany is the exception. Its series rises continuously across the whole period, from 18.2 to 57.9 per cent, without an interruption of more than two years. This is not because Germany left its support framework alone. The German system was revised repeatedly over the period, including the 2012 photovoltaic amendment and the successive reforms of the renewable energy act in 2014 and 2017. What distinguishes it is that revisions applied to future installations, with plants already commissioned remaining on the terms in force at the time of commissioning. Germany changed the rules more often than Romania did. It did not change them for investors who had already committed.

The comparison therefore suggests a distinction that the frequency of legislative amendment would obscure: what appears to matter is not how often a support framework is revised, but whether revisions reach installations that have already been built.

4.2 Evidence from the EU-27

Four countries cannot establish a general pattern. To test whether the association holds more widely, the rule set out in Section 3.3 was applied to all twenty-seven member states across the same period.

Of the member states identified in the literature as having intervened retroactively, every one whose intervention can be dated to a specific instrument records a stagnation period of at least four years beginning in the year of the intervention or within three years of it. Table 2 sets out the comparison. Portugal, also identified in that literature, is omitted because its intervention could not be attributed to a single measure; its longest stagnation period, 2015 to 2019, is reported in Appendix Table A1. The set of treated states follows Sendstad et al. (2022), with Romania added and with Poland included separately: its certificate revenues collapsed through market oversupply rather than legislative action, so no intervention date is coded, but the stagnation it records is of the same order. Germany, which made no such intervention, records the shortest stagnation period of any member state, at two years.

Table no.2 Stagnation periods and coded interventions, treated member states

Country	Intervention	Stagnation period	Duration	Lag (years)
Spain	2013	2013–2019	7	0
Italy	2014	2014–2019	6	0
Bulgaria	2012	2013–2017	5	+1
Greece	2012	2013–2016	4	+1
Romania	2013	2014–2021	8	+1
Czechia	2011	2014–2022	9	+3
Poland	market-driven	2014–2019	6	—

Source: stagnation periods are authors' calculations from Eurostat, nrg_ind_ren, applying the rule set out in Section 3.3. The set of states treated as having intervened retroactively follows Sendstad et al. (2022), with Romania added and Portugal omitted because its intervention could not be dated to a single instrument. Intervention dates refer to the principal measure in each case: for Greece, Law 4093/2012, Article I, Paragraph I.2 (Government Gazette A 222/12.11.2012); for Romania, Emergency Ordinance 57/2013. Poland's certificate revenues fell through market oversupply rather than legislative action and no intervention date is coded.

Where a member state intervened more than once, the date given is that of the principal measure affecting installations already operating. For Spain this is the 2013 reform rather than the tariff reductions of 2010, and for Italy the 2014 restructuring rather than the earlier levy; Sendstad et al. (2022) code the earlier measures in both cases. The stagnation periods reported here begin within three years of either date.

The second finding qualifies the first substantially. Stagnation is common. At the two-percentage-point threshold, twenty-three of the twenty-seven member states record a period of at least four years, including several — Slovenia, Hungary, Latvia and the Netherlands among them — with no documented retroactive episode. Appendix Table A1 reports the full results. Renewable deployment stalls for many reasons: recession, constraints on grid connection, shifts in electricity demand, planning restrictions, or a support scheme reaching the limit of its budget.

That count is sensitive to the threshold chosen. At one percentage point fifteen states record a period of four years or more; at three percentage points, twenty-five do. The ranking of countries is more stable than the count, and Germany records the shortest period at all three thresholds.

The implication for interpretation is precise, and it runs in one direction only. The evidence is consistent with the proposition that retroactive intervention is followed by prolonged stagnation. It does not support the converse — that stagnation indicates retroactive intervention — and the data presented here contradict that reading directly.

This limits what the analysis can claim. It does not establish that retroactive intervention caused the stagnation observed in Romania, and a descriptive comparison of this kind cannot do so. Both the timing and the sign of the association are nonetheless consistent across every case with a coded intervention date, and the country with the most sustained record of prospective-only revision shows the least interruption. Section 5 examines the Romanian case in detail, where the legislative record permits a closer account of what was altered, for whom, and when.

5. The Romanian green certificate scheme

5.1 Design and operation

Romania's support scheme for renewable electricity was established by Law 220/2008 and approved under State aid rules in July 2011 (European Commission, 2011). Rather than paying producers a guaranteed price, the scheme combined a mandatory quota with a tradable instrument. Producers received green certificates for each megawatt-hour generated and delivered to the grid. Electricity suppliers were obliged by law to buy a set number of certificates each year, and recovered the cost through consumer tariffs. Certificates were issued free of charge by the transmission system operator, Transelectrica, and traded on the OPCOM exchange.

Two features of the instrument matter for what follows. The number of certificates awarded per megawatt-hour varied by technology and by the year in which a plant was accredited, so the level of support was set at the point of accreditation and was expected to hold for the life of the installation. And certificates carried a validity of twelve months: any certificate still held by a producer when that period expired was annulled. The instrument was designed to be sold quickly.

Prices were bounded. As originally enacted, the law set a floor of €27 and a ceiling of €55 per certificate, each indexed annually to the previous year's average eurozone inflation rate as published by Eurostat. Within that band, the price was determined by supply and demand on the exchange. By 2016 indexation had raised the band to approximately €29.40 and €59.90, or 132.40 and 269.72 lei. Suppliers failing to meet their quota paid a penalty set at twice the ceiling — 539 lei per certificate in 2016 — so that non-compliance could never be cheaper than purchase.

The band was subsequently replaced. Article XIII of Emergency Ordinance 24/2017 provides that, from the ordinance's entry into force until 31 March 2032, certificates may be traded only between a minimum of €29.4 and a maximum of €35. The new bounds are fixed in euro and are not indexed. Three consequences follow. The ceiling was reduced from an indexed €55, worth approximately €60 at the time, to a flat €35 — a reduction of some 40 per cent in the highest price any producer could realise. The floor was frozen at €29.40, the level indexation had reached in 2016. And because neither bound is indexed, both erode in real terms across the fifteen years to 2032. The penalty for unmet quota obligations was set at €70, again twice the ceiling. The same ordinance extended the period during which certificates may be traded to 31 March 2032 irrespective of the expiry of a plant's accreditation, removing for certificates held thereafter the requirement to sell within twelve months.

Support was generous by European standards, particularly for solar. Table 3 shows the number of certificates awarded per megawatt-hour by technology and accreditation year.

Table no.3 Green certificates awarded per MWh, by technology and accreditation year

Technology	2011	2012	2013	2014	2015	2016
Wind	2	2	2	1.5	1.5	1.5
New small hydro <10 MW	3	3	3	2.3	2.3	2.3
Retechnologised small hydro <10 MW	2	2	2	2.3	2.3	2.3
Biomass	2	2	2	2	2	2
Solar	6	6	6	3	3	3

Source: Ministry of Energy, Schema de sprijin prin certificate verzi.

A solar plant accredited in 2012 therefore earned six certificates for every megawatt-hour. At a certificate price in the middle of the permitted band, this represented support several times the prevailing wholesale electricity price. The scheme worked as intended: renewable electricity rose from 30.4 per cent of gross electricity consumption in 2010 to 41.7 per cent in 2014, an increase of more than eleven percentage points in four years.

Where the price actually settled within that band is the central fact about how this scheme functioned.

Table 4 reports the weighted average price and traded volume on the spot segment of the certificate market.

Table no.4 Green certificate price and spot volume, 2012-2020

Year	Certificates traded	lei/certificate	EUR/certificate
2012	1,053,229	244.09	56.44
2013	4,161,317	190.71	42.66
2014	2,675,174	161.60	36.07
2015	36,618	130.95	29.36
2016	8,468	132.25	29.40
2017	523,785	132.03	29.40
2018	2,599,148	134.31	29.40
2019	4,562,134	136.82	29.40
2020	6,578,991	139.51	29.40

Source: OPCOM annual reports, 2013 to 2020. Figures to 2016 relate to the centralised market (PCCV); from September 2017 to the anonymous spot market (PCSCV) that replaced it. Euro values are converted at the rate prescribed by Law 220/2008.

In 2012 the price stood at €56.44, at the ceiling of the permitted band. By 2015 it had fallen to €29.36, a decline of 48 per cent in three years, and the market had reached the floor.

The monthly path through 2013 is worth noting. The price opened the year at 243.85 lei in January and fell to 168.69 lei by May, a decline of 31 per cent in five months, before recovering to 200.00 lei in December. Emergency Ordinance 57/2013 was adopted on 4 June and took effect on 1 July. The steepest part of the fall therefore preceded the measure itself, following the regulator's finding of overcompensation in March and the public circulation of draft reductions in the intervening months. This is consistent with investors repricing on the expectation of intervention rather than on its enactment, though the accumulating certificate surplus was depressing prices over the same period and the two effects cannot be separated with these data.

It then stopped. From 2016 to 2020 the price in euro was €29.40 in every year, identical to the cent across five consecutive years. The figure in lei rises across the same period, from 132.25 to 139.51, but this reflects only the exchange rate at which a fixed euro amount is converted. In the currency in which the band is defined, the price did not move at all. From April 2017 this

follows directly from the statute: the floor was fixed at €29.40 and the market sat on it.

Nor did it move within years. The monthly series records 134.31 lei in every month of 2018, 136.82 lei in every month of 2019, and 139.51 lei in every month of 2020. A price that is constant to two decimal places across thirty-six consecutive months is not a price being formed by supply and demand. It is a regulatory floor, permanently binding.

A price resting on its floor is itself evidence of excess supply: at the minimum permitted price, more certificates were offered than the quota obliged suppliers to buy. Spot volumes are reported in Table 4, but they are not comparable across the 2017 change in market design, and the spot segment was in any case the smaller of the two. They are not relied on here.

5.2 The 2013 intervention

Romania's monitoring of the scheme, conducted under the conditions attached to the Commission's approval decision (European Commission, 2011), found that producers were being overcompensated. In March 2013 ANRE, the national energy regulator, reported that technology costs — particularly for solar photovoltaics — had fallen faster than the scheme's parameters anticipated, and that realised returns exceeded the reference rates used when the scheme was authorised.

The government responded with two measures in the same year. They are routinely discussed together, but they are different in kind, and the distinction is central to this paper.

The first was a reduction in support levels. Government Decision 994/2013 cut the number of certificates awarded: solar from six to three, wind from two to 1.5, new small hydro from three to 2.3. As Table 3 shows, the reduction applied to plants accredited from 2014 onwards. Emergency Ordinance 57/2013 provided explicitly that the reduction applied only to installations accredited after the decision entered into force. Investors who had not yet committed capital faced different terms; those who had were untouched. This is ordinary policy adjustment, announced in advance and applying prospectively.

The second measure was different. The same ordinance provided that, from 1 July 2013, a portion of the certificates due to producers would be temporarily withheld from trading — two certificates per megawatt-hour for solar plants, one for wind, one for new small hydro. This applied to producers accredited by ANRE up to 31 December 2013: that is, to installations already built or already committed. The certificates were still issued and still recorded in the producer's account. They simply could not be sold, nor transferred to a supplier to meet the mandatory quota. Transelectrica's operating procedure describes them as deferred from trading.

The measure was presented as temporary. Law 23/2014, which approved the ordinance with modifications, set out the arrangements for reversing it, and the government's explanatory note gave a timetable: recovery would begin in January 2017 for small hydro and solar and in January 2018 for wind, completing no later than December 2020. Producers were told that their revenue was postponed by three to four years.

That timetable was not kept, and for solar producers the deferral was extended rather than reversed. The arrangements now in force are those of article 6, paragraphs (2^2) and (2^6) of Law 220/2008 as amended: Emergency Ordinance 24/2017 withheld a further two certificates per megawatt-hour from the same producers between April 2017 and, as first enacted, December 2024, with recovery of both tranches deferred to 2025–2030. Law 184/2018, approving that ordinance with modifications, shortened the additional deferral to December 2020 and brought recovery forward to January 2021. The position that now applies is that wind and small hydro certificates deferred from 2013 are released in equal monthly instalments between January 2018 and December 2025, and that solar certificates withheld continuously between July 2013 and December 2020 are released between January 2021 and December 2030.

5.3 The value of deferred certificates

It is important to be precise about what was and was not done, because the formal position is defensible and the economic position is not.

Romania did not cancel any certificate. In its state aid file on the scheme, the European Commission records that although the country amended the legal basis repeatedly, it never reduced the number of certificates granted to installations already admitted to the support scheme. That statement is accurate. Every deferred certificate remains owed, and will eventually be released.

What changed was when. Because a certificate is a claim on future revenue, postponement reduces its present value, and postponement measured in years reduces it substantially. Table 5 sets out the effect, discounting deferred certificates at constant real rates to the point of deferral.

Table no.5 Present value of deferred certificates relative to immediate sale

Technology	Certificates deferred, per MWh	Deferral period	Release period	PV at 6%	at 9%	at 12%
Onshore wind	1 of 2	Jul 2013 – Dec 2017	Jan 2018 – Dec 2025	70%	60%	52%
New small hydro <10 MW	1 of 3	Jul 2013 – Dec 2017	Jan 2018 – Dec 2025	70%	60%	52%
Solar	2 of 6	Jul 2013 – Dec 2020	Jan 2021 – Dec 2030	61%	49%	40%

Source: authors' calculations. Present value is expressed relative to sale at the moment of issue, computed month by month across the deferral window and averaged with equal weights, as set out in Section 3.4. Discount rates are illustrative and are not estimates of the cost of capital faced by Romanian producers.

The effect differs by technology and by discount rate. At nine per cent, a deferred wind certificate was worth about three-fifths of what it would have fetched on immediate sale, and a deferred solar certificate about half. Because one certificate in two was withheld from wind producers and two in six from solar producers, this amounts to a loss of roughly a fifth of the support earned by a wind producer during the deferral period, about a sixth for a solar producer, and about an eighth for a small hydro producer. No certificate was withdrawn. Roughly a tenth to a quarter of the value of support earned in those years disappeared, depending on technology and on the rate at which future receipts are discounted.

Two further considerations sharpen this. Producers found themselves holding, for the better part of a decade, an asset the scheme's own rules treated as short-dated, a constraint relaxed only in 2017. Producers found themselves holding, for the better part of a decade, an asset the scheme's own rules treated as short-dated. Second, and more consequential for what investors could infer, the deferral was itself revised twice. A producer who accepted the 2013 measure as a temporary correction, on the assurance that repayment would be complete by 2020, learned in 2017 that repayment would instead begin in 2025, and in 2018 that it would begin in 2021 and run to 2030. The remedy proved as revisable as the original commitment, in both directions.

This is the distinction the paper turns on. A government that reduces support for future installations tells investors that the terms of new projects have changed. A government that alters the terms of projects already built tells them something different and more durable: that the terms of any project may change. Deployment is consistent with the second reading. Having added more than eleven percentage points between 2010 and 2014, it added one further point over the following seven years. What investors concluded cannot be observed directly from deployment data, and Section 6.1 considers what else may account for the slowdown.

6. Discussion

6.1 What the Romanian case shows

The measures adopted in Romania in 2013 are often described together as a correction of an over-generous support scheme. On the evidence set out above, they were two measures of a different character.

The reduction in certificate numbers was a straightforward adjustment. It followed a regulatory finding of overcompensation, it was proportionate to that finding, and it applied only to installations accredited after it took effect. Investors considering a project from 2014 faced terms that were less generous than those available in 2012, and they knew it before committing. Support schemes across Europe were adjusted in this way throughout the period, as

technology costs fell, and there is no reason to treat such adjustment as a failure of policy. It is what a support scheme is supposed to do.

The deferral was different. It applied to producers already accredited, whose capital was already committed and whose revenue expectations were already embedded in financing arrangements. It did not reduce the number of certificates owed. It changed the date on which they could be sold, and for solar producers the withholding was subsequently extended rather than reversed, so that certificates earned between 2013 and 2020 are recovered over the decade to 2030. Discounted at the illustrative rates used here, roughly a tenth to a quarter of the value of the support earned during those years was removed without any entitlement being withdrawn.

The certificate price compounded the effect. By 2016 it had settled at the floor of the legal band and remained there for five years. Its level across the release period to 2030 cannot be known, but a producer forming expectations in those years saw a market that was not producing prices above its regulatory minimum.

Emergency Ordinance 24/2017, which extended the deferral, also lowered the price at which the released certificates could be sold. Until 2017 the ceiling stood at an indexed €55; from April 2017 it was fixed at €35 until 2032, with no indexation. A producer awaiting certificates deferred in 2013 therefore faced not only a longer wait but a lower maximum realisable price on arrival, and a bound that erodes in real terms throughout the waiting period. Neither change reduced the number of certificates owed.

Credibility is not the only candidate explanation for what followed, and the evidence assembled here cannot separate it from several others. The prospective reduction in certificate numbers was substantial in its own right — halving the allocation to new solar plants — and would be expected to slow new investment whatever investors inferred about the durability of the scheme. The certificate price fell by nearly half between 2012 and 2015, reducing revenues for all producers irrespective of the deferral, and the surplus driving that fall arose from a quota set below the volume of certificates the scheme was issuing. The deployment surge of 2012 and 2013 was itself a response to terms the regulator subsequently found to be over-generous, so some slowing was to be expected once those terms were corrected. Grid connection constraints and the twelve-month validity rule, which forced sales into a saturated market until it was relaxed in 2017, would each have contributed. These operated simultaneously and in the same direction, and no design available here distinguishes their contributions. What can be said is narrower: a measure that reached installations already built coincided with a seven-year interruption, the same coincidence appears in every comparable case, and the member state that confined its revisions to future installations shows no comparable interruption.

The most consequential feature, however, is the one that emerged only over time. The repayment schedule announced in 2013 promised completion by 2020. It was subsequently amended twice. Emergency Ordinance 24/2017 extended the solar deferral to 2024 and postponed recovery to 2025–2030; Law 184/2018 then shortened the extension to 2020 and brought recovery forward to 2021. A producer who accepted the original measure as a temporary emergency, on the assurance that the position would be restored within a few years, learned that the assurance was itself revisable. That is a different proposition from a support scheme being less generous than expected. It is a support scheme in which no commitment, including a commitment made in remedy of an earlier one, can be treated as fixed.

Some investors took a similar view and acted on it. Ten companies holding interests in five Romanian photovoltaic plants brought arbitration proceedings over the amendments, and in February 2024 a tribunal found that the Energy Charter Treaty had been breached and ordered Romania to pay €42.2 million in compensation, together with interest and costs (European Commission, 2026). The finding is external to the analysis presented here and reaches it by a different route, but it supports the same reading: that the amendments removed value from parties who had already invested, notwithstanding that no entitlement was formally withdrawn. The sequel is instructive in its own right. In July 2026 the Commission opened an in-depth investigation into whether payment of the award would itself constitute State aid incompatible with the internal market, and Romania gave notice of withdrawal from the Energy Charter Treaty in May 2026, with effect from May 2027. The mechanism through which these investors obtained a remedy is being closed as the remedy itself is contested.

6.2 Frequency of revision and stability of commitment

The comparison in Section 4 points to a distinction that is easily obscured. Germany revised its renewable support framework repeatedly across the period examined, through the 2012 photovoltaic amendment and the successive reforms of the renewable energy act. By any count of legislative interventions, Germany was not a country of stable energy policy. Yet Germany records the shortest interruption to renewable electricity deployment of any member state, and its share rose without a break from 18.2 per cent in 2010 to 57.9 per cent in 2025.

What distinguished the German revisions was their scope. They set the terms on which future installations would be supported and left installations already commissioned on the terms under which they had been built. An investor reading the German record would conclude that the terms of new projects were subject to change, which is ordinary commercial risk, but that the terms of a completed project were not.

Romania revised its framework less often and produced the opposite result. The relevant variable therefore appears to be not how frequently a government legislates, but whether its legislation reaches capital that has already been committed. A support scheme that is adjusted every two years but never retroactively offers a more reliable basis for investment than one that is adjusted once in a decade and reaches backwards when it is.

This has a practical implication for scheme design. The protection that matters is not a guarantee that terms will not change. No government can offer that credibly, and investors do not expect it. What matters is a guarantee that changes will apply prospectively — and, more particularly, a mechanism that makes such a guarantee costly to break.

6.3 Limitations

Three limitations bear on the interpretation of these results.

The comparative analysis is descriptive. It establishes that periods of stagnation follow retroactive interventions in every case with a coded intervention date, and that the member state with the most consistently prospective record shows the shortest interruption. It does not establish causation, and Section 6.1 sets out the alternative explanations that operated simultaneously in the Romanian case. The identification of stagnation periods relies on a threshold chosen for consistency rather than derived from theory. Deployment stalls for many reasons, and Section 4.2 shows that most member states record such a period at some point.

The valuation in Section 5.3 rests on assumptions that are stated rather than estimated. The discount rate is imposed, results are reported across a range, and the calculation assumes that deferred certificates are released in full and at unchanged real value — the assumption most favourable to the position that no support was withdrawn. The figures indicate a magnitude, not a measured return.

Finally, the analysis addresses one instrument class in one member state in detail. Whether the transmission of policy risk observed here is characteristic of quota-and-certificate schemes generally, or specific to the Romanian design, cannot be settled on a single case. The absence of comparable studies of certificate-based schemes in Central and Eastern Europe is itself a gap worth addressing.

7. Conclusions

Romania raised the renewable share of its electricity consumption by eleven percentage points between 2010 and 2014 and by one point over the seven years that followed. In 2010 it led the four countries examined here; by 2025 it ranked third, overtaken by both Spain and Germany.

This paper has examined the interruption through the credibility of policy commitments rather than their generosity. In 2013 Romania withheld from trading a portion of the green certificates owed to producers whose installations

were already operating. The measure reduced no producer's entitlement, and the European Commission records that support levels for installations already in the scheme were never cut. But release was promised by 2020, the withholding was then extended to 2020 for solar producers, and recovery runs to 2030. Discounted at conventional rates, a substantial share of the value of the support earned in those years was removed — about a fifth for wind producers at a nine per cent rate. The certificates were, in addition, designed to be traded within twelve months, and the price at which they were then selling sat at the floor of its legal band, unchanged to the cent, from 2016 to 2020.

The comparative evidence is consistent with this reading without confirming it. Every case with a coded intervention date records prolonged stagnation beginning at or shortly after it. Stagnation is nonetheless common and has many causes, and the association observed here is suggestive rather than diagnostic.

Two implications follow for the design of support schemes. The first is that the distinction between prospective and retroactive revision deserves more weight than the frequency of revision, both in assessing a country's policy record and in designing instruments intended to attract private capital. A scheme revised often but only forward offers firmer ground than one revised rarely and backwards.

The second concerns the form in which commitments are made. Romania's support was established by statute, and a statute can be amended by a subsequent statute. The deferral, the schedule for reversing it, and the amendment of that schedule were each accomplished in this way. What redress investors eventually obtained came not from Romanian law but from the Energy Charter Treaty, and Romania has given notice of withdrawal from that treaty with effect from 2027 (European Commission, 2026). Instruments now being adopted across the Union, including in Romania, place support terms in contracts between producers and a designated counterparty. Whether that form proves more durable than legislation is an open question, and one made more pressing by the closing of the external route. The next decade of European energy policy will answer it; the Romanian record suggests it is the right question to ask.

References

Blackman, Gerald and Zeckhauser, Richard. 1992. "Fragile commitments and the regulatory process". *Yale Journal on Regulation*, 9: 73.

Boomsma, Trine Krogh and Linnerud, Kristin. 2015. "Market and policy risk under different renewable electricity support schemes". *Energy*, 89: 435-448.

Boomsma, Trine Krogh, Meade, Nigel and Fleten, Stein-Erik. 2012. "Renewable energy investments under different support schemes: a real options approach". *European Journal of Operational Research*, 220(1): 225-237.

Buzogány, Aron and Davidescu, Simona. 2022. "Energy Governance in Romania". In Knodt, Michèle and Kemmerzell, Jörg (eds), *Handbook of Energy Governance in Europe*. Cham: Springer, pp. 993-1017.

Chassot, Sylviane, Hampl, Nina and Wüstenhagen, Rolf. 2014. "When energy policy meets free-market capitalists: the moderating influence of worldviews on risk perception and renewable energy investment decisions". *Energy Research & Social Science*, 3: 143-151.

Dalby, Peder Andreas Oppebøen, Gillerhaugen, Gisle, Hagspiel, Verena, Leth-Olsen, Tord and Thijssen, Jacco J. J. 2018. "Green investment under policy uncertainty and Bayesian learning". *Energy*, 161: 1262-1281.

European Commission. 2011. *Decision on State Aid SA.33134 (2011/N) — Romania: Green certificates for promoting electricity from renewable sources, Brussels.*

European Commission. 2015. *Decision C(2015) 2886 final, State Aid SA.37177 (2015/NN) — Romania: Amendments to the green certificates support system for promoting electricity from renewable sources*, Brussels, 4 May 2015.

European Commission. 2026. *Commission opens in-depth investigation into arbitration award ordering Romania to pay compensation to ten energy investors, Press release IP/26/1685, case SA.113263*, Brussels, 29 July 2026.

Eurostat. 2026. *Share of energy from renewable sources* (nrg_ind_ren), Luxembourg, accessed 20 September 2026.

Eyraud, Luc, Wane, Abdoul Aziz, Zhang, Changchang and Clements, Benedict. 2011. "Who's going green and why? Trends and determinants of green investment". *IMF Working Papers*, 11/296: 1-38.

García-Álvarez, María Teresa, Cabeza-García, Laura and Soares, Isabel. 2017. "Analysis of the promotion of onshore wind energy in the EU: feed-in tariff or renewable portfolio standard?". *Renewable Energy*, 111: 256-264.

García-Álvarez, María Teresa, Cabeza-García, Laura and Soares, Isabel. 2018. "Assessment of energy policies to promote photovoltaic generation in the European Union". *Energy*, 151: 864-874.

Guvernul României. 2013a. *Ordonanţa de urgenţă nr. 57/2013 privind modificarea şi completarea Legii nr. 220/2008 pentru stabilirea sistemului de promovare a producerii energiei din surse regenerabile de energie*, Monitorul Oficial al României, Partea I, nr. 335, 7 iunie 2013.

Guvernul României. 2013b. *Hotărârea Guvernului nr. 994/2013 privind aprobarea măsurilor de reducere a numărului de certificate verzi în situaţiile prevăzute la art. 6 alin. (2) lit. a), c) şi f) din Legea nr. 220/2008*, Monitorul Oficial al României, Partea I, nr. 788, 16 decembrie 2013.

Guvernul României. 2017. *Ordonanţa de urgenţă nr. 24/2017 privind modificarea şi completarea Legii nr. 220/2008 pentru stabilirea sistemului de promovare a producerii energiei din surse regenerabile de energie şi pentru modificarea unor acte normative*, Monitorul Oficial al României, Partea I, nr. 224, 31 martie 2017.

Hellenic Republic. 2012. *Law 4093/2012, Article I, Paragraph I.2, Government Gazette A 222*, 12 November 2012.

Helm, Dieter, Hepburn, Cameron and Mash, Richard. 2003. "Credible carbon policy". *Oxford Review of Economic Policy*, 19(3): 438-450.

Karneyeva, Yuliya and Wüstenhagen, Rolf. 2017. "Solar feed-in tariffs in a post-grid parity world: the role of risk, investor diversity and business models". *Energy Policy*, 106: 445-456.

Kydland, Finn E. and Prescott, Edward C. 1977. "Rules rather than discretion: the inconsistency of optimal plans". *Journal of Political Economy*, 85(3): 473-491.

Laffont, Jean-Jacques and Tirole, Jean. 1996. "Pollution permits and environmental innovation". *Journal of Public Economics*, 62(1-2): 127-140.

Lüthi, Sonja and Wüstenhagen, Rolf. 2012. "The price of policy risk - empirical insights from choice experiments with European photovoltaic project developers". *Energy Economics*, 34(4): 1001-1011.

Ministerul Energiei. n.d. *Schema de sprijin prin certificate verzi*, Bucureşti, accessed 26 September 2026.

Mitchell, Catherine, Bauknecht, Dierk and Connor, Peter M. 2006. "Effectiveness through risk reduction: a comparison of the renewable obligation in England and Wales and the feed-in system in Germany". *Energy Policy*, 34(3): 297-305.

Năstase, Gabriel, Şerban, Alexandru, Dragomir, George, Brezeanu, Alin Ionuţ and Bucur, Ion. 2018. "Photovoltaic development in Romania. Reviewing what has been done". *Renewable and Sustainable Energy Reviews*, 94: 523-535.

Năstase, Gabriel, Şerban, Alexandru, Năstase, Andrei Florin, Dragomir, George, Brezeanu, Alin Ionuţ and Iordan, Nicolae Florin. 2017. "Hydropower development in Romania. A review from its beginnings to the present". *Renewable and Sustainable Energy Reviews*, 80: 297-312.

OPCOM. 2013-2020. *Raport anual de sinteză a rezultatelor funcţionării pieţelor centralizate operate de OPCOM*, Bucureşti, annual editions 2013 to 2020.

Parlamentul României. 2008. *Legea nr. 220/2008 pentru stabilirea sistemului de promovare a producerii energiei din surse regenerabile de energie*, republicată în Monitorul Oficial al României, Partea I, nr. 577, 13 august 2010.

Parlamentul României. 2014. *Legea nr. 23/2014 pentru aprobarea Ordonanţei de urgenţă a Guvernului nr. 57/2013*, Monitorul Oficial al României, Partea I, nr. 184, 14 martie 2014.

Parlamentul României. 2018. *Legea nr. 184/2018 pentru aprobarea Ordonanţei de urgenţă a Guvernului nr. 24/2017 privind modificarea şi completarea Legii nr. 220/2008 pentru stabilirea sistemului de promovare a producerii energiei din surse regenerabile de energie şi pentru modificarea unor acte normative*, Monitorul Oficial al României, Partea I, nr. 635, 20 iulie 2018.

Ritzenhofen, Ingmar and Spinler, Stefan. 2016. "Optimal design of feed-in-tariffs to stimulate renewable energy investments under regulatory uncertainty - a real options analysis". *Energy Economics*, 53: 76-89.

Sendstad, Lars H., Hagspiel, Verena, Mikkelsen, Wilhelm Jebsen, Ravndal, Ruben and Tveitstøl, Martin. 2022. "The impact of subsidy retraction on European renewable energy investments". *Energy Policy*, 160: 112675.

Transelectrica (Compania Naţională de Transport al Energiei Electrice). 2018. *Procedura de emitere a certificatelor verzi pentru energia electrică produsă din surse regenerabile de energie*, Cod TEL 03.11, Revizia 7, București.

Zamfir, Andreea, Colesca, Sofia Elena and Corbos, Razvan-Andrei. 2016. "Public policies to support the development of renewable energy in Romania: A review". *Renewable and Sustainable Energy Reviews*, 58: 87-106.

Appendix Table A1 Longest stagnation period by member state, 2010-2025

Member state	Start	End	Duration (years)	Coded intervention
Austria	2014	2017	4	—
Belgium	2015	2017	3	—
Bulgaria	2013	2017	5	2012
Croatia	2014	2017	4	—
Cyprus	2014	2018	5	—
Czechia	2014	2022	9	2011
Denmark	2023	2025	3	—
Estonia	2012	2017	6	—
Finland	2010	2012	3	—
France	2014	2017	4	—
Germany	2012	2013	2	—
Greece	2013	2016	4	2012
Hungary	2010	2018	9	—
Ireland	2020	2023	4	—
Italy	2014	2019	6	2014
Latvia	2017	2024	8	—
Lithuania	2016	2019	4	—
Luxembourg	2010	2013	4	—
Malta	2020	2025	6	—
Netherlands	2010	2015	6	—
Poland	2014	2019	6	market
Portugal	2015	2019	5	not dated
Romania	2014	2021	8	2013
Slovakia	2014	2023	10	—
Slovenia	2010	2019	10	—
Spain	2013	2019	7	2013
Sweden	2015	2018	4	—

Source: authors' calculations from Eurostat, nrg_ind_ren (REN_ELC), applying the rule set out in Section 3.3 at a two-percentage-point threshold. Coded interventions follow Sendstad et al. (2022), with Romania added; Greece is dated to Law 4093/2012 and Romania to Emergency Ordinance 57/2013. Poland's certificate revenues fell through market oversupply rather than legislative action. Portugal is identified in the literature as a retroactive case but could not be dated to a single instrument. A dash indicates no documented retroactive episode.

CAN PUBLISHED DIGITAL TRANSFORMATION CASES TEST A CONFIGURATIONAL THEORY? A THREE-VALUED TESTABILITY DIAGNOSIS OF PLUS–D

Hirotoshi Sato,
Cristian Vlad[*]

Abstract

Can published case studies test configurational explanations of digital transformation and resilience? We diagnose the testability of PLUS–D using eleven European goods-producing SME and mid-sized cases recoded from three published studies. Nine cases report transformation progression under chronic disturbance; only two report resilience under an acute shock. Present, absent and unreported conditions are evaluated with strong-Kleene logic, separating realized at-risk instances from corpus-uninstantiated and missingness-blocked claims. Only P5 has a realized instance, but that firm comes from a result-referentially selected source study; its rejecting-stance/stalled-progression correspondence is therefore an illustration, not validation. Three propositions are corpus-uninstantiated and four are blocked by missing evidence. All three cross-theory linkages remain untested. The contribution is an information-systems-oriented testability diagnosis for reusing published digital-transformation cases: it identifies what the record can adjudicate, how reporting endogeneity limits inference and what primary data a valid test requires.

Keywords: digital transformation; information systems; secondary case analysis; configurational theory; three-valued logic; testability; SMEs

JEL Classification: L26; O33; M15; L60

1. Introduction

After Russia's invasion of Ukraine, 68% of EU firms faced energy-bill increases of 25% or more, manufacturing most exposed at 74% [1, p. 12]. Digital technology is not scarce: 70% of EU firms — 77% in manufacturing — already use an advanced technology [1, p. 30]. SMEs differ from large firms in depth, not access: 33% implement several simultaneously, against 50% [1, p. 30].

Shallow adoption plus shock exposure concentrated on manufacturing poses a question linear adoption models cannot answer. Published evidence documents family manufacturers whose transformation stalled under owners rejecting digitalization on identity grounds [2] alongside a five-employee firm that built a digital sales channel within weeks of losing its market [3]: effort and outcomes are not proportional.

[*] Hirotoshi Sato is PhD Candidate at the Bucharest University of Economic Studies.
Cristian Vlad is Partner Faculty, Globis University Professor, Nagaoka University of Science and Technology.

Building on paradox theory [4], threat–rigidity theory [5] and dynamic capabilities [6], PLUS–D proposes configurational explanations over Paradoxical leadership (P), Learning and sensing capabilities (L), Unabsorbed slack (U), Shock exposure (S) and Digitalization (D, presence-anchored), joined to decision architecture and the pivotal rights-holder's stance. This study does not claim to validate that framework. Instead, it asks whether published digital-transformation cases can place its propositions at empirical risk. Nine of the eleven cases describe transformation progression under chronic industry disturbance; only two describe crisis resilience under an acute shock, so the two outcomes are not pooled as one construct:

RQ: To what extent can published digital-transformation case evidence adjudicate PLUS–D's configurational propositions, and which measurement, sampling or logical constraints prevent a valid test?

Two pre-stated strata, a NACE-anchored sector rule and a codebook govern the recoding of eleven firm-level cases. A formal apparatus (Section 4) — strong-Kleene semantics, severity σ and its completable ceiling, codability κ and property-space coverage — determines case-wise evidentiary status and diagnoses what the record can decide; corpus-level thresholds and sampling eligibility are declared separately. PLUS–D is the object of this information-systems-oriented testability diagnosis, not a framework claimed as verified.

An earlier conference paper [7] introduced the three lenses, the linkage concept, the condition set, Figure 1 and conceptual P1–P5. New here are the RQ, corpus, three-valued apparatus, all recoding, diagnostics, results and discussion. The evaluation is exploratory rather than pre-registered: P1, P3 and P4 were repaired after their original clauses proved ill-formed in the measurement language; P5b and Rule D-t are revision-stage amendments; P6 is corpus-derived. These timings are carried into the proposition and method sections rather than represented as an ex-ante confirmatory test.

2. Theoretical background

2.1. Three lenses and their specification gaps

Paradox theory treats organizations as sites of persistent tensions to be engaged, not resolved, through acceptance and iterating resolution — notably temporal or structural separation [4]; paradoxical leader behaviours link to adaptive outcomes [8], though both–and feasibility is contested [9]. Separation, however, presupposes deployable resources, sensing routines and decision latitude the theory leaves unspecified.

Threat–rigidity theory predicts the opposite pathology: threat produces stress, restricted information processing and constricted control, so organizations revert to well-learned routines precisely when novelty is required [5]. Threat-versus-opportunity appraisal moderates this [10], [11]; unspecified are its preconditions — the scanning, resources and decision rights under which an opportunity appraisal survives a shock.

Dynamic capabilities theory supplies the reconfiguration vocabulary — sensing, seizing, transforming [6]. Sensing and learning capabilities recur as SME transformation triggers [12], while the controlling family's disposition governs whether they are exercised [2]; underspecified is the configuration under which sensed opportunities are seized, since sensing without deployable resources or owner sponsorship yields awareness without action [13].

2.2. The conversion problem in information systems research

Information systems research frames the dependent variable as conversion: IT creates value as digital options requiring complementary capabilities [14]; returns follow depth and integration rather than adoption [15]; business-model experimentation mediates the payoff [16]. Resilience is a capability process [17] resting on antecedent endowments, notably unabsorbed slack [18], [19]; SME evidence links it to digitalization only indirectly, through resource availability [20], and finds configurations rather than single levers [21]. Adoption is not conversion quantitatively either: across 245 North American SMEs the depth and scope of crisis-time digitalisation relate to resilience in inverted-U form [22] — an external-validity contrast, not a European replication. Missing is a testable account of combinations, supplied by configurational logic [23]: equifinality [24] and causal asymmetry — failure configurations are not Boolean complements of success ones [25] — are invisible to linear models.

3. The PLUS–D framework

3.1. Integration mechanism

The lenses fail in complementary ways; PLUS–D's contribution is three cross-theory linkages no lens supplies alone.

1. **Paradox × slack (the material-precondition linkage).** Both–and framing becomes practice only when deployable resources fund the separation it requires.

2. **Threat–rigidity × paradox and prior crisis experience (appraisal survival).** Opportunity appraisal moderates rigidity [10]; PLUS–D proposes that an earlier crisis, when explicitly invoked in the response repertoire, supplies an experiential basis for interpreting a new shock, while paradoxical framing keeps alternative responses available.

3. **Capabilities × decision architecture (sponsorship).** Sensing converts into seizing only when decision-rights holders carry the learning agenda: in owner-dominated firms this sharpens Teece's [6] entrepreneurial-management argument into an observable ex-ante condition and specializes the family-firm ability–willingness conjunction [26], [27].

3.2. Conditions

- **P — Paradoxical leadership orientation:** both–and framing of competing demands, enacted through temporal or structural separation [4], [8].
- **L — Learning and sensing capabilities:** scanning, experimentation and absorption of external knowledge [6], [12].

- **U — Unabsorbed slack:** a pre-existing stock of uncommitted resources — financial headroom, spare capacity, managerial attention [18], [19]; in-crisis deployability events are recorded separately.
- **S — Shock exposure:** *chronic*, sustained discontinuous pressure (disruption of a mature industry); *acute*, a discrete exogenous shock (a pandemic lockdown).
- **D — Digitalization:** depth and integration beyond isolated tools [15], time-indexed as D_t0 and read before the disturbance (Section 5.2).
- **DA — Decision architecture and stance:** the allocation of decision rights (central, decentralized, balanced), plus Stance, recording the pivotal rights-holder's disposition toward the digital agenda (rejecting ≺ passive ≺ sponsoring), read from ex-ante indicators (personal digital use, sponsorship of the first digital project, digital hiring), so stance is never inferred from success. Socioemotional wealth puts family principals at both ends [28]: not ownership but the observable stance is the condition. Stance re-operationalizes the willingness construct of the corpus's principal source [2]; since De Massis et al. [26] formalize ability and willingness as jointly sufficient for family-oriented particularistic behavior, the DA × Stance conjunction is that claim re-expressed set-theoretically for the digital agenda, resource discretion becoming decision rights and family-centred goals an observable technology-domain stance [27].
- **PCE — Prior crisis experience:** documented survival of an earlier crisis, invoked in the response repertoire.

Outcome. Regime-specific: transformation progression (advanced / partial / stalled) under chronic disturbance [17]; crisis resilience (high / partial / low) under acute shock. Grades compare only within regime.

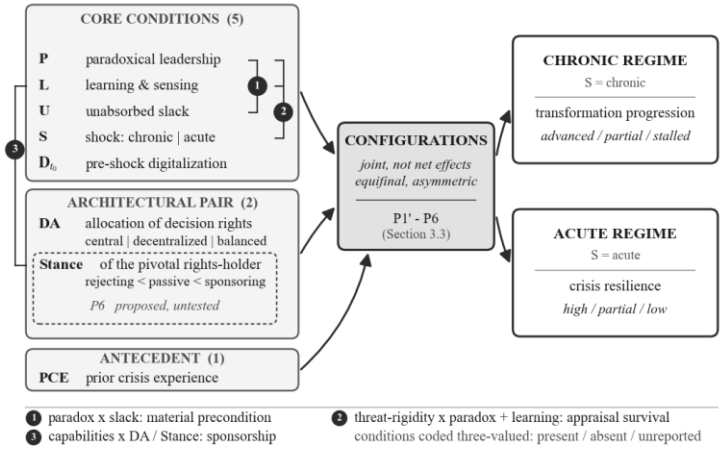


Figure 1. The PLUS–D framework: eight elements — five core conditions (P, L, U, S, D), the decision-architecture–stance pair and prior crisis experience — whose configurations, not net effects, produce regime-specific outcomes; the stance element carries P6, annotated as proposed and untested.

3.3. Propositions in set-theoretic form

Each proposition is a sufficiency claim whose antecedent is a conjunction of literals evaluated three-valued (Section 4.1). Shock regime is a literal of the antecedent, not an external scope parameter, so an unreported regime evaluates to u rather than silently excluding the case, and the confirming-instance threshold is counted within regime; the same device splits the former P4′ into P4a and P4b. The success/failure asymmetry is deliberate [25].

- **P1′ — Slack-enabled paradox pathway.** P ∧ U ∧ D_t0 ∧ (S = chronic) ⊆ O_advanced; the binary t_0 anchor replaces P1's ordinal digitalization clause, a replacement rather than a weakening.
- **P2 — Capability-driven adaptation pathway.** L ∧ D_t0 ∧ (DA = decentralized) ∧ (S = acute) ⊆ O_high, even without unabsorbed slack.
- **P3′ — Experience-enabled adaptive vigilance pathway.** PCE ∧ P ∧ ¬D_t0 ∧ (S = acute) ⊆ O_high, prior crisis experience and paradoxical framing converting threat arousal into vigilant scanning.
- **P4a — High-investment trap, chronic regime.** D_t0 ∧ (DA = central) ∧ ¬U ∧ ¬P ∧ (S = chronic) ⊆ O_stalled.
- **P4b — High-investment trap, acute regime.** D_t0 ∧ (DA = central) ∧ ¬U ∧ ¬P ∧ (S = acute) ⊆ O_low. Resource strain plus information-processing constriction converts investment into rigidity [5], [16]; the proceedings version's regime-indexed consequent [7] becomes this pair.
- **P5 — Identity lock-in.** (Stance = rejecting) ∧ (DA = central) ∧ ¬L ∧ (S = chronic) ⊆ O_stalled.
- **P5b — Distributed rights.** (Stance = rejecting) ∧ (DA ≠ central) ∧ (S = chronic) ⊆ ¬O_stalled: that stance is not decisive where rights are distributed.
- **P6 — Sponsorship pathway (proposal).** (Stance = sponsoring) ∧ L ∧ D_t0 ∧ (DA = central) ∧ (S = chronic) ⊆ O_advanced: its former scope condition, owner-led rights, folded in as DA = central and L carried because the proposal instantiates the capabilities × decision-architecture linkage (Section 3.1). Derived in Section 6.3, proposed for primary testing.

Seven stated propositions and one proposal result: P5b a declared amendment, P4a/P4b the folding-induced split of P4′ (Section 4.2).

4. Formal apparatus

4.1. Three-valued coding and strong-Kleene semantics

Coding is an assignment v: C × $\mathcal{C}$ → {1, 0, u} over the conditions of Section 3.2 and the case set $\mathcal{C}$: present (1) on explicit evidence, absent (0) only on explicit negation or directly contradictory evidence, undetermined (u) on silence or ambiguity. Literals take the forms c, ¬c, (X = x) and (X ≠ x), and every literal over a u-cell evaluates to u.

Antecedents are conjunctions of literals evaluated in strong-Kleene logic K_3 [29, §64, pp. 332–340] (Table 1, panel A): $[\![\text{Ant}(P_j)]\!](i) = 1$ if every literal is 1, 0 if any literal is 0, u otherwise. K_3's third value is read as *unknown* — unreported — not as Kleene's *undefined*: the distinction is not terminological, since the unknown reading motivates the strong tables and the undefined reading the weak ones [29]. Under the information order of Section 4.2 the strong tables are the greatest monotone extension of the classical tables, so the choice is forced rather than licensed. Two features matter: 0 dominates u, so one absent condition settles an otherwise unreadable case; and excluded middle fails, $[\![c \vee \neg c]\!](i) = u$ wherever $v(c, i) = u$, so silence-is-not-absence follows from the semantics.

Table 1. Strong-Kleene semantics and the antecedent–outcome verdict grid

A. Conjunction $[\![x \wedge y]\!]$	y = 1	y = u	y = 0
x = 1	1	u	0
x = u	u	u	0
x = 0	0	0	0
B. Negation $[\![\neg x]\!]$	x = 1 → 0	x = u → u	x = 0 → 1
C. Verdict grid $[\![\text{Ant}]\!](i)$	O(i) = O_pred	O(i) ≠ O_pred	Contribution
1	**1** — confirming instance, i ∈ I(P_j)	**0** — contradicting instance, i ∈ F(P_j)	σ increases by 1
u	**1** (u ∨ 1) — true without risk	**u** — undetermined	none; corpus-wide → Undetermined (type III)
0	**1** — vacuously true	**1** — vacuously true	none; corpus-wide → antecedent uninstantiated (type II)

Note. Panels A and B give the strong-Kleene truth tables for the connectives used in antecedent evaluation [29, §64, esp. pp. 332–335]; panel C gives the case-wise K_3 value of $[\![\neg Ant \vee O]\!](i)$ in bold, collapsed onto whether the observed outcome is the predicted one. Four of the six cells make the implication true; only the $[\![Ant]\!] = 1$ row puts it at risk, so σ counts that row alone (truth without risk is not support). Source: derived.

4.2. Deriving the verdict rules; the fifth category

A proposition $\text{Ant}(P_j) \subseteq O_pred$ asserts sufficiency; case-wise it is the material implication $[\![\neg \text{Ant} \vee O]\!](i)$, and since outcomes are fully coded the informative object is the 3 × 2 grid of antecedent value against outcome match (Table 1, panel C). Nothing turns on this definition rather than Łukasiewicz's primitive →, which differs in one cell only, both arguments undetermined: outcomes being coded in eleven of eleven cases, that cell is never instantiated and the two agree at all eighty-eight proposition–case pairs.

The K_3 grid determines only case-wise evidentiary status: confirming, contradicting, undetermined or vacuously true. It does not derive numerical

thresholds or sampling eligibility for corpus-level verdicts. Let C = I \ F denote confirming instances. We therefore apply a separately declared, mutually exclusive external decision rule in this order: **Refuted** if |F| ≥ 2; **Revision indicated** if |F| = 1; **Supported** if |F| = 0, |C| ≥ 2 and the cases are eligible for support-side inference; **Provisionally supported** if |F| = 0, |C| = 1 and support-side eligibility holds; **Illustrative pattern only** if |F| = 0 and |C| ≥ 1 but result-referential sampling precludes support-side inference; **Undetermined** if σ = 0 and at least one antecedent evaluates to u; and **antecedent uninstantiated** if every antecedent evaluates to 0. The two-instance threshold and support-side eligibility rule are external decisions, not consequences of K_3.

The grid also exposes a category the proceedings rules did not name [7]: σ = 0 arises either because some antecedent is undetermined, or because every one evaluates to 0, no *case* being undetermined — individual cells may be, where a coded literal already forces the conjunction to 0. The second is vacuously true on this case set: **antecedent uninstantiated** (type II). This corpus-level label does not claim that the logical formula is globally unsatisfiable.

Three verdict-rule amendments are declared, not passed off as mechanical rule application [30]. First, the component-contradiction clause is narrowed to necessity-in-path claims: under equifinality a case matching every literal but one, yet carrying the predicted outcome, exhibits a second sufficient path and cannot contradict a sufficiency claim [24]. Only P5b asserts a within-path necessity — centralized rights necessary for a rejecting stance to stall the firm — so the clause is specified but not exercised, σ(P5b) = 0. Second, the refutation-side rules are made mutually exclusive by distinguishing one contradicting instance from two or more. Third, P5b is itself a revision-era split of the proceedings version's converse clause. Rule D-t (Section 5.2) is a measurement amendment and is counted separately.

Monotonicity: refutations persist, support-side patterns do not. Order the truth values by information, u ⊏ 0 and u ⊏ 1, extended pointwise: v ⊑ v′ means v′ fills some undetermined cells of v. The strong-Kleene connectives are monotone in ⊑, so ⟦Ant⟧*v(i)* ⊑ ⟦*Ant*⟧{v′}(i) and, outcomes being fully coded, I_v ⊆ I_{v′}, F_v ⊆ F_{v′} and σ_v ≤ σ_{v′}. Thus F only grows; a refutation-side verdict persists, whereas a support-side pattern is defeasible. Type II is terminal under completion because 0 is already maximal, while type III is non-terminal. Numerical verdict thresholds and sampling eligibility remain external rules. P5 currently has σ = 1 and σ_max = 2; completing Steel's Stance as rejecting would add a matching instance but would not remove the sampling limitation.

4.3. Severity σ, codability κ, property-space coverage

Let I(P_j) = {i ∈ 𝒞 : ⟦Ant⟧(i) = 1} and F(P_j) = {i ∈ I(P_j) : O(i) ≠ O_pred}. **Realized test severity** is σ(P_j) = |I(P_j)|, the number of cases that

put the proposition at risk; it counts at-risk cases, not independent evidence chains. Because $[\![\text{Ant}]\!](i) = 1$ only if every literal evaluates to 1, $I(P_j) \subseteq E(\ell) := \{i \in \mathcal{C} : [\![\ell]\!](i) = 1\}$ for every literal ℓ, so $\sigma(P_j) \leq \min_\{\ell \in \text{Ant}(P_j)\} |E(\ell)|$ — a bound read from the antecedent columns alone, computable before any outcome is coded and needing no dominance relation. Marginals do not deliver σ: P5b's two substantive literals have two positive instances each but disjoint extensions, so the bound is 2 while $\sigma(P5b) = 0$.

Measurement dividend. The completable ceiling of severity is $\sigma_max(P_j) = |\{i \in \mathcal{C} :$ no literal of $\text{Ant}(P_j)$ evaluates to 0 at $i\}|$ — the cases at 1 or u, each at-risk under some completion and no other case ever. The difference $\sigma_max - \sigma$ is the **measurement dividend**: severity obtainable from these eleven cases by reporting alone. Table 5 gives $\sigma_max = (8, 0, 2, 7, 0, 2, 0, 5)$ against $\sigma = (0, 0, 0, 0, 0, 1, 0, 0)$ — up to 23 further at-risk instances in the sum of proposition-specific ceilings. Those gains are not jointly attainable because P1′ and P4a require opposite values of P and U at shared cases; the best single completion raises total σ from 1 to 17. $\sigma_max = 0$ is the arithmetic content of type II.

Extensional collapse. Since $I(\text{Ant}) = \bigcap_\{\ell \in \text{Ant}\} E(\ell)$, a literal ℓ' is *extensionally redundant* whenever $E(\ell) \subseteq E(\ell')$: deleting ℓ' leaves I, F and σ unchanged. Here E(Stance = rejecting) = {Textiles} is contained in both E(¬L) and E(DA = central), so the full P5 antecedent cannot be distinguished from weaker antecedents retaining rejecting Stance. The guarantee covers I, F and σ only; σ_max and untestability type need not be invariant. Like σ and κ, the extensions ignore outcomes, so collapse is a pre-coding diagnostic.

Six literals here have empty extension, in three structurally distinct kinds. U, ¬U, PCE and D_t0 are empty through reporting and leave their cases at u; DA = decentralized is empty on a fully coded condition, so it forces 0 rather than u, which makes P2 uninstantiated on this corpus; and ¬P is a distinct structural blocker, P being coded present at three cases and negated at none (3/0/8), so absent paradox cognition is unobserved rather than unreported (Section 6.4). Every missingness-blocked proposition contains at least one such literal (P1′: U, D_t0; P3′: PCE; P4a: D_t0, ¬U, ¬P; P6: D_t0), so its bound is attained by a single column.

σ differs from the antecedent-set case counts inside consistency denominators [31], [32] in role, not arithmetic: computed before outcomes are read and used as a design instrument rather than a parameter of fit. The novelty claimed is narrow — multi-value QCA multiplies a condition's *levels* [33], whereas the third value here is a *truth* value for unreported cells. The truth tables determine case-wise evidentiary status; the corpus-level thresholds remain declared decision rules. We know of no prior treatment of missingness in set-theoretic secondary coding that combines these elements; the claim is open to correction.

Codability κ(c) is the realized share of non-u cells for condition c — an ex post property of this corpus, not of the genre (Table 4); U and PCE stand at 0.000. The **property space** Ω is the product of the conditions' level sets, $|\Omega| = 2^4 \times 2 \times 3 \times 3 \times 2 = 576$. A point is instantiated only if a case is coded on every condition, and *none here is: the rate is 0/576 = 0.0%* — a corollary of κ(U) = κ(PCE) = 0, not an independent finding. On the fully coded conditions (L, DA, S), |Ω_coded| = 12 and five configurations are observed: coverage 5/12 = 41.7% (Section 6.2). Parameters of fit are deferred, but not for incomputability: consistency clears the pre-registered thresholds there (5/6 = 0.833 w.r.t. O_advanced, 2/2 = 1.000 w.r.t. O_stalled), but five of the eight conditions are dropped, so any consistent point is confounded with the unmeasured ones [31], [34].

4.4. Pre-coding testability screening

Severity is forecastable before coding from two rates: ρ_report(c), the probability that a case study of this genre reports condition c at all, and ρ_pos(c), the probability that a reported value is the positive one the literal requires; then $E[\sigma(P_j)] \approx |\mathcal{C}| \cdot \Pi_c \rho_report(c) \cdot \rho_pos(c)$. Case studies of SME digitalization report capabilities, governance and technology stock routinely, slack stocks and prior-crisis histories only incidentally, so ρ_report(U) ≈ ρ_report(PCE) ≈ 0. It is operatively a zero-factor screen: one condition with ρ_report ≈ 0 drives the product to ≈ 0, so every proposition carrying U or PCE had E[σ] ≈ 0 before any case was read. Both rates are calibrated on the same three-study genre sample they screen, so the pre-coding claim is illustrated, not validated; validation requires a held-out sample of the genre. The division of labour with κ is exact: κ is ex post and corpus-specific, ρ_report ex ante and genre-level.

The product form assumes independent reporting, which the corpus does not provide. Rates calibrated and applied on these same three studies illustrate the arithmetic rather than validate the screen; the assumption-free severity bound remains the operative diagnostic.

The apparatus separates three kinds of untestability. **Type I, ill-formed:** the antecedent is not expressible in the measurement language (an ordinal predicate over a binary condition, say); the repair is restatement at no data cost, applied to **P1** and **P3** — restated as P1′ and P3′ — and to **P4**'s consequent, regime-indexed as P4′ and then split into P4a and P4b (Section 3.3). P6 is a new proposal and P5b a declared amendment, neither a type-I repair. **Type II, antecedent uninstantiated:** the claim is well formed, but every case-level antecedent evaluates to 0; only new cases help. **Type III, missingness-blocked:** satisfiability is undecided because required cells are u; only measurement helps. The apparatus is bounded to conjunctive antecedents over crisp or ordinal conditions with regime-scoped graded outcomes, not necessity claims, disjunctive antecedents or fuzzy membership.

5. Corpus and coding

5.1. Population, strata, sector rule, and screening

The corpus combines criterion screening with explicitly disclosed theoretical sampling, in the lineage of case-survey and meta-synthetic reuse of published case evidence [35], [36] — a conceptual synthesis, not a systematic review. In particular, the three [2] cases were retained as a result-referential contrast — two stalled willingness-suppressing cases and one enabling case — and cannot provide confirmatory support-side evidence for P5.

Two strata were stated before screening. **Stratum 1 — EU-definition SMEs:** goods producers (NACE A–C) under 250 employees, headcounts marginally above the cap entering flagged, with no verdict resting on them. **Stratum 2 — family-controlled mid-sized manufacturers:** majority family-owned, family-managed goods producers of 250–1,000 employees concentrating decision rights in the family; the ceiling is an authorial scope decision and these cases are scope-flagged.

The sector rule is NACE-anchored and outcome-independent in content — a firm qualifies if it produces physical goods — but its cost is recorded: excluding services removes the corpus's only candidate acute-shock failure, the restaurant in [3]. The disturbance criterion requires a documented chronic or acute exogenous disturbance; the geopolitical shock motivating the programme has no firm-level case evidence meeting it [37], so the test draws on two documented European regimes — chronic digital disruption of mature manufacturing and the acute COVID-19 shock.

Six criteria were applied at study and case screening: (C1) stratum membership; (C2) goods-producing, NACE A–C; (C3) digitalization described; (C4) disturbance documented; (C5) a case-level resilience-relevant outcome; (C6) three conditions codable. Two study exclusions cut against convenience — [13], the closest CEE context, and [38]; [39] fell on the same criteria and enters as narrative context only. Within [2], however, three of fourteen firms were retained through result-referential theoretical sampling. The remaining eleven were not recoded for PLUS–D; their source-reported characteristics are listed for transparency, but no complete-case criterion failure or duplicate configuration is inferred.

Eleven cases result: six Italian SMEs [12], three Northern-Italian family manufacturers [2] and two DACH producers under COVID-19 [3].

Table 2. Source-study screening against criteria C1–C6

Study, design and context	Judgment
[12] — 6 Italian manufacturing family SMEs; chronic digital disruption of mature "Made in Italy" industries; fieldwork 2019	**Include — 6 cases** (Stratum 1; chronic regime)
[2] — 14 Northern-Italian manufacturing family firms; chronic Industry 4.0 pressure; 54 interviews	**Include — 3 cases for theoretical illustration:** Textiles and Steel as stalled willingness-suppressing cases, and Food produce as an enabling contrast. Selection was result-referential. The other eleven firms were not recoded for PLUS–D; no complete-case exclusion classification is claimed
[3] — 5 DACH/Liechtenstein SMEs; acute COVID-19 shock; temporary business model innovation	**Include — 2 cases**: spirits manufacturer (NACE C), organic agri-food producer (NACE A). Three service firms excluded by the NACE rule, among them the study's least successful case (restaurant, NACE I) — the documented cost of the sector rule
[13]; [38]	**Exclude** — C5, C6: group-level evidence; coping outcomes not assessed
[37] — 40 interviews, managers of large and mid-sized Ukrainian firms across 13 mostly non-goods-producing sectors; acute wartime shock; thematic analysis	**Exclude** — C1–C2, C5–C6: firms outside both strata; findings thematic, no per-case conditions. Closest available evidence on the motivating geopolitical shock
[39]; [40]; six survey and review studies of SME digitalization	**Exclude** — C4–C6: engagement levels or thematic aggregates, no case narratives. Named in the deposited screening log

Note. C1–C6 as defined in the text. The audit package distinguishes criterion screening from the result-referential theoretical sampling of the three [2] cases and lists the eleven non-recoded firms without assigning unobserved PLUS–D classifications. Source: authors' screening and sampling record.

5.2. Codebook, coding rules, and coder

Coding followed a purpose-built codebook (Table 3 summarizes the contested conditions; the full rules are supplied in the supplementary package). The coding unit is the whole case, published narratives supporting no finer slicing; the three-valued convention of Section 4.1 binds throughout, so silence read as absence is barred by the semantics. Two rules bind the coder against convenient inference (Table 3): P is paradox *cognition*, U a *pre-existing stock*. Outcomes are calibrated per regime so failure-side evidence registers; D is binary, conflating channel-side with production-side digitalization.

Time indexing. D is read at t_0 — before the disturbance and before the source's transformation narrative begins — and the outcome at t_1, so the two are independent by construction and "the advanced cases are the digitalized ones" cannot hold by definition; where no onset is datable, t_0 is the last narrative point before that programme. **Rule D-t** requires integration across at least two of {digital sales channel, CRM/customer data, analytics}, or Industry 4.0 process technology; a stand-alone sales channel does not meet the presence anchor. The rule was adopted during revision and applied to all three cases reporting pre-

disturbance evidence. Fratelli Carli's channel was recoded to D_t0 = 0, leaving no positive D_t0 instance; a single-indicator sensitivity would instead put Carli at 1 and P6 at $\sigma \geq 1$.

All 69 non-missing cells carry a quote or comparative-table anchor with a source locator. Recoding was performed by a single human coder, also an author of the framework under test; no independent human second coder was involved. For a non-exhaustive robustness check, a fresh AI assistant received the codebook and source excerpts with assigned codes withheld and generated source-grounded codes for 18 selected cells. The codes matched 16 of 18 assignments ([2] 6 of 8; [3] 10 of 10). P5 outcomes and shock-regime cells were not included, and [2] D_end was descriptive rather than proposition-bearing. The two mismatches concerned Steel Stance and D_end. The stricter Steel Stance = u reading was adopted in the final matrix; this AI-assisted check is neither human intercoder assessment nor intra-coder re-derivation. Further safeguards are the quote-anchored audit trail and explicit decision rules, including amendments disclosed in Sections 4.2 and 5.2. Shock exposure is coded per study for nine cases; at the [2] cases it rests on that study's Industry-4.0 framing (p. 2301, p. 2306) — the corpus's weakest anchor, now located, still a standing-condition statement rather than a discrete shock.

Table 3. Codebook anchors for the four contested conditions

Condition	Presence anchor (quoted example)	Absence anchor (quoted example)
P — paradoxical leadership orientation	both–and framing enacted through separation: "reach a balance between the old and the new" [12]; a distinct unit or communication line for the new activity alongside the old	explicit either/or framing of competing demands. A negative attitude toward digital technology codes to Stance, not to P = 0
L — learning and sensing	systematic scanning; pilots before rollout; absorption of external knowledge; new functions created for digitally related work	long-tenured managers who "just do the same thing… set up a practice and that's how they look at it" [2]; decisions from owner experience only
U — unabsorbed slack (pre-existing stock)	documented pre-existing reserves, patient capital, or spare capacity available before the disturbance	explicit statement of no financial headroom or inability to fund a response. In-crisis freed capacity and external grants → deployability-event memo, not U = 1
Stance — stance of the pivotal rights-holder	*sponsoring:* "The family pushed the digitalization project… This is the priority of the new generation" [2]; "The family started the digitalization process! I wanted the first e-commerce" [12]	*rejecting:* an explicit refusal of the digital agenda attributed to the rights-holder, e.g. "You can have all the data you want, but do you need this data?" [2]. Identity foreclosure or association withdrawal without a technology-domain refusal is coded missing, not rejecting

Note. Stance is ordinal (rejecting ≺ passive ≺ sponsoring) and coded only where the act is attributed to the pivotal rights-holder at case level; study-level attributions are recorded as disclosed alternatives. The mechanical conditions (PCE, S, D, DA, Outcome) are specified in the supplementary codebook. Source: authors' codebook; quotations from the source studies as cited.

6. Results

6.1. Coding matrix, frequencies, and codability

Table 4 reports the coding matrix.

Table 4. Coding matrix and condition codability (11 cases; 1 = present, 0 = absent, . = missing)

Case (study)	Stratum, size	P	L	U	Stance	S	D_t0	D_end	DA	Outcome
Chronic regime — outcome: transformation progression										
Fratelli Carli (M)	1 (150)	1	1	.	spon	chr	0	1	central	advanced
De Matteis (M)	1 (270*)	.	1	.	spon	chr	.	1	central	advanced
Freddy (M)	1 (130)	.	1	.	spon	chr	.	1	central	advanced
Essequadro (M)	1 (36)	.	1	.	spon	chr	.	1	central	advanced
B.Home (M)	1 (57)	.	1	.	spon	chr	.	0	central	partial
SOVET (M)	1 (30)	.	1	.	.	chr	.	1	central	advanced
Food produce (Ap)	1 (112)	.	1	.	spon	chr	.	1	balanced	partial
Steel (Ap)	2 (837)	.	0	.	.	chr	.	0	central	stalled
Textiles (Ap)	1 (103)	.	0	.	rej	chr	.	0	central	stalled
Acute regime — outcome: crisis resilience										
Case A (C)	1 (>200†)	1	1	.	.	acu	0	0	balanced	high (non-digital)
Case E (C)	1 (5)	1	1	.	spon	acu	0	1	central	high (digital)
κ (codability)	—	**0.273**	**1.000**	**0.000**	**0.727**	**1.000**	**0.273**	**1.000**	**1.000**	**1.000**

*Note. Studies: M = [12]; Ap = [2] (cases labelled by sector: their Case D = Textiles, Case H = Steel, Case C = Food produce); C = [3]. Stance ∈ {rejecting ≺ passive ≺ sponsoring}; spon = sponsoring, rej = rejecting. * De Matteis (270 employees) marginally exceeds the 250-employee cap; † Case A is reported only as ">200 employees": both flagged marginal. PCE is missing in 11 of 11 cases and omitted as a column; U is never observed. Stance is missing at SOVET, Steel and Case A; Steel's identity and association-withdrawal passages do not explicitly reject digitalization. Deployability events (memo fields, not U): Case A — capacity freed by demand contraction; Case E — in-crisis investment in cooling and a farm store. κ = share of non-missing cells. Outcome grades are [DERIVED], not grades printed in the sources. Source: authors' recoding.*

Marginals: P 3/0/8; L 9/2/0; Stance 7/1/3 sponsoring/rejecting/missing; D_t0 0/3/8; DA 9 central, 2 balanced. L is fully coded and prevalent, while the resource-and-cognition conditions are sparse: P is never explicitly negated, U is never observed and D_t0 = 1 has no instance. Outcome levels align with the source studies, so between-study patterns may reflect their sampling logics. No case instantiates the complete property space (0/576); every verdict concerns a projection.

6.2. Configuration inventory and property-space coverage

The full partial-configuration inventory is supplied in the supplementary package. On the fully coded projection (L, DA, S), the 11 cases occupy five of 12 possible points (41.7%); seven points are logical remainders. Three descriptive rows collapse to (L = 1, DA = central, S = chronic), illustrating why the partial inventory cannot support minimization.

Two observations follow. First, in the chronic regime every advanced case combines L with D_end and both stalled cases lack both, but the pattern carries no evidential weight: of the 18 cross-pairs differing on D_end, 17 are concordant, 0 discordant, 1 a tie, so γ(D_end, ordered chronic outcome) = 1.000 — definitional overlap. Second, among the eight Stance-coded cases the single rejecting firm stalled, while sponsoring outcomes disperse (chronic: advanced 4, partial 2; acute: high 1). This descriptive pattern cannot test causal asymmetry [25].

6.3. Proposition verdicts and realized severity

Table 5. Proposition verdicts, realized severity σ, completable ceiling σ_max and untestability type

Proposition (folded antecedent)	σ	σ_max	Type	Verdict
P1′ P ∧ U ∧ D_t0 ∧ (S = chr) ⊆ O_advanced	0	8	III	Undetermined by missingness (u = 8, 0 = 3); blockers: U unmeasured; no case combines P = 1 with pre-disturbance digitalization
P2 L ∧ D_t0 ∧ (DA = decentralized) ∧ (S = acu) ⊆ O_high	0	0	II	Antecedent uninstantiated; DA fully coded, decentralized rights realized nowhere
P3′ PCE ∧ P ∧ ¬D_t0 ∧ (S = acu) ⊆ O_high	0	2	III	Undetermined by missingness (u = 2, 0 = 9); blocker: PCE (κ = 0.000)
P4a D_t0 ∧ (DA = central) ∧ ¬U ∧ ¬P ∧ (S = chr) ⊆ O_stalled	0	7	III	Undetermined by missingness (u = 7, 0 = 4); blockers: U, ¬P; D_t0 = 1 has zero instances
P4b D_t0 ∧ (DA = central) ∧ ¬U ∧ ¬P ∧ (S = acu) ⊆ O_low	0	0	II	Antecedent uninstantiated: both acute cases carry D_t0 = 0 and P = 1
P5 (Stance = rejecting) ∧ (DA = central) ∧ ¬L ∧ (S = chr) ⊆ O_stalled	**1**	2	Sampling-limited	**One-case illustration** consistent with P5; ineligible for support-side inference because the case comes from result-referential theoretical sampling. Steel-rejecting alternative: σ = 2
P5b (Stance = rejecting) ∧ (DA ≠ central) ∧ (S = chr) ⊆ ¬O_stalled	0	0	II	Antecedent uninstantiated: the two substantive extensions are disjoint
P6 (Stance = sponsoring) ∧ L ∧ D_t0 ∧ (DA = central) ∧ (S = chr) ⊆ O_advanced	0	5	III	Undetermined by missingness (u = 5, 0 = 6); blocker: D_t0 has no positive instance

Note. $\sigma = |\{i \in \mathcal{C} : [\![Ant]\!](i) = 1\}|$ and $\sigma_max = |\{i \in \mathcal{C} : \text{no literal evaluates to 0 at } i\}|$. The measurement dividend is 23 in the proposition-specific sum. The three type-II propositions are vacuously true on this corpus. P2 and P4b remain type II under the Rule D-t sensitivity. Under the adopted coding I(P5) = {Textiles}, F(P5) = ∅ and Steel's antecedent is u; coding Steel Stance as rejecting would raise σ(P5) to 2 without changing its sampling ineligibility. Outcome grades are [DERIVED]. Source: authors' computation from Table 4.

Table 5 reports the verdicts; every σ = 0 follows from the antecedent columns of Table 4, before any outcome is coded. Three propositions are antecedent-uninstantiated and four are missingness-blocked. P5 alone has a realized at-risk case (σ = 1), but it is an illustration rather than a support verdict because it came from result-referential theoretical sampling.

P5 is the only proposition with a realized at-risk case. Textiles instantiates the adopted antecedent and is stalled, yielding σ = 1 and F = ∅. Its owner dismisses digitalization on its merits — "you can have all the data you want, but do you need this data?" (Table 3) [2]. This is evidence consistent with P5, but not confirmatory support: the case was retained through result-referential theoretical sampling, and Stance, ¬L and outcome come from a dependent source narrative.

Steel-Stance adjudication. The final matrix adopts the fresh-assistant reading of Steel's Stance as missing because the cited identity and association-withdrawal passages do not explicitly reject digitalization. If the earlier rejecting code were retained, I(P5) would become {Steel, Textiles} and σ(P5) would rise from 1 to 2. Steel D_end = missing would not affect any proposition-level σ because D_end is not a P5 literal. Either reading remains sampling-limited and ineligible for a support-side verdict.

Three dependencies are disclosed rather than smoothed. First, [2] grades cases through the willingness construct that also grounds Stance, so outcomes were re-derived from digitalization-progress evidence; source-level dependence remains. Second, P5 depends on assigning chronic Industry-4.0 pressure to Textiles from a study-level anchor; withdrawing that assignment makes σ(P5) = 0. Third, E(Stance = rejecting) = {Textiles} is contained in E(¬L) and E(DA = central), so the full configuration is observationally equivalent here to weaker antecedents retaining rejecting Stance.

P2, P4b and P5b are antecedent-uninstantiated (Table 5); P5b only under the adopted coding, its status resting on the Food-produce Stance cell — the corpus's only chronic case with DA ≠ central, coded sponsoring here — so were that cell missing P5b would be missingness-blocked, a sensitivity disclosed in the supplementary package. Case E — capability core, centralized family leadership, outcome high — is not a counterexample to P2, which is silent on cases outside its antecedent; its existence is consistent with, but no single case tests, equifinality [24]. It motivates P6, proposed rather than tested: among chronic owner-led sponsoring cases with end-of-case digitalization, four of four advanced — $\tilde{\sigma}$(P6 | D_end) = 4, F = ∅, against σ(P6) = 0 — an association constitutively confounded with the digitalization–outcome overlap, so P6 enters the follow-up untested.

P1′, P3′, P4a and P6 are undetermined by missingness (blockers in Table 5). Because the sources record deployability events rather than stocks, primary testing should measure resources as both pre-existing stock and deployability at

the decision moment. The acute cases do not report whether prior crisis experience was invoked, so P3′ requires direct measurement of that condition. P4a meets a success/stall bias: threat–rigidity [5] and business-model evidence [16] keep it alive, but the sector rule removed the nearest failure candidate ([3]'s restaurant).

The three cross-theory linkages of Section 3.1 map one for one onto propositions, each ending in a blocker: paradox × slack onto P1′, blocked by U; appraisal survival onto P3′, blocked by PCE; sponsorship onto P6, blocked by D_t0 — the framework's integrative content is exactly the untested part.

6.4. Report-conditional measurement endogeneity

The missingness pattern is itself a finding. P is codable in 3 of 7 success cases and 0 of 4 non-success, so reporting is outcome-dependent for a condition that enters two propositions. Stance is codable in 1 of 2 stalled cases and 7 of 9 non-stalled cases; the stricter Steel adjudication therefore removes the earlier appearance that Stance was especially visible at failures. Because P is codable only where a source narrates success, $F = \emptyset$ holds under current reporting for any P-containing antecedent, so the corpus cannot presently refute P1′ or P3′. This report-conditional measurement endogeneity reinforces the decision not to assign a support-side verdict. The $\kappa(c \mid O)$ are supplied in the supplementary package.

7. Discussion

7.1. Contributions

The central result is a diagnosis of evidential capacity rather than a validation of PLUS–D. Nine cases concern transformation progression under chronic disturbance, whereas only two concern resilience under an acute shock. Pooling these outcomes as one construct would overstate both construct consistency and empirical coverage. P5's single realized instance comes from a result-referential theoretical sample; it is therefore an illustration, not confirmation. The evidence cannot distinguish the full P5 configuration from weaker explanations retaining rejecting stance.

For information-systems research, the analysis shifts attention from whether digital technologies are present to whether published evidence permits claims about their organizational conversion [14], [41]. Digital-transformation cases report technologies, achievements and managerial narratives, but often omit the temporally ordered organizational conditions required to test configurational explanations. The resulting missingness is not random: success narratives make some leadership conditions visible, while failure-oriented accounts make resistance visible. The three-valued apparatus makes that limitation auditable by distinguishing absence from non-reporting, identifying uninstantiated antecedents and estimating how much additional severity measurement could provide [36]. Its contribution is not that K_3 verifies PLUS–

D, but that it prevents descriptive case correspondences from being presented as confirmation.

The diagnosis also bounds the substantive theories. The acute cases come from a study of successful adapters, so acute rigidity cannot appear here [5]. In the selected [2] contrast, rights-holder stance and learning capability co-vary, so neither can be established as the discriminator [28]. The sensing-to-seizing hinge in owner-led firms [6] remains unresolved, and decision architecture is near-invariant — 9 central of 11, none decentralized. All three cross-theory linkages map onto blocked propositions; the integrative content of PLUS–D remains proposed for primary testing.

7.2. Boundary conditions, limitations, and the follow-up design

The claims are analytical and corpus-specific, not statistical [31]. Nine of eleven cases are Italian, none from Central or Eastern Europe; two sit at or above the EU SME size threshold, a third may. The acute subset has no outcome variance and predates the 2022 geopolitical shock. Outcomes were derived by the recoder, one human coder also authored the framework, the non-exhaustive robustness check was AI-assisted, and no case instantiates the complete property space. The results therefore describe the testability of these reports, not the prevalence or causal effectiveness of PLUS–D configurations.

A valid follow-up should separate transformation progression from resilience, measure conditions before outcomes, sample successful and unsuccessful transformations, include non-central decision architectures and collect independent evidence for stance, learning, slack, prior crisis experience and pre-disturbance digitalization. It should pre-register consistency ≥ 0.80, PRI ≥ 0.70 and frequency ≥ 2 [30]. Proposition-specific completion ceilings imply up to 23 further at-risk instances from fuller reporting, but jointly compatible completion raises total σ by at most 16, from 1 to 17. P5 requires new, prospectively selected cases. In Textiles, rejecting owner stance co-occurred with absent learning capability, centralized rights and stalled progression; the evidence does not identify stance as the binding constraint.

8. Conclusion

This study used PLUS–D to diagnose whether published digital-transformation cases can test a configurational explanation. The answer is largely negative but methodologically informative. Nine of the eleven cases concern transformation progression and only two concern resilience. Three propositions have antecedents uninstantiated in this corpus, four are missingness-blocked and all three cross-theory linkages remain untested. P5 has one realized instance from a result-referential theoretical sample; its rejecting-stance/stalled-progression correspondence is an illustration rather than validation. Thus no proposition receives a support-side verdict.

The contribution is a three-valued testability diagnosis for secondary information-systems and digital-transformation case research. By distinguishing absence from non-reporting and evaluating antecedents before outcomes, the approach identifies what a corpus can adjudicate without converting missing evidence into apparent support. Reliability remains limited: no independent human second coder was involved; a non-exhaustive AI-assisted source-grounded check matched 16 of 18 selected assignments and changed the final Steel Stance adjudication, but does not substitute for human intercoder assessment. PLUS–D should remain a framework proposed for primary testing.

Declarations

The recoding was performed by one of the authors, also an author of the framework under test (Section 5.2). No independent human second coder was involved. An anonymized supplementary package containing the quote-anchored coding ledger, codebook, sampling record, outcome derivations, sensitivity logs and the non-exhaustive AI-assisted 18-cell robustness worksheet will be supplied to the editor and reviewers during submission. Public deposit may follow acceptance. Competing interests: none declared.

References

[1] European Investment Bank, *EIB Investment Survey 2023: European Union Overview*. Luxembourg: European Investment Bank, 2023, doi: 10.2867/199464.

[2] S. Appleton, M. Mismetti, D. Matt, and A. De Massis, "Unpacking willingness in family firms facing the digital transformation," *Small Business Economics*, vol. 65, no. 4, pp. 2301–2330, 2025, doi: 10.1007/s11187-025-01057-8.

[3] T. Clauss, M. Breier, S. Kraus, S. Durst, and R. V. Mahto, "Temporary business model innovation — SMEs' innovation response to the Covid-19 crisis," *R&D Management*, vol. 52, no. 2, pp. 294–312, 2022, doi: 10.1111/radm.12498.

[4] W. K. Smith and M. W. Lewis, "Toward a theory of paradox: A dynamic equilibrium model of organizing," *Academy of Management Review*, vol. 36, no. 2, pp. 381–403, 2011, doi: 10.5465/amr.2009.0223.

[5] B. M. Staw, L. E. Sandelands, and J. E. Dutton, "Threat-rigidity effects in organizational behavior: A multilevel analysis," *Administrative Science Quarterly*, vol. 26, no. 4, pp. 501–524, 1981, doi: 10.2307/2392337.

[6] D. J. Teece, "Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance," *Strategic Management Journal*, vol. 28, no. 13, pp. 1319–1350, 2007, doi: 10.1002/smj.640.

[7] Authors (details withheld for double-blind review), "Title withheld," in *Proc. 19th International Management Conference*, Bucharest, 2025.

[8] Y. Zhang, D. A. Waldman, Y.-L. Han, and X.-B. Li, "Paradoxical leader behaviors in people management: Antecedents and consequences," *Academy of Management Journal*, vol. 58, no. 2, pp. 538–566, 2015, doi: 10.5465/amj.2012.0995.

[9] J. Schad, M. W. Lewis, S. Raisch, and W. K. Smith, "Paradox research in management science: Looking back to move forward," *Academy of Management Annals*, vol. 10, no. 1, pp. 5–64, 2016, doi: 10.5465/19416520.2016.1162422.

[10] P. Chattopadhyay, W. H. Glick, and G. P. Huber, "Organizational actions in response to threats and opportunities," *Academy of Management Journal*, vol. 44, no. 5, pp. 937–955, 2001, doi: 10.5465/3069439.

[11] M. J. Mazzei, J. DeBode, K. A. Gangloff, and R. Song, "Old habits die hard: A review and assessment of the threat-rigidity literature," *Journal of Management*, vol. 51, no. 6, pp. 2154–2181, 2025, doi: 10.1177/01492063241286493.

[12] M. Matarazzo, L. Penco, G. Profumo, and R. Quaglia, "Digital transformation and customer value creation in Made in Italy SMEs: A dynamic capabilities perspective," *Journal of Business Research*, vol. 123, pp. 642–656, 2021, doi: 10.1016/j.jbusres.2020.10.033.

[13] D. Horváth and R. Zs. Szabó, "Driving forces and barriers of Industry 4.0: Do multinational and small and medium-sized companies have equal opportunities?" *Technological Forecasting and Social Change*, vol. 146, pp. 119–132, 2019, doi: 10.1016/j.techfore.2019.05.021.

[14] V. Sambamurthy, A. Bharadwaj, and V. Grover, "Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms," *MIS Quarterly*, vol. 27, no. 2, pp. 237–263, 2003, doi: 10.2307/30036530.

[15] P. C. Verhoef, T. Broekhuizen, Y. Bart, A. Bhattacharya, J. Q. Dong, N. Fabian, and M. Haenlein, "Digital transformation: A multidisciplinary reflection and research agenda," *Journal of Business Research*, vol. 122, pp. 889–901, 2021, doi: 10.1016/j.jbusres.2019.09.022.

[16] H. Bouwman, S. Nikou, and M. de Reuver, "Digitalization, business models, and SMEs: How do business model innovation practices improve performance of digitalizing SMEs?" *Telecommunications Policy*, vol. 43, no. 9, art. 101828, 2019, doi: 10.1016/j.telpol.2019.101828.

[17] S. Duchek, "Organizational resilience: A capability-based conceptualization," *Business Research*, vol. 13, pp. 215–246, 2020, doi: 10.1007/s40685-019-0085-7.

[18] L. J. Bourgeois, "On the measurement of organizational slack," *Academy of Management Review*, vol. 6, no. 1, pp. 29–39, 1981, doi: 10.5465/amr.1981.4287985.

[19] J. Tan and M. W. Peng, "Organizational slack and firm performance during economic transitions: Two studies from an emerging economy," *Strategic Management Journal*, vol. 24, no. 13, pp. 1249–1263, 2003, doi: 10.1002/smj.351.

[20] D. Őri, I. Szabó, A. Kő, and T. Kovács, "Digitalizing in crisis: The role of organizational resilience in SMEs' digitalization," *Journal of Enterprise Information Management*, vol. 37, no. 4, pp. 1185–1205, 2024, doi: 10.1108/JEIM-03-2023-0141.

[21] H. Karadağ, F. Şahin, N. Karamollaoğlu, and M. Saunila, "Disentangling the dynamic digital capability, digital transformation, and organizational performance relationships in SMEs: A configurational analysis based on fsQCA," *Information Technology and Management*, vol. 27, no. 2, pp. 141–157, 2026, doi: 10.1007/s10799-024-00437-y.

[22] K. K. Sinha, S. Raby, and T. Salari, "Exploring the scope and depth of digitalisation in times of crisis: Implications for SME resilience," *International Small Business Journal: Researching Entrepreneurship*, vol. 43, no. 3, pp. 219–245, 2025, doi: 10.1177/02662426241293000.

[23] P. C. Fiss, "A set-theoretic approach to organizational configurations," *Academy of Management Review*, vol. 32, no. 4, pp. 1180–1198, 2007, doi: 10.5465/amr.2007.26586092.

[24] D. H. Doty, W. H. Glick, and G. P. Huber, "Fit, equifinality, and organizational effectiveness: A test of two configurational theories," *Academy of Management Journal*, vol. 36, no. 6, pp. 1196–1250, 1993, doi: 10.2307/256810.

[25] P. C. Fiss, "Building better causal theories: A fuzzy set approach to typologies in organization research," *Academy of Management Journal*, vol. 54, no. 2, pp. 393–420, 2011, doi: 10.5465/amj.2011.60263120.

[26] A. De Massis, J. Kotlar, J. H. Chua, and J. J. Chrisman, "Ability and willingness as sufficiency conditions for family-oriented particularistic behavior: Implications for theory and empirical studies," *Journal of Small Business Management*, vol. 52, no. 2, pp. 344–364, 2014, doi: 10.1111/jsbm.12102.

[27] J. J. Chrisman, J. H. Chua, A. De Massis, F. Frattini, and M. Wright, "The ability and willingness paradox in family firm innovation," *Journal of Product Innovation Management*, vol. 32, no. 3, pp. 310–318, 2015, doi: 10.1111/jpim.12207.

[28] P. Berrone, C. Cruz, and L. R. Gómez-Mejía, "Socioemotional wealth in family firms: Theoretical dimensions, assessment approaches, and agenda for

future research," *Family Business Review*, vol. 25, no. 3, pp. 258–279, 2012, doi: 10.1177/0894486511435355.

[29] S. C. Kleene, *Introduction to Metamathematics*. Amsterdam: North-Holland, 1952.

[30] T. Greckhamer, S. Furnari, P. C. Fiss, and R. V. Aguilera, "Studying configurations with qualitative comparative analysis: Best practices in strategy and organization research," *Strategic Organization*, vol. 16, no. 4, pp. 482–495, 2018.

[31] C. C. Ragin, *Redesigning Social Inquiry: Fuzzy Sets and Beyond*. Chicago, IL: University of Chicago Press, 2008.

[32] C. Q. Schneider and C. Wagemann, *Set-Theoretic Methods for the Social Sciences: A Guide to Qualitative Comparative Analysis*. Cambridge: Cambridge University Press, 2012.

[33] L. Cronqvist and D. Berg-Schlosser, "Multi-value QCA (mvQCA)," in B. Rihoux and C. C. Ragin, Eds., *Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques*. Thousand Oaks, CA: SAGE, 2009, pp. 69–86.

[34] I. O. Pappas and A. G. Woodside, "Fuzzy-set qualitative comparative analysis (fsQCA): Guidelines for research practice in information systems and marketing," *International Journal of Information Management*, vol. 58, art. 102310, 2021, doi: 10.1016/j.ijinfomgt.2021.102310.

[35] R. Larsson, "Case survey methodology: Quantitative analysis of patterns across case studies," *Academy of Management Journal*, vol. 36, no. 6, pp. 1515–1546, 1993.

[36] C. Hoon, "Meta-synthesis of qualitative case studies: An approach to theory building," *Organizational Research Methods*, vol. 16, no. 4, pp. 522–556, 2013.

[37] N. B. Lindström, L. Razmerita, S. Prokopenko, and N. Popovich, "Building digital resilience in major shocks: How Ukrainian organizations enact digital transformation in times of war," in *Proceedings of the 57th Hawaii International Conference on System Sciences*, 2024, pp. 6813–6822, doi: 10.24251/hicss.2024.816.

[38] S. Kraus, T. Clauss, M. Breier, J. Gast, A. Zardini, and V. Tiberius, "The economics of COVID-19: Initial empirical evidence on how family firms in five European countries cope with the corona crisis," *International Journal of Entrepreneurial Behavior & Research*, vol. 26, no. 5, pp. 1067–1092, 2020, doi: 10.1108/IJEBR-04-2020-0214.

[39] J. Soluk, N. Kammerlander, and A. De Massis, "Exogenous shocks and the adaptive capacity of family firms: Exploring behavioral changes and digital technologies in the COVID-19 pandemic," *R&D Management*, vol. 51, no. 4, pp. 364–380, 2021.

[40] A. Garzoni, I. De Turi, G. Secundo, and P. Del Vecchio, "Fostering digital transformation of SMEs: A four levels approach," *Management Decision*, vol. 58, no. 8, pp. 1543–1562, 2020, doi: 10.1108/MD-07-2019-0939.

[41] I. Khurana, D. K. Dutta, and A. Singh Ghura, "SMEs and digital transformation during a crisis: The emergence of resilience as a second-order dynamic capability in an entrepreneurial ecosystem," *Journal of Business Research*, vol. 150, pp. 623–641, 2022.

Bibliography

S. Appleton, M. Mismetti, D. Matt, and A. De Massis, "Unpacking willingness in family firms facing the digital transformation," *Small Business Economics*, vol. 65, no. 4, pp. 2301–2330, 2025, doi: 10.1007/s11187-025-01057-8.

Authors (details withheld for double-blind review), "Title withheld," in *Proc. 19th International Management Conference*, Bucharest, 2025.

P. Berrone, C. Cruz, and L. R. Gómez-Mejía, "Socioemotional wealth in family firms: Theoretical dimensions, assessment approaches, and agenda for future research," *Family Business Review*, vol. 25, no. 3, pp. 258–279, 2012, doi: 10.1177/0894486511435355.

L. J. Bourgeois, "On the measurement of organizational slack," *Academy of Management Review*, vol. 6, no. 1, pp. 29–39, 1981, doi: 10.5465/amr.1981.4287985.

H. Bouwman, S. Nikou, and M. de Reuver, "Digitalization, business models, and SMEs: How do business model innovation practices improve performance of digitalizing SMEs?" *Telecommunications Policy*, vol. 43, no. 9, art. 101828, 2019, doi: 10.1016/j.telpol.2019.101828.

S. W. Bradley, D. A. Shepherd, and J. Wiklund, "The importance of slack for new organizations facing 'tough' environments," *Journal of Management Studies*, vol. 48, no. 5, pp. 1071–1097, 2011.

P. Chattopadhyay, W. H. Glick, and G. P. Huber, "Organizational actions in response to threats and opportunities," *Academy of Management Journal*, vol. 44, no. 5, pp. 937–955, 2001, doi: 10.5465/3069439.

J. J. Chrisman, J. H. Chua, A. De Massis, F. Frattini, and M. Wright, "The ability and willingness paradox in family firm innovation," *Journal of Product Innovation Management*, vol. 32, no. 3, pp. 310–318, 2015, doi: 10.1111/jpim.12207.

M. Civelek, V. Krajčík, and A. Ključnikov, "The impacts of dynamic capabilities on SMEs' digital transformation process: The resource-based view perspective," *Oeconomia Copernicana*, vol. 14, no. 4, pp. 1367–1392, 2023.

T. Clauss, M. Breier, S. Kraus, S. Durst, and R. V. Mahto, "Temporary business model innovation — SMEs' innovation response to the Covid-19

crisis," *R&D Management*, vol. 52, no. 2, pp. 294–312, 2022, doi: 10.1111/radm.12498.

L. Cronqvist and D. Berg-Schlosser, "Multi-value QCA (mvQCA)," in B. Rihoux and C. C. Ragin, Eds., *Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques*. Thousand Oaks, CA: SAGE, 2009, pp. 69–86.

A. De Massis, J. Kotlar, J. H. Chua, and J. J. Chrisman, "Ability and willingness as sufficiency conditions for family-oriented particularistic behavior: Implications for theory and empirical studies," *Journal of Small Business Management*, vol. 52, no. 2, pp. 344–364, 2014, doi: 10.1111/jsbm.12102.

D. H. Doty, W. H. Glick, and G. P. Huber, "Fit, equifinality, and organizational effectiveness: A test of two configurational theories," *Academy of Management Journal*, vol. 36, no. 6, pp. 1196–1250, 1993, doi: 10.2307/256810.

S. Duchek, "Organizational resilience: A capability-based conceptualization," *Business Research*, vol. 13, pp. 215–246, 2020, doi: 10.1007/s40685-019-0085-7.

European Investment Bank, *EIB Investment Survey 2023: European Union Overview*. Luxembourg: European Investment Bank, 2023, doi: 10.2867/199464.

P. C. Fiss, "A set-theoretic approach to organizational configurations," *Academy of Management Review*, vol. 32, no. 4, pp. 1180–1198, 2007, doi: 10.5465/amr.2007.26586092.

P. C. Fiss, "Building better causal theories: A fuzzy set approach to typologies in organization research," *Academy of Management Journal*, vol. 54, no. 2, pp. 393–420, 2011, doi: 10.5465/amj.2011.60263120.

A. Garzoni, I. De Turi, G. Secundo, and P. Del Vecchio, "Fostering digital transformation of SMEs: A four levels approach," *Management Decision*, vol. 58, no. 8, pp. 1543–1562, 2020, doi: 10.1108/MD-07-2019-0939.

G. George, "Slack resources and the performance of privately held firms," *Academy of Management Journal*, vol. 48, no. 4, pp. 661–676, 2005.

T. Greckhamer, S. Furnari, P. C. Fiss, and R. V. Aguilera, "Studying configurations with qualitative comparative analysis: Best practices in strategy and organization research," *Strategic Organization*, vol. 16, no. 4, pp. 482–495, 2018.

C. Hoon, "Meta-synthesis of qualitative case studies: An approach to theory building," *Organizational Research Methods*, vol. 16, no. 4, pp. 522–556, 2013.

D. Horváth and R. Zs. Szabó, "Driving forces and barriers of Industry 4.0: Do multinational and small and medium-sized companies have equal

opportunities?" *Technological Forecasting and Social Change*, vol. 146, pp. 119–132, 2019, doi: 10.1016/j.techfore.2019.05.021.

H. Karadağ, F. Şahin, N. Karamollaoğlu, and M. Saunila, "Disentangling the dynamic digital capability, digital transformation, and organizational performance relationships in SMEs: A configurational analysis based on fsQCA," *Information Technology and Management*, vol. 27, no. 2, pp. 141–157, 2026, doi: 10.1007/s10799-024-00437-y.

I. Khurana, D. K. Dutta, and A. Singh Ghura, "SMEs and digital transformation during a crisis: The emergence of resilience as a second-order dynamic capability in an entrepreneurial ecosystem," *Journal of Business Research*, vol. 150, pp. 623–641, 2022.

S. C. Kleene, *Introduction to Metamathematics*. Amsterdam: North-Holland, 1952.

S. Kraus, T. Clauss, M. Breier, J. Gast, A. Zardini, and V. Tiberius, "The economics of COVID-19: Initial empirical evidence on how family firms in five European countries cope with the corona crisis," *International Journal of Entrepreneurial Behavior & Research*, vol. 26, no. 5, pp. 1067–1092, 2020, doi: 10.1108/IJEBR-04-2020-0214.

R. Larsson, "Case survey methodology: Quantitative analysis of patterns across case studies," *Academy of Management Journal*, vol. 36, no. 6, pp. 1515–1546, 1993.

N. B. Lindström, L. Razmerita, S. Prokopenko, and N. Popovich, "Building digital resilience in major shocks: How Ukrainian organizations enact digital transformation in times of war," in *Proceedings of the 57th Hawaii International Conference on System Sciences*, 2024, pp. 6813–6822, doi: 10.24251/hicss.2024.816.

M. Matarazzo, L. Penco, G. Profumo, and R. Quaglia, "Digital transformation and customer value creation in Made in Italy SMEs: A dynamic capabilities perspective," *Journal of Business Research*, vol. 123, pp. 642–656, 2021, doi: 10.1016/j.jbusres.2020.10.033.

M. J. Mazzei, J. DeBode, K. A. Gangloff, and R. Song, "Old habits die hard: A review and assessment of the threat-rigidity literature," *Journal of Management*, vol. 51, no. 6, pp. 2154–2181, 2025, doi: 10.1177/01492063241286493.

N. Nohria and R. Gulati, "Is slack good or bad for innovation?" *Academy of Management Journal*, vol. 39, no. 5, pp. 1245–1264, 1996.

D. Őri, I. Szabó, A. Kő, and T. Kovács, "Digitalizing in crisis: The role of organizational resilience in SMEs' digitalization," *Journal of Enterprise Information Management*, vol. 37, no. 4, pp. 1185–1205, 2024, doi: 10.1108/JEIM-03-2023-0141.

I. O. Pappas and A. G. Woodside, "Fuzzy-set qualitative comparative analysis (fsQCA): Guidelines for research practice in information systems and

marketing," *International Journal of Information Management*, vol. 58, art. 102310, 2021, doi: 10.1016/j.ijinfomgt.2021.102310.

C. C. Ragin, *Redesigning Social Inquiry: Fuzzy Sets and Beyond*. Chicago, IL: University of Chicago Press, 2008.

V. Sambamurthy, A. Bharadwaj, and V. Grover, "Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms," *MIS Quarterly*, vol. 27, no. 2, pp. 237–263, 2003, doi: 10.2307/30036530.

J. Schad, M. W. Lewis, S. Raisch, and W. K. Smith, "Paradox research in management science: Looking back to move forward," *Academy of Management Annals*, vol. 10, no. 1, pp. 5–64, 2016, doi: 10.5465/19416520.2016.1162422.

C. Q. Schneider and C. Wagemann, *Set-Theoretic Methods for the Social Sciences: A Guide to Qualitative Comparative Analysis*. Cambridge: Cambridge University Press, 2012.

K. K. Sinha, S. Raby, and T. Salari, "Exploring the scope and depth of digitalisation in times of crisis: Implications for SME resilience," *International Small Business Journal: Researching Entrepreneurship*, vol. 43, no. 3, pp. 219–245, 2025, doi: 10.1177/02662426241293000.

W. K. Smith and M. W. Lewis, "Toward a theory of paradox: A dynamic equilibrium model of organizing," *Academy of Management Review*, vol. 36, no. 2, pp. 381–403, 2011, doi: 10.5465/amr.2009.0223.

J. Soluk, N. Kammerlander, and A. De Massis, "Exogenous shocks and the adaptive capacity of family firms: Exploring behavioral changes and digital technologies in the COVID-19 pandemic," *R&D Management*, vol. 51, no. 4, pp. 364–380, 2021.

B. M. Staw, L. E. Sandelands, and J. E. Dutton, "Threat-rigidity effects in organizational behavior: A multilevel analysis," *Administrative Science Quarterly*, vol. 26, no. 4, pp. 501–524, 1981, doi: 10.2307/2392337.

J. Tan and M. W. Peng, "Organizational slack and firm performance during economic transitions: Two studies from an emerging economy," *Strategic Management Journal*, vol. 24, no. 13, pp. 1249–1263, 2003, doi: 10.1002/smj.351.

D. J. Teece, "Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance," *Strategic Management Journal*, vol. 28, no. 13, pp. 1319–1350, 2007, doi: 10.1002/smj.640.

P. C. Verhoef, T. Broekhuizen, Y. Bart, A. Bhattacharya, J. Q. Dong, N. Fabian, and M. Haenlein, "Digital transformation: A multidisciplinary reflection and research agenda," *Journal of Business Research*, vol. 122, pp. 889–901, 2021, doi: 10.1016/j.jbusres.2019.09.022.

W. Yin, "Identifying the pathways through digital transformation to achieve supply chain resilience: An fsQCA approach," *Environmental Science and Pollution Research*, vol. 30, no. 4, pp. 10867–10879, 2023.

J. Zhang, J. Long, and A. M. E. von Schaewen, "How does digital transformation improve organizational resilience? Findings from PLS-SEM and fsQCA," *Sustainability*, vol. 13, no. 20, art. 11487, 2021.

Y. Zhang, D. A. Waldman, Y.-L. Han, and X.-B. Li, "Paradoxical leader behaviors in people management: Antecedents and consequences," *Academy of Management Journal*, vol. 58, no. 2, pp. 538–566, 2015, doi: 10.5465/amj.2012.0995.

BEYOND SEAMLESSNESS: AN EFFORT–REWARD IMBALANCE AND PSYCHOLOGICAL REACTANCE PERSPECTIVE ON THE VALUE OF FRICTION IN AI-ENABLED PHYGITAL RETAIL

Sachindra Kumar,
Deepa Kumari,
Satish Kumar Chaudhary[*]

Abstract

The customer journey is now frictionless for 10 years, but the AI systems now deeply entrenched in the "phygital" (physical + digital) stores regularly add friction: biometric checks, one-time-password verification and identity-confirmation steps are slowing customers down to keep them safe and personalised. This study confronts the question of whether such friction, created by AI, is always bad or can be accepted or even appreciated in certain well-defined circumstances. Based on the Effort–Reward Imbalance (ERI) theory (Siegrist, 1996) and Psychological Reactance Theory (Brehm, 1966) a conceptual model was developed and tested through questionnaires for 311 urban consumers who had visited AI stores for shopping in the last three months. Based on reliability analysis, correlation analysis and path analysis through hierarchical regression, it was found that the perceived effort increases the imbalance of effort–reward, and the perceived reward decreases the imbalance of effort–reward, which in turn affects reduction in the level of satisfaction with the journey. If the friction is perceived as being security justified, the increase in psychological reactance is much reduced. This reactance then decreases satisfaction and intention to continue. The results validate a "value of friction" hypothesis: friction justifies the value provided, and is accepted without resistance, while friction out of proportion or lack of explanation causes loss of satisfaction and loyalty.

Keywords: phygital retail; AI-enabled customer journey; friction; effort–reward imbalance; psychological reactance; consumer autonomy; security; continuance intention

JEL Classification: M31.

1. Introduction

For the last 10 years, the focus in retail tech has been on frictionless commerce. All the innovations around self-checkout, one-click payments, cashier-less stores, and AI-driven recommendation engines were based on one basic principle: Every extra step from the moment a consumer decides to make a purchase to the moment it is completed is a cost that needs to be reduced (Klaus, 2021). It has become even more pronounced in the quest for seamlessness, with "phygital" retail, the deliberate integration of physical stores

[*] Sachindra Kumar is a Research Scholar, Sharda University, Greater Noida, U.P. 201309, IN
Deepa Kumari is an Associate Professor, Sharda University, Greater Noida, U.P. 201309, IN
Satish Kumar Chaudhary is a Research Scholar, Gopal Narayan Singh University, Jamuhar, BIHAR, IN.

with digital, AI-powered touchpoints like smart mirrors, computer-vision-based checkout, conversational assistants, and biometric verification.It has become even more apparent in the pursuit of seamlessness, with "phygital" retail, where digital, AI-enabled touchpoints like smart mirrors, computer-vision-based checkout, conversational assistants and biometric verification are deliberately integrated into physical stores (Batat, 2022; Jacob et al., 2021; Lemon & Verhoef, 2016).

But those very AI systems that will make our lives easier have sneaked in some new frictions. At checkout, the customer is asked to stop, comply and wait when he or she is asked to verify the face or fingerprints; the one-time-password (OTP) for high-value purchases; the step-up authentication when the AI system detects unusual behaviour; and consent prompts for data-driven personalisation all call for customer stop, comply and wait. The push toward frictionless self-service is now often described as a point of tradeoff: Security and fraud-prevention considerations always involve steps taken back in the journey, and adding these steps must be balanced with the push toward frictionless self-service. People now start talking about the need to turn friction into a design parameter, and make sure it is not over- or under-engineered, but optimally engineered, in the right place, for the right purpose.

This paper does not assume this, but takes it as a proposition worthy of testing. It builds on two widely used theories from fields outside of mainstream retail studies: Effort–Reward Imbalance (ERI) theory, from the field of occupational health psychology (Siegrist, 1996) and Psychological Reactance Theory, from social psychology (Brehm, 1966) to explore where and when friction with AI is beneficial, and where and when it is harmful, for the customer journey. ERI theory provides a perspective on the "value" side of friction: friction is not bad, it's only bad when there's insufficient value to match the effort (security, personalisation, trust); friction is strain in and of itself. A lens on the side of "autonomy" would be provided by reactance theory, which posits that friction becomes an expense when it is perceived as an outside system that is limiting the shopper's freedom to shop the way they want, thereby creating a motivational need to avoid it.

How does the use of AI with effort affect perceived imbalance, and what is the effect of the reward? (2) Does the use of AI with effort increase the perceived imbalance and does the reward buffer the effect? (3) Is psychological reactance linked to negative outcomes?(4) Is perceived autonomy restriction related to negative outcomes? (3) Does an increased association between autonomy restriction and reactance occur when friction is viewed as an element of security justification? (4) Does the decrease in journey satisfaction and in intention to continue due to imbalance and reactance occur simultaneously?

The paper makes three contributions. It brings ERI theory (which has been applied almost exclusively in occupational-stress research) into the domain of

AI retail applications, and extends the notion of customer effort to a reciprocity problem rather than merely a cost problem. Secondly, it defines "security justification" as a boundary condition which reduces the reactance, providing a more specific answer to the "personalisation paradox" that has been reported in the latest research on AI in marketing. Third, it provides the retailer with an evidence-based argument in designing "value-adding friction" instead of "default frictionlessness". The rest of the paper summarizes the two theories and phygital-retail literature, constructs seven hypotheses and a conceptual model, outlines the survey procedure, presents the results and offers some theoretical and managerial implications.

The theoretical background is provided, and a hypothesis is formulated.Theoretical background and formulation of the hypothesis.

2. Theoretical Background and Hypothesis Development

2.1 Phygital Retail and the Friction Paradox

Phygital retail is a conscious blend of physical and digital experiences that allows the customer's journey to seamlessly shift between the two points (Batat, 2022; Johnson & Barlow, 2021). Phygitality is not just an overlay of existing channels (Klaus, 2021) and the elimination of friction is a key design goal for phygitalisation. (Lemon & Verhoef, 2016; Jacob et al., 2021). At the heart of this is AI: computer vision, biometrics, and recommendation engines make 'walk in, walk out' and 'scan and go' formats possible.

But it is also the AI foundation that makes things convenient that makes things convenient and often needs verification. The more frictionless formats become, the more that retailers are going to be susceptible to new vulnerabilities (theft, fraud, identity misuse), and need to re-introduce checks at certain touchpoints along the way. This isn't a frictionless path, but one that is frictionless in some places and slowed in others as AI smooths out some aspects of it and slows others down on purpose. The field of phygital-retail exists, but existing research has looked at friction as a thing to be minimised by definition – not whether some friction is functional, rather than dysfunctional, when designed properly.

2.2 Effort–Reward Imbalance Theory

Effort–Reward Imbalance theory was developed to explain stress related strain in an occupational setting: The theory suggests that psychological and physiological strain is caused not by effort alone, but by an imbalance between effort and reward (Siegrist, 1996). The central reciprocity logic of the model is supported by a large number of studies in occupational contexts (van Vegchel et al., 2005) and the principle of 'costs' versus 'gains' applies to other social transactions where costs are involved besides paid work (Karasek & Theorell, 1990).

The interaction between the shopper and an AI-based retail system can be structured as a similar process as that of ERI: The shopper invests effort (time, cognitive effort, physical effort, etc.), exchanges this effort for a reward that the system calculates (security assurance, personalised offers, quicker visits in the future, etc.), and the system itself does not control the rules that govern the interaction. When applied to this context, ERI theory suggests that the effort verification steps enabled by AI are not inherently dissatisfying, when authentication is not.When applied to this context, ERI theory predicts that the effort verification steps enabled by AI are not inherently dissatisfying, when authentication is. It is important whether the reward is viewed as being in line with that effort. As the effort level increases and the perceived reward level decreases, a strain–satisfaction imbalance arises, which, similar to the occupational ERI literature, should lead to reduced satisfaction with the journey itself, here termed consumer strain.

H1: Perceived effort is positively associated with effort–reward imbalance.

H2: Perceived reward is negatively associated with effort–reward imbalance.

H3: Effort–reward imbalance is negatively associated with customer journey satisfaction.

2.3 Psychological Reactance Theory

Psychological Reactance Theory suggests that if a person's freedom is threatened or denied, then there is a motivational arousal which will manifest itself in various forms of resistance, irritation, or non-compliance (Brehm, 1966; Brehm & Brehm, 1981). Reactance is well documented in the marketing literature as a response to unsolicited recommendations and prescriptive advice (Fitzsimons & Lehmann, 2004), and has become a key explanatory mechanism in recent AI-marketing research: consumer experiences of algorithmic systems that override their preferences, default choices without consent, or that are known to restrict the range of visible options have been shown to lead to reductions in satisfaction and adoption (Longoni et al., 2019; Nokhiz & Ruwanpathirana, 2025; Oh et al., 2025).

AI enabled phygital friction is a potential source of reactance as several of its steps are irrefutable: a shopper may not opt-out of biometric verification and still be able to checkout for a purchase without payment; a shopper may not be able to skip the OTP step to complete a high value transaction. If the shoppers feel that the AI system is directing the journey, rather than themselves, then the level of autonomy restriction should increase.

H4: Perceived autonomy restriction is positively associated with psychological reactance.

H6: Psychological reactance is negatively associated with customer journey satisfaction.

Reactance theory also suggests that there needs to be a boundary condition, and that is when freedom is restricted as being arbitrary or illegitimate rather than when the restricting party's reason for the restriction is understood and accepted. This logic is reinforced by research on trust, which shows that in digital settings, users' trust in the system and their compliance with the requirements for the system are affected by the perceived legitimacy of the system's requirements (Gefen et al., 2003). We therefore predict that such restrictions, ascribable to a legitimate security concern, will be re-interpreted as protective rather than control, although its association with reactance will be reduced, but not abolished.

H5: The positive relationship between perceived autonomy restriction and psychological reactance is weaker when security justification of friction is high than when it is low.

2.4 Journey Satisfaction and Continuance Intention

The overall satisfaction of the customer journey (the shopper's impression of the AI-enabled journey) is conceptualized as a proximal factor of effort-reward imbalance and of reactance, which are two different psychological pathways to the customer journey's dissatisfaction. Satisfaction is an established antecedent to continuance intention in technology-mediated service scenarios: When a shopper is satisfied with an AI experience she or he is more likely to continue, and reactance can also negatively influence continuance, even without affecting satisfaction.

H7: Customer journey satisfaction is positively associated with continuance intention.

3. Conceptual Model

The two theoretical pathways are combined in one path model (figure 1). The top route presents the Effort–Reward Imbalance route with Perceived Effort and Perceived Reward flowing into Effort–Reward Imbalance, impacting on Journey Satisfaction. The Psychological Reactance route (bottom) connects to the Psychological Reactance via the mediator of Security Justification of Friction and also indirectly to Journey Satisfaction. The shared proximal driver of Continuance Intention is Journey Satisfaction. The model does not view the two theories as competing, but rather complementary explanations: effort is tolerated when it's reciprocated, restriction is tolerated when it's justified. Together they define the circumstances in which AI-powered friction becomes friction and the circumstances in which it becomes friction plus value.Together they define when friction with AI becomes friction and when friction with AI becomes friction plus value..

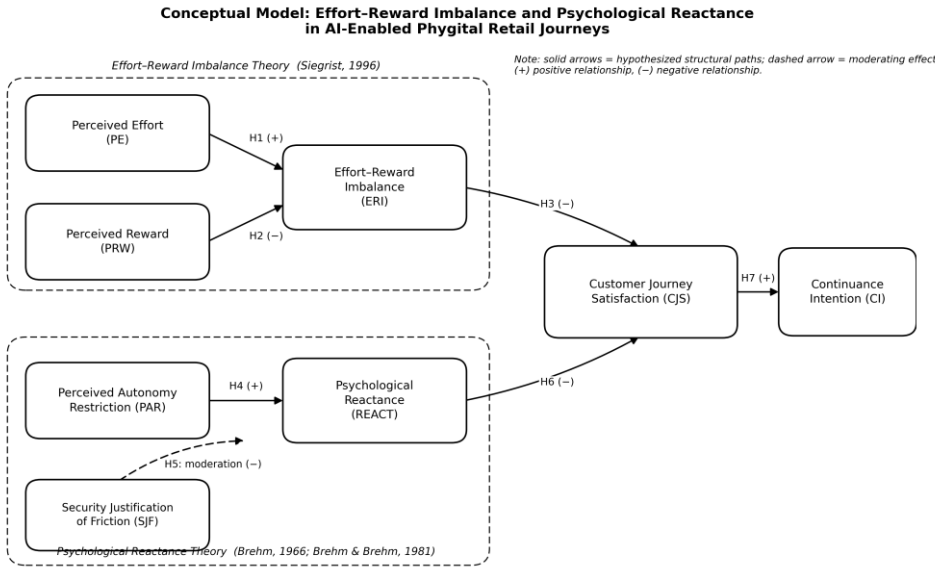


Figure 1. Conceptual model linking Effort–Reward Imbalance Theory and Psychological Reactance Theory to AI-enabled phygital retail journey outcomes.

4. Methodology

4.1 Research Design and Sample

A cross-sectional, quantitative survey design was used. Those who were eligible for the survey were 18 years or older and were customers of a retail format they defined as AI-enabled or "phygital" (uses self-checkout with computer-vision monitoring, biometric or app verification, or an in-store experience that is connected to the retailer's app). The data was collected online from the consumers in Delhi-NCR and other Metro and Non-Metro cities in India. A total of 342 questionnaires were received of which 31 (9.1%) were discarded due to incomplete responses or because they failed one of the attention-check items, leaving an analytic sample of N = 311. Demographic characteristics of the final sample are shown in Table 1.

4.2 Measures

All constructs were assessed using multi-item Likert-type scales (1 = strongly disagree and 5 = strongly agree), adapted from the effort–reward imbalance and psychological reactance literatures and adapted to the AI-enabled retail journeys. Perceived Effort (4 items) and Perceived Reward (4 items) operationalized the cost and gain components of the ERI theory, while Effort–Reward Imbalance (3 items) captured the perceived imbalance between effort and reward directly. Perceived Autonomy Restriction (4 items) and Psychological Reactance (4 items) operationalised the reactance route and Security Justification of Friction (3 items) measured the extent to which respondents agreed that the friction was a legitimate security rationale.

Customer Journey Satisfaction (4 items) and Continuance Intention (3 items) were the outcome measures. A single item control (familiarity with AI in retail 1-5) was also gathered. The coding scheme and full item wording are included in the item codebook that accompanies the data set.

4.3 Procedure

The questionnaire was sent online, preceded by a screening question and an informed consent statement and anonymity guarantee. The order of the items in each construct block was predetermined, and order effects were minimised by varying the order of the construct blocks presented. The average time it took to complete the median was around seven minutes.

4.4 Common Method Variance

Common method variance (CMV) is an issue since all constructs were self-reported in one questionnaire (Podsakoff et al., 2003). At the design stage, procedural remedies were used (anonymity, psychological separation of predictor and outcome blocks, reverse-worded attention checks). In addition, a Harman single-factor test also was applied: An unrotated principal-component analysis of all 29 items accounted for 17.5% of the total variance, which is below the 50% criterion considered to be indicative of a CMV problem, suggesting that common method variance is probably not responsible for the pattern of results.

4.5 Analytical Strategy

Internal consistency was assessed with Cronbach's alpha, and convergent validity with average variance extracted (AVE) and composite reliability (CR), following conventional thresholds (α and CR $\geq$ .70; AVE $\geq$ .50) (Fornell & Larcker, 1981; Nunnally, 1978). Discriminant validity was assessed by comparing the square root of each construct's AVE with its correlations with other constructs. Hypotheses were tested using correlation analysis and hierarchical ordinary least squares (OLS) regression on standardised composite (mean) construct scores a regression-based path-analytic approach appropriate for testing a decomposed structural model of this size. The moderation hypothesis (H5) was tested by entering a mean-centred interaction term.

5. Results

5.1 Sample Profile

Demographic profile of final sample (N = 311) is summarized in Table 1. The male population exceeded the female population in the sample (55.0%) and the highest age group consisted of 25-34 year olds (34.4%). Just over half (49.5%) had an undergraduate qualification, just over a third a postgraduate qualification (34.7%). The respondents were distributed almost evenly among the income brackets and 46.3% of the respondents lived in Delhi-NCR, followed by other metro cities (29.6%) and non-metro/tier-2–3 cities (24.1%). As per the eligibility screening, 100% of respondents had visited an AI enabled

phygital store within the last three months; 62.1% of respondents visited the store 3 or more times in the last three months.

Table 1. Demographic Profile of Respondents (N = 311)

Variable	Category	n	%
Age	25-34	107	34.4%
	18-24	75	24.1%
	35-44	55	17.7%
	45-54	50	16.1%
	55 and above	24	7.7%
Gender	Male	171	55.0%
	Female	138	44.4%
	Other / Prefer not to say	2	0.6%
Education	Undergraduate	154	49.5%
	Postgraduate	108	34.7%
	Up to Higher Secondary	29	9.3%
	Doctorate / Other	20	6.4%
Monthly Household Income (INR)	Rs.30,001-60,000	93	29.9%
	Rs.60,001-1,00,000	89	28.6%
	Above Rs.1,00,000	68	21.9%
	Below Rs.30,000	61	19.6%
Occupation	Salaried employee	158	50.8%
	Student	87	28.0%
	Self-employed / Business	51	16.4%
	Other	15	4.8%
Region	Delhi-NCR	144	46.3%
	Other metro city	92	29.6%
	Non-metro / Tier-2,3 city	75	24.1%
Visits to AI-enabled store (last 3 months)	3-5 times	129	41.5%
	1-2 times	118	37.9%
	6 or more times	64	20.6%

5.2 Reliability and Validity

Cronbach's alpha (0.70) and composite reliability (0.90) values were satisfactory for all eight constructs (range = .78–.84 and .90–.92 respectively), signifying good internal consistency. The mean variance extracted was between .70 and .79, well above the .50 threshold, thus indicating convergent validity. Discriminant validity was supported by the square root of AVE for each construct being greater than the inter-construct correlation for each construct with the other constructs (highest inter-construct correlation = .46, between Perceived Autonomy Restriction and Psychological Reactance, shown in parentheses on the diagonal in Table 4).

Table 2. Reliability and Convergent Validity

Construct	Items	Cronbach's α	CR	AVE
Perceived Effort (PE)	4	0.831	0.916	0.731
Perceived Reward (PRW)	4	0.840	0.921	0.745
Effort–Reward Imbalance (ERI)	3	0.800	0.917	0.788
Perceived Autonomy Restriction (PAR)	4	0.821	0.910	0.717
Psychological Reactance (REACT)	4	0.833	0.917	0.735
Security Justification of Friction (SJF)	3	0.783	0.909	0.769
Customer Journey Satisfaction (CJS)	4	0.811	0.905	0.704
Continuance Intention (CI)	3	0.792	0.913	0.778

5.3 Descriptive Statistics and Correlations

Moderately favourable, but not extreme evaluations of the overall AI-enabled journey are shown by the composite construct, which was evaluated at M = 3.31–3.35, SD = 0.77–0.83 (Table 3).

Table 3. Descriptive Statistics of Composite Construct Scores

Construct	M	SD	Min	Max
Perceived Effort (PE)	3.34	0.78	1.25	5.00
Perceived Reward (PRW)	3.34	0.79	1.00	5.00
Effort–Reward Imbalance (ERI)	3.31	0.82	1.00	5.00
Perceived Autonomy Restriction (PAR)	3.35	0.77	1.00	5.00
Psychological Reactance (REACT)	3.31	0.80	1.25	5.00
Security Justification of Friction (SJF)	3.32	0.79	1.00	5.00
Customer Journey Satisfaction (CJS)	3.32	0.77	1.25	5.00
Continuance Intention (CI)	3.31	0.83	1.00	5.00

Unsurprisingly, there was a positive correlation between Perceived Effort and Effort–Reward Imbalance ($r = .28$, $p < .01$), and a negative correlation between Perceived Reward and Effort–Reward Imbalance ($r = -.23$, $p < .01$). Perceived Autonomy Restriction was strongly negatively correlated with Psychological Reactance ($r = .46$, $p < .01$) and Security Justification of Friction was negatively correlated with Reactance ($r = -.32$, $p < .01$). The Effort–Reward Imbalance ($r = -.23$, $p < .01$) and Reactance ($r = -.28$, $p < .01$) were negatively related to the Journey Satisfaction, which was, in turn, positively related to the Continuance Intention ($r = .41$, $p < .01$).

Table 4. Correlation Matrix (Fornell–Larcker Discriminant Validity Table)

	PE	**PRW**	**ERI**	**PAR**	**REACT**	**SJF**	**CJS**	**CI**
PE	**(0.86)**							
PRW	0.14	**(0.86)**						
ERI	0.28	-0.23	**(0.89)**					
PAR	-0.05	-0.07	0.03	**(0.85)**				
REACT	-0.06	-0.05	0.03	0.46	**(0.86)**			
SJF	0.06	-0.00	-0.03	-0.21	-0.32	**(0.88)**		
CJS	-0.06	0.06	-0.23	-0.13	-0.28	0.11	**(0.84)**	
CI	0.07	0.08	-0.06	-0.16	-0.28	0.06	0.41	**(0.88)**

Note. Diagonal values in parentheses and bold are the square root of AVE. PE = Perceived Effort; PRW = Perceived Reward; ERI = Effort–Reward Imbalance; PAR = Perceived Autonomy Restriction; REACT = Psychological Reactance; SJF = Security Justification of Friction; CJS = Customer Journey Satisfaction; CI = Continuance Intention.

5.4 Hypothesis Testing

The findings of the four regression models to test H1–H7 are presented in Table 5.

The results for Model 1 (DV: Effort–Reward Imbalance) supported H1 (Perceived Effort was significant, positive predictor, $\beta = .32$, $t = 5.99$, $p < .001$) and H2 (Perceived Reward was significant, negative predictor, $\beta = -.28$, $t = -5.21$, $p < .001$) ($R^2 = .152$).

Model 2 (DV: Psychological Reactance) supported H4 as Perceived Autonomy Restriction was a strong positive predictor ($\beta = .41$, $t = 8.32$, $p < .001$). In keeping with the hypothesis, Security Justification of Friction was a significant negative predictor ($\beta = -.23$, $t = -4.70$, $p < .001$), and the Autonomy Restriction × Security Justification interaction term was significant and negative ($\beta = -.10$, $t = -2.00$, $p = .046$), meaning that the positive effect of autonomy restriction on reactance was weaker among respondents who perceived the friction as security-justified ($R^2 = .274$).

The results of Model 3 (DV: Customer Journey Satisfaction) indicated that both Effort–Reward Imbalance ($\beta = -.22$, $t = -4.08$, $p < .001$) and Psychological Reactance ($\beta = -.27$, $t = -5.03$, $p < .001$) were negative predictors, thus supporting both H3 and H6 ($R^2 = .123$).

For H7, Customer Journey Satisfaction was a significant positive predictor of Model 4 (DV: Continuance Intention) with $\beta = .36$, $t = 6.79$, $p < .001$. Psychological Reactance also had a significant direct negative effect on continuance intention beyond its indirect pathway through satisfaction ($\beta = -.18$, $t = -3.37$, $p < .001$) which "signifies that psychological Reactance could evoke an evaluative resistance to future use (dissatisfaction) and a more direct pathway of resistance ($R^2 = .197$).

Table 5. Structural Path Coefficients (Standardised)

Hyp.	Structural Path	β (std.)	t	p	Decision
H1	PE → ERI	0.317	5.99	< .001	Supported
H2	PRW → ERI	-0.276	-5.21	< .001	Supported
H4	PAR → REACT	0.414	8.32	< .001	Supported
	SJF → REACT	-0.234	-4.70	< .001	
H5	PAR × SJF → REACT (interaction)	-0.104	-2.00	0.046	Supported
H3	ERI → CJS	-0.218	-4.08	< .001	Supported
H6	REACT → CJS	-0.268	-5.03	< .001	Supported
H7	CJS → CI	0.360	6.79	< .001	Supported
	REACT → CI (direct)	-0.179	-3.37	< .001	

Table 5b. Model Fit Summary

Model	Dependent Variable	R^2	F-test p
Model 1	Effort–Reward Imbalance (ERI)	0.152	< .001
Model 2	Psychological Reactance (REACT)	0.274	< .001
Model 3	Customer Journey Satisfaction (CJS)	0.123	< .001
Model 4	Continuance Intention (CI)	0.197	< .001

All seven hypotheses were supported. Table 6 summarises the hypothesis-testing outcomes.

Table 6. Hypothesis Summary

Hyp.	Statement	Result
H1	Perceived effort is positively associated with effort–reward imbalance.	Supported
H2	Perceived reward is negatively associated with effort–reward imbalance.	Supported
H3	Effort–reward imbalance is negatively associated with journey satisfaction.	Supported
H4	Perceived autonomy restriction is positively associated with psychological reactance.	Supported
H5	Security justification of friction weakens the autonomy restriction → reactance link.	Supported
H6	Psychological reactance is negatively associated with journey satisfaction.	Supported
H7	Journey satisfaction is positively associated with continuance intention.	Supported

6. Discussion

The results validate the paper's core claim, namely that AI-induced friction in phygital retail is not necessarily bad, but rather its effects rely on the trade-off between effort and reward and whether the consumer is convinced of the restriction it creates is fair. Journey satisfaction is the point of convergence of two psychologically independent paths. The Effort–Reward Imbalance route reveals that consumers don't simply assess one part of the equation when it

comes to AI-powered verification and security measures – they assess them alongside the reward they're getting. As long as perceived reward (security assurance, useful personalisation) matches perceived effort, imbalance and dissatisfaction will be low, consistent with the reciprocity logic of ERI theory as used in the workplace (Siegrist, 1996; van Vegchel et al., 2005), and suggesting that this logic is applicable to consumer-oriented AI environments.

The Psychological Reactance route implies that friction is incurred in a different manner when it is perceived as an imposition on choice, rather than a cost–reward exchange. This is in line with the increasing amount of AI-marketing research that has documented reactance as a response to algorithmic systems that limit or veto consumer decisions (Longoni et al., 2019; Oh et al., 2025). What's novel is the moderating effect of security justification: If consumers recognize and accept the justification for a restriction, the same objective friction generates significantly less reactance. This finding expands on the "personalisation paradox" and the "algorithm aversion" bodies of literature by specifically marking a boundary condition in which perceived legitimacy of purpose is not perceived as aversive, but all constraints imposed on users by AI are not.

Importantly, reactance had an indirect effect on continuance intention via satisfaction, as well as a direct effect, indicating that repugnance of AI-related friction is not solely evaluative. The terms "satisfactory" and "disengage" can be interpreted as a single behaviour by some customers who are satisfied even as they avoid using specific AI elements that limit autonomy (such as not using AI recommendations, staying away from self-checkout lanes, or asking for assistance from humans).

These together make a new definition of the "frictionless commerce" goal. The effort–reward and autonomy-restriction paths suggest two independent design levers proportionate reward and transparent justification that can enable retailers to remove the friction they need for security, fraud prevention, or data governance without causing the satisfaction or loyalty drop and strain or resistance that result from removing it. It's not just about minimizing friction, it's about tuning it, in other words, it's about having a value function for friction.

7. Implications

7.1 Theoretical Implications

By applying the logic of effort–reward imbalance beyond its original application in an occupational stress context to the consumer context of the AI-enabled retail journey, this study proposes a new framework for understanding the effort–reward dynamic and how it shapes consumer evaluation of the security-focused, effortful actions embedded within the retail journey. It also contributes to the literature by introducing security justification as a novel, theory-consistent boundary condition for the autonomy-restriction–reactance

relationship in an AI context, lending empirical specificity to recent arguments in the literature that research should examine when, and not only if, algorithmic systems place a boundary on choice (Nokhiz & Ruwanpathirana, 2025; Oh et al., 2025). Lastly, the theories are integrated in a single model, showing that "cost" (effort–reward) and "control" (autonomy–reactance) are analytically distinct paths toward dissatisfaction, something that previous phygital-retail research, which has viewed friction as a monolithic concept, has failed to make explicit.

7.2 Managerial Implications

There are four practical implications for retailers and AI system designers.

Effort matches, visible, proportionate reward the more effort the more reward, and if it's visible to the shopper it's more likely to be perceived as balance than if it's not.

Tell rather than tell: When introducing a step, briefly and specifically communicate the reason for the step (e.g., "Verify for protection of your account").

Maintain some level of perceived control, wherever possible, such as providing an alternative path (assisted checkout) as well as a mandatory AI path, because it is the perceived control that is the heart of reactance theory, even if the underlying process cannot be avoided.

Some resistance behaviors do not always correlate with satisfaction scores, such as feature avoidance, opt-outs and escalation to human staff, so these also need to be followed up.

8. Limitations and Future Research

These conclusions are subject to a few limitations. The design is cross sectional and correlational, no causal direction of effects can be assumed among the modeled constructs and reverse or reciprocal relationships (e.g., when satisfaction is low, the retrospective report of effort is low) may not be excluded. All measures were self-reported and there was no serious common method problem as suggested by Harman's single-factor test, but this kind of test is not a substitute for other methods like a marker-variable design. The sample was recruited using convenience sampling on the internet and consisted of urban India, and care was taken with the generalisability of the findings from this sample to other cultural and economic settings; an issue that is of particular concern in respect of reactance and which previous studies indicated varies with cultural orientation towards autonomy. The study also applied regression-based path analysis on composite scores instead of a fully latent variable structural equation model, which would not fully account for measurement error, and a larger sample would enable more careful, simultaneous testing of the measurement and structural model, as well as formal tests of mediation and moderated mediation. The moderate variance explained for each endogenous

construct (12–27%) also suggests that other predictors, such as brand trust, prior negative experience with the technology, privacy concern, and technology readiness may have an influence and should be included in future models. Experimental testing of the model with artificial manipulation of AI-enabled friction and how easily it is perceived as security-justified is also recommended for future research, as are the further study of boundary conditions like the type of friction (biometric vs. OTP vs. consent prompts), which could vary in terms of how easily they are perceived as security-justified.

9. Conclusion

The default goal for retail tech has always been frictionless, but the AI systems that power the phygital experiences of today can't help but have some friction and this study suggests in some cases it's beneficial. The study, which combines two theories, Effort–Reward Imbalance theory and Psychological Reactance Theory, demonstrates that AI-induced friction negatively affects journey satisfaction and continuance intention when effort is greater than reward or when there is perceived lack of security justification for the friction but that proportional justice of reward and meaningful security justification buffer and significantly mitigate these effects. Where it applies to retailers building the future AI-powered store, it's not about removing friction but about optimizing it: align effort with visible payoff; communicate limitations instead of silently imposing them; and maintain a degree of consumer choice in an automated flow. With this approach, friction can become a friend to a great customer experience, not an enemy.

References

Batat, W. (2022). What does phygital really mean? A conceptual introduction to the phygital customer experience (PH-CX) framework. Journal of Strategic Marketing, 32(8), 1220–1243.

Brehm, J. W. (1966). A theory of psychological reactance. Academic Press.

Brehm, S. S., & Brehm, J. W. (1981). Psychological reactance: A theory of freedom and control. Academic Press.

Fitzsimons, G. J., & Lehmann, D. R. (2004). Reactance to recommendations: When unsolicited advice yields contrary responses. Marketing Science, 23(1), 82–94.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research, 18(1), 39–50.

Gefen, D., Karahanna, E., & Straub, D. W. (2003). Trust and TAM in online shopping: An integrated model. MIS Quarterly, 27(1), 51–90.

Jacob, F., Pez, V., & Volle, P. (2021). Shifting to phygital experience management with design science: A six-step method to manage customer journeys. Journal of Strategic Marketing, 31(5), 851–871.

Johnson, M., & Barlow, R. (2021). Defining the phygital marketing advantage. Journal of Theoretical and Applied Electronic Commerce Research, 16(6), 2365–2385.

Karasek, R., & Theorell, T. (1990). Healthy work: Stress, productivity, and the reconstruction of working life. Basic Books.

Klaus, P. (2021). Phygital the emperor's new clothes? Journal of Strategic Marketing, 29(8), 1057–1060.

Lemon, K. N., & Verhoef, P. C. (2016). Understanding customer experience throughout the customer journey. Journal of Marketing, 80(6), 69–96.

Longoni, C., Bonezzi, A., & Morewedge, C. K. (2019). Resistance to medical artificial intelligence. Journal of Consumer Research, 46(4), 629–650.

Nokhiz, P., & Ruwanpathirana, A. K. (2025). Consumer autonomy or illusion? Rethinking consumer agency in the age of algorithms. Journal of Social Computing, 6(3), 184–208.

Nunnally, J. C. (1978). Psychometric theory (2nd ed.). McGraw-Hill.

Oh, J., Nah, S., & Yang, Z. D. (2025). How autonomy of artificial intelligence technology and user agency influence AI perceptions and attitudes: Applying the theory of psychological reactance. [Manuscript].

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. Journal of Applied Psychology, 88(5), 879–903.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist, 55(1), 68–78.

Siegrist, J. (1996). Adverse health effects of high-effort/low-reward conditions. Journal of Occupational Health Psychology, 1(1), 27–41.

van Vegchel, N., de Jonge, J., Bosma, H., & Schaufeli, W. (2005). Reviewing the effort–reward imbalance model: Drawing up the balance of 45 empirical studies. Social Science & Medicine, 60(5), 1117–1131.