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TECHNOLOGY TRANSFER IN MOROCCO: COMPLEMENTARITY BETWEEN FOREIGN DIRECT INVESTMENT AND FOREIGN TRADE, AND THEIR EFFECTS ON MANUFACTURING EXPORT PERFORMANCE

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Abstract:

This paper aims to analyze the complementarity between foreign direct investment (FDI) and foreign trade in the evolution of the technology transfer process in Morocco. The study focuses on their contribution to manufacturing export performance, particularly in the automotive industry. Furthermore, we seek to demonstrate that FDI contributes to the structuring of technological diffusion through subsidiary processes and dedicated training schemes, while foreign trade introduces technologies embodied in imported goods. In the case of the automotive sector, illustrated by Renault's experience, the investigation highlights an evolution toward higher value-added production, accompanied by progressive strengthening of local skills and better integration of supply chains. The article also identifies current limitations (weak local R&D, strategic dependence) and ultimately suggests recommendations to articulate the two channels in service of an integrated and sovereign industrial strategy.

Keywords: Technology Transfer, FDI-Trade Complementarity, Embedded Technological Diffusion, Automotive Value Chains, Industrial Upgrading, absorption capacity.

Résumé :

Cet article essaie d'analyser la complémentarité entre les investissements directs étrangers (IDE) et le commerce extérieur dans l'évolution du processus de transfert de technologie au Maroc, où l'on met l'accent sur leur contribution à la performance des exportations manufacturières, particulièrement dans l'industrie automobile. Par ailleurs, nous cherchons à démontrer que les IDE contribuent à la structuration de la diffusion technologique via les processus des filiales et les dispositifs de formation dédiés, tandis que le commerce extérieur introduit des technologies incorporées dans les biens importés. Dans le secteur automobile, illustré par l'expérience de Renault, l'investigation met en lumière une évolution vers une production à plus forte valeur ajoutée, accompagnée d'un renforcement progressif des compétences locales et d'une meilleure intégration des chaînes d'approvisionnement. L'article identifie également les limites actuelles (faiblesse de la R&D locale, dépendance stratégique) et propose, in fine, des recommandations pour articuler ces deux canaux au service d'une stratégie industrielle intégrée et souveraine.

Mots-clés : transfert de technologie, Complémentarité IDE- commerce, Diffusion technologique incorporée, Chaînes de valeur automobiles, Montée en gamme industrielle, capacités d'absorption.

Introduction

In a global context marked by acceleration technological progress, developing countries face a dual challenge: reducing the technological gap with advanced economies and consolidating local capacities for absorption, adaptation, and innovation. Morocco, in this regard, aspires to strengthen its economic and industrial transformation by positioning itself as a competitive regional hub for productive investment, particularly in high technological value-added sectors. For that, Technology transfer (TT) is identified as a strategic lever to increasing competitiveness, accelerating innovation, and improving export performance. It can be achieved through several ways, among which Foreign Direct Investment (FDI) and foreign trade play a prominent role. The former generates positive externalities (positive spillovers) through subsidiary establishment, human resource training, and industrial network development, whereas the latter brings in technologies embodied in imported goods, thereby fostering a higher level of technical sophistication in domestic production processes.

The economic and management literature has, for several decades, emphasized the pivotal role of multinational enterprises in facilitating technology transfer to developing economies. Foreign direct investment is thus widely regarded as a key channel for knowledge diffusion, generating technological spillovers through human capital development and the introduction of innovative production processes (Blomström & Kokko, 1998).

At the same time, international trade constitutes a major transmission mechanism, particularly through the importation of technologically intensive capital goods (Grossman & Helpman, 1991; Keller, 2004). However, the effectiveness of these flows remains highly contingent upon the absorptive capacity of host economies, thereby underscoring the critical importance of the interplay between trade openness and local learning capabilities (Mowery & Oxley, 1995; Narula & Dunning, 2000).

Within emerging economies, the interactions between foreign direct investment, international trade, and technological diffusion have become a central pillar of industrial transformation strategies. Contemporary literature highlights that integration into global value chains acts as a catalyst for technological learning and export upgrading. However, the efficiency of this catch-up dynamic remains conditional upon endogenous prerequisites, notably the presence of robust absorptive capacities and an institutional framework conducive to innovation and industrial expansion.

Numerous empirical and institutional works have showed the central role of these two channels in the Moroccan case. For instance, the study by Bennani & Dinar (2023) indicates the complementarity between FDI and technological imports and demonstrates that these two levers must be considered jointly to foster optimal diffusion of knowledge and expertise. Similarly, the

Direction of Studies and Financial Forecasts (2017) attached to the Ministry of Finance, has published a strategic note that provides a detailed analysis of the evolution of technological content in Moroccan manufacturing exports, showing the progress achieved through targeted sectoral strategies. Finally, the sectoral study by Elkhider & Kissai (2023) concretely illustrates these dynamics through the case of the automotive industry, notably via the experience of Renault Morocco, which has substantially contributed to export upgrading and skill development.

Against this backdrop, our study aims to answer the following question: **to what extent do Foreign Direct Investment and foreign trade participate, in a complementary manner, in strengthening technology transfer and improving the export performance of the Moroccan manufacturing sector, particularly in the automotive industry?**

In an increasingly interdependent global economy, where competitiveness hinges on technological mastery, developing countries such as Morocco cannot rely on passive transfer mechanisms alone. Effective absorption requires a proactive strategy combining investment attractiveness, commercial integration, and skill upgrading. By combining conceptual, empirical, and sectoral insights, our study seeks to provide a comprehensive interpretation of Morocco's technological dynamics and to identify institutional levers capable of maximizing technological and economic spillovers.

This article is structured into four sections. The first develops the conceptual and theoretical framework by examining the interrelations between foreign direct investment, international trade, and technology transfer mechanisms. The second outlines the methodological approach and the nature of the data employed. The third section provides an empirical analysis of the complementarity between foreign direct investment and foreign trade in Morocco, with a particular focus on their role in technological diffusion and export performance. The fourth section extends the analysis to the Moroccan automotive sector as a structuring case study, highlighting the structuring role of the industrial ecosystem and the contribution of transnational corporations. The final section synthesizes the main findings and discusses their implications for industrial and trade policies.

1. Conceptual and theoretical framework

1.1. Definition and forms of technology transfer

According to the Organisation for Economic Cooperation and Development (OECD), *technology transfer is defined as the process by which knowledge, skills, production methods, or technical innovations are transmitted from one actor - frequently a company or research center - to another, often based in a country or organization with inferior technological capacity.* This process includes both tangible dimensions, namely the provision of equipment, and intangible aspects, such as human capital education or the transmission of organizational know-how.

In line with this broad definition, the literature commonly distinguishes three complementary forms of TT: first, material transfer, involving the acquisition of physical technologies (machines, infrastructure); second, conceptual transfer, related to codified knowledge such as designs, patents, licenses, or software; and third, capacity transfer, which concerns the development of practical know-how through training, mentoring, and repeated learning interactions.

Several theoretical frameworks have been mobilized to explain this phenomenon. The imitation and diffusion model proposed by Rogers (1962) essentially emphasizes the progressive adoption of innovation by organizations. The technological dependence model developed by Fairless (1960) highlights the risks associated with the structural dependence of developing countries on foreign technologies. In addition, the interactive learning approach (Freeman, 1987), has underlined the importance of interactions between innovation system actors, as well as the knowledge accumulation theory formulated by Lundvall (1992), which states that technological capabilities increase through experience, cooperation, and organizational practices.

These different approaches converge toward a dynamic and systemic vision of technology transfer, which could not be reduced to a simple exchange of technical assets, but must be perceived as a co-constructed, evolving process, conditioned by economic, institutional, and human factors.

1.2. Foreign direct investment as a channel of technological transfer

Foreign Direct Investment represents one of the most effective channels of technological diffusion in developing countries. Beyond their traditional function of capital mobilization, FDI constitutes a strategic vector for transferring know-how, organizational skills, and advanced technologies.

Institutionally, the OECD defines FDI as an investment by a foreign economic actor in a local entity, with the objective of establishing a lasting relationship and significantly influencing its management. This definition is completed by that of the World Bank, which insists on the threshold of holding at least 10% of capital as an indicator of stable and sustained control. For so, Krugman (1991) underlines the logic of multinational firm expansion in a globalized economic environment.

Several economic theories provide a more comprehensive understanding of the FDI determinants and their role in technological transfer. The comparative advantage theory, developed by Ricardo, stipulates that foreign firms invest in countries endowed with specific resources or skills, such as low labor costs or privileged access to raw materials. Internalization theory (Coase, 1937) emphasizes the importance for companies of internally mastering their value chains rather than relying on market contracts. Dunning's OLI paradigm (1981) proposes a synthesis articulating

three types of advantages: Ownership (firm-specific assets), Location (host country attractiveness), and Internalization (relevance of internal rather than externalized management).

Furthermore, technological transfer via FDI can be realized through different channels. First, local subsidiaries benefit from imported production technologies and standardized processes. Next, multinational firms often invest in personnel training, in advanced production infrastructure, or even in R&D centers. Positive externality mechanisms also manifest through imitation effects, through subcontracting relationships, or the rotation of qualified personnel to other local companies. Finally, strategic partnerships or joint ventures facilitate the sharing of technologies, patents, and managerial practices.

However, the impact of FDI on the local productive fabric largely depends on the absorption capacity of local companies, the regulatory framework, institutional stability, and the existence of incentive public policies. Technology transfer is therefore neither automatic nor homogeneous: it consequently requires close articulation between foreign investment strategies and local industrial policies.

1.3. Foreign trade and embedded technological transfer

Foreign trade constitutes another essential vector of technology transfer, notably through imported goods with high technological content. In this perspective, imports of sophisticated equipment goods, electronic components, or specialized machines allow the indirect introduction of advanced technologies into the national economy. These imported goods play a structuring role in the modernization of production capacities, particularly in high value-added industrial sectors. According to economic literature, international trade acts as a channel for technological innovation diffusion (Grossman & Helpman, 1991), particularly when developing countries import goods from technologically advanced economies. These imported products incorporate not only advanced technical functions but also convey quality standards, production standards, and adaptation requirements that foster organizational learning.

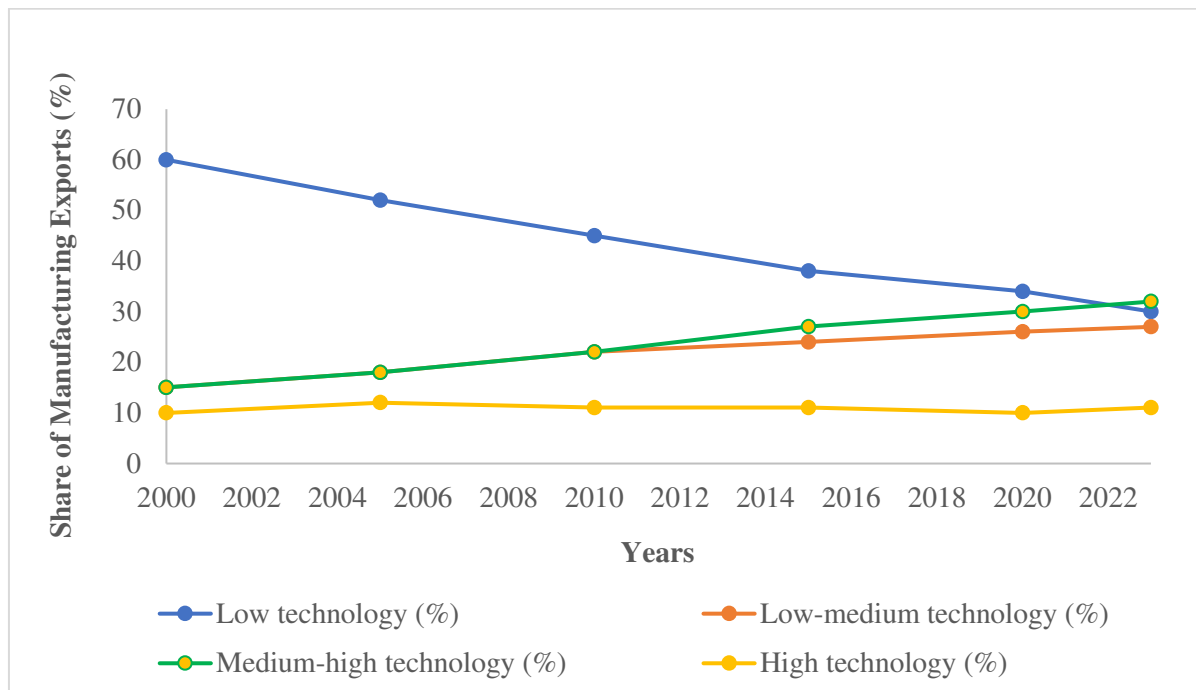
In Morocco's case, data from the Department of Economic Studies and Financial Forecast (DEPF, 2017) indicate that the country has experienced notable evolution in the technological structure of its manufacturing exports. Between 2000 and 2015, the share of products with medium to high technological content rose from 19% to 36% of total manufacturing exports. This progression is partly explained by technological diffusion effects induced by imports, notably from European and Asian partners, which have contributed to modernizing value chains in key sectors such as automotive, aeronautics, and Information and Communication Technologies.

Technological imports are not reduced to equipment supply. They often require related services, such as technical assistance, documentation, initial training, and even implicit transfer of

industrial processes. Therefore, foreign trade acts as an "integrated transfer" channel, even more effective as local companies have minimal technological absorption capacity.

However, this channel also presents limitations. In the absence of industrial integration strategies or local content requirements, imports can substitute for national innovation effort, making transfer purely passive, in the absence of lasting spillovers. Hence the importance of associating this lever with active policies of training, standardization, and skill development in Moroccan companies.

Figure 1: Evolution of the Technological Content of Moroccan Manufacturing Exports between 2000 and 2023



Source: Authors

The figure 1 illustrates the progressive evolution of the technological structure of Moroccan exports. It indicates a constant decline in the share of products with low technological content, compensated by a progression of medium-technology products, notably in automotive, electronic components, and aeronautics sectors. However, the stagnation of very high-technology goods exports reveals still significant and requires improvement margins in terms of local innovation.

Considering the elements previously mentioned, it appears that technology transfer clearly constitutes a multidimensional process, operating through a diversity of channels, logics, and institutional frameworks. FDI ensures structured transfer via formal devices, such as subsidiary establishment, human capital training, joint ventures, or R&D center creation. In parallel, foreign trade acts as a more diffuse transfer lever, mobilizing the importation of high technological

intensity goods and the implicit diffusion of technical standards, industrial standards, and organizational practices.

These two vectors present distinct but interdependent mechanisms, calling for a complementary rather than opposed perspectives. Their respective effectiveness remains however dependent on the absorption capacity of local actors, the quality of the regulatory framework, as well as their integration into coherent industrial strategies.

It is in this perspective that the following section will examine an empirical analysis of the Moroccan case, examining the complementarity dynamic between foreign direct investment and foreign trade. The objective is to evaluate the joint effects of these two levers on technological diffusion and on the structural transformation of the export fabric, to better understand interaction mechanisms and the conditions of their effectiveness.

2. Research methodology

This study adopts a qualitative and exploratory approach based on documentary analysis, which aims to analyze technology transfer processes in Morocco, in connection with foreign direct investment and foreign trade. The objective is to examine the complementarity between these two channels of innovation diffusion and the improvement of export performance, particularly in the manufacturing sector, and more specifically in the automotive industry.

The methodological framework of this study is grounded in an empirical analysis drawing on institutional and sectoral data related to foreign direct investment flows, international trade, and the structure of the Moroccan automotive industry. Adopting an analytical perspective on sectoral dynamics, the study relies on statistical series and authoritative institutional reports to identify the mechanisms underlying technological diffusion.

The use of aggregated and sectoral data represents a well-established approach for analyzing structural transformations in emerging economies (Mayer et al., 2003), particularly in contexts where access to firm-level microdata is constrained by limitations in availability or completeness.

This methodological positioning is consistent with a body of research that highlights the relevance of qualitative, documentary, and interpretive approaches for examining complex and multidimensional phenomena. In line with the recommendations of Creswell (2014) and Yin (2018), this approach prioritizes an analytical understanding of underlying mechanisms rather than a strict measurement of statistical causality. Such an approach enables a contextualized interpretation of industrial dynamics, which is essential for capturing the interplay between the strategies of transnational firms and national development trajectories.

The choice of this approach results of several considerations. On the one hand, the multidimensional nature of technology transfer comprising economic, institutional, technological,

and organizational aspects justifies recourse to an interpretative approach mobilizing varied and complementary sources. On the other hand, access to aggregated and updated databases is limited, thus it is considered more relevant to construct the analysis from institutional documents and validated sectoral studies.

Moreover, we analyze certain sources according to a logic of documentary triangulation, which privileges the junction of statistical data, empirical findings, and institutional interpretations. This analysis thus allowed identifying sectoral trends, technological diffusion mechanisms, and formulating hypotheses on synergies between FDI and foreign trade.

We also mobilized graphic representation tools to illustrate export dynamism, the distribution of imports by technological content, as well as the extent of local integration in the automotive sector. Although the study is not based on a properly quantitative or econometric investigation, it relies on consolidated indicators from the aforementioned institutional sources, which guarantees the reliability and relevance of findings.

Finally, certain methodological limitations must be acknowledged, mainly due to the absence of microdata, the non-availability of cross-temporal series beyond 2020 for certain variables, and dependence on official publications. These limits are partially compensated by recourse to updated sectoral sources (up to 2023) and by an analytical approach focused on structural dynamics rather than exhaustive quantification.

Given the structure of available data and the interpretive nature of this research, no econometric estimation was conducted; instead, the article builds on validated institutional series and cross-sector evidence.

3. Empirical Analysis of the Complementarity between FDI and Foreign Trade

After outlining the main conceptual mechanisms of technology transfer through FDI and foreign trade, it is now appropriate to adopt an empirical perspective to concretely understand how these two channels interact in the Moroccan context. This section focuses on exploring their effective complementarity and assesses their cross effects on technological dynamics and structural transformation of the export base.

3.1. Interdependence: goods importation vs. knowledge acquisition

FDI and foreign trade should not be apprehended as two distinct levers, but rather as closely interconnected instruments that serve technological diffusion. Their complementarity manifests at several levels, both structural and operational.

Consistent with the spillover mechanisms outlined earlier, FDI-driven human capital upgrading facilitates the absorption of imported technologies and strengthens learning dynamics within Moroccan value chain.

According to the Economic and Financial Report 2025, Morocco's automotive export largely dominated by international groups, reached a record level in 2023, representing 44% of total industrial exports. This performance is inseparable from imports of cutting-edge equipment and high-tech parts, largely integrated by local subsidiaries. Furthermore, the increase in the share of medium-high technology exports, from 27% in 2015 to 32% in 2023, reflects this synergy effect between FDI flows and international commercial circuits.

However, the effectiveness of this complementarity remains conditioned by several factors, including the quality of human capital, the availability of efficient logistics infrastructures, and the existence of industrial policies promoting technological integration. Without coherent coordination, foreign trade may reinforce dependence on imported technologies rather than stimulate genuine learning dynamics. For this reason, articulating FDI and trade within a broader strategy of supply-chain integration, skills upgrading, and innovation capacity building remains crucial for consolidating long-term technological gains.

Recent literature on foreign direct investment and global value chains emphasizes that the interaction between these two flows has become a central driver of technological diffusion in emerging economies. A growing body of research highlights that the presence of multinational enterprises fosters the upgrading of productive structures and the increasing sophistication of exports. This process operates through multiple channels, including demonstration effects, organizational learning, and the diffusion of technological standards within local industrial systems (Alfaro et al., 2021; Keller, 2021). Moreover, the extent to which these externalities are effectively leveraged depends critically on the quality of the institutional environment and the absorptive capacity of local actors (Taglioni & Winkler, 2021).

However, the literature on the effects of foreign direct investment on technology transfer and export performance remains heterogeneous. While a strand of research emphasizes the positive externalities associated with integration into global value chains, other studies offer a more nuanced perspective, stressing that such effects are neither automatic nor uniformly distributed. The effectiveness of FDI largely depends on the absorptive capacity of the local productive system, the level of human capital, and the quality of the institutional environment (Narula & Marin, 2003). In certain contexts, subsidiaries of multinational enterprises may operate as productive enclaves, generating only limited learning spillovers for domestic firms. These divergent findings underscore the need for empirical investigations into the conditions under which FDI inflows and international trade can effectively catalyze structural transformation in emerging economies.

3.2. Empirical evidence for Morocco (2011–2023)

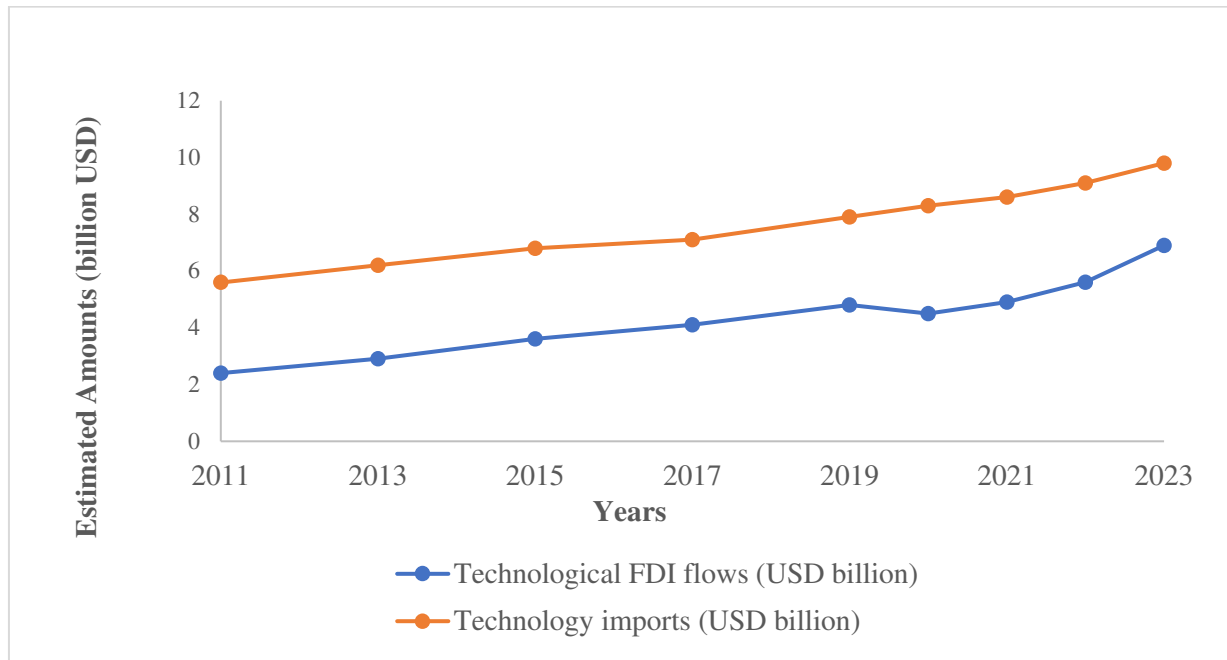
An examination of Morocco's technological flows over the period 2011-2023 confirms a positive dynamic in terms of technological integration. This period has been featured by sustained growth of FDI with high technological content, as well as significant strengthening of imports of advanced industrial goods.

FDI flows with technological dimension rose from USD 2.4 billion in 2011 to approximately USD 6.9 billion in 2023, reflecting an expansion of high value-added investment projects in sectors such as automotive, renewable energy, electronics, and more recently, electric mobility. The planned establishment of the Gotion High-Tech battery gigafactory valued at USD 6.4 billion illustrates this strategic shift toward technologically intensive activities.

Simultaneously, technological goods imports reached USD 9.8 billion in 2023, driven by increased demand for industrial equipment, electronic components, automated systems, and capital goods destined for export. These flows are notably fed by the needs of integrated industrial platforms operating within the framework of global subcontracting.

The following figure illustrates the ascending trajectory of technological flows in Morocco:

Figure 2: Evolution of Technology Flows to Morocco, 2011-2023



Source: Authors

Figure 2, elaborated using data from DEPF (2017) and the Economic and Financial Report 2025, highlights the parallel upward trends of FDI with strong technological content and imports of high-tech goods. This correlation reflects a configuration in which foreign investment serves as a

catalyst for technological upgrading through international trade flows. It also signals the growing maturity of Morocco's productive base, which is progressively acquiring the capacity to absorb more sophisticated technologies and integrate them into domestic production systems.

The empirical findings presented corroborate several patterns identified in the literature on the impact of foreign direct investment on the structural transformation of emerging economies. More specifically, the predominance of the automotive sector in Morocco's export dynamics illustrates the mechanisms through which the presence of transnational firms fosters technological diffusion and integration into global value chains.

These findings support the view that FDI acts as a key vector of knowledge transfer, through the introduction of innovative production processes, the adoption of industrial standards, and the development of productive linkages between foreign affiliates and the domestic economic fabric. Nevertheless, the magnitude of these externalities remains contingent upon the absorptive capacity of domestic actors and the effectiveness of industrial policies aimed at promoting local integration and upgrading.

4. Sectoral Application: The Moroccan Automotive Industry

Given the growing importance of the automotive sector in Morocco's industrial and export structure makes it essential to examine how this industry concretely contributes to technology transfer. Supported by the establishment of major actors and targeted industrial policies, the sector has become a key vector of technological integration and upgrading. This section draws on empirical evidence, particularly the case of Renault Morocco, to analyze how the automotive ecosystem illustrates the complementarity between FDI, foreign trade, and local skill development.

4.1. FDI as a vector of technology transfer (Renault case)

Renault's establishment in Morocco constitutes a decisive milestone in the country's industrial upgrading. The opening of the Tangier plant in 2012 introduced a production model aligned with international standards in automation, quality control, industrial logistics, and eco-efficiency. This investment quickly became one of the Kingdom's most structuring FDI projects due to its technological depth and catalytic effects on the wider automotive ecosystem.

Beyond production, Renault has contributed significantly to skill upgrading through the IFMIA training center and partnerships with OFPPT and universities, enabling the transfer of advanced competencies in assembly technologies, robotics, logistics flow management, and industrial quality systems. This learning dynamic has supported the emergence of more than 200 local suppliers and contributed to raising the integration rate above 60%, according to the Ministry of Industry.

From a commercial perspective, Renault Morocco has become the country's leading industrial exporter. In 2023, more than 250,000 vehicles were shipped to over 70 destinations, generating export revenues exceeding USD 3.5 billion. This performance is inseparable from the Tanger Med industrial-port complex, whose maritime connectivity to more than 180 international ports facilitates both the importation of high-tech components and the global distribution of finished vehicles.

Taken together, the Renault case illustrates how strategically anchored FDI—combined with training, ecosystem development, and logistics excellence—can profoundly reshape the productive and export structure of an emerging economy.

4.2. Effects on export performance

The expansion of the automotive sector driven by investments from Renault, Stellantis, and their suppliers has profoundly reshaped Morocco's manufacturing export structure. In less than a decade, the sector has become the country's leading export industry. According to the Economic and Financial Report 2025, automotive exports reached over 130 billion dirhams in 2023, accounting for nearly 44% of total industrial exports.

This performance reflects Morocco's capacity to meet international standards in quality, lead times, and regulatory compliance, supported by the Tanger Med logistics platform and a steadily improving technical workforce.

Figure 3: Evolution of Moroccan Industrial Exports by Sector (2014–2023)



Source: Authors

As illustrated in Figure 3, export levels increased from 33 billion dirhams in 2014 to almost 130 billion in 2023, while traditional sectors such as textiles and agri-food recorded more moderate progress. This shift demonstrates the structuring impact of FDI-supported strategies and targeted industrial policies that have prioritized higher technology segments.

The move toward more technologically intensive production is equally evident in the growing complexity of models manufactured domestically, which increasingly incorporate electronic components, driver-assistance systems, and robotized assembly processes. These developments confirm the presence of a sustained technological diffusion dynamic, combining FDI inflows, local learning, and deeper integration into global value chains.

This transformation is also the result of strengthened human capital. The rising demand for technicians and engineers has prompted reforms in vocational and university programs, particularly in mechatronics, logistics, and production engineering while specialized training institutions such as IFMIA in Tangier and Casablanca play a crucial role in supporting this upgrading. Overall, these elements show that the automotive industry acts less as a purely quantitative export engine than as a qualitative lever of structural transformation, grounded in skill development, productive specialization, and increasing insertion into international industrial networks.

4.3. Logistical and industrial complementarity with imports

The development of the automotive sector in Morocco relies on a strong complementarity between foreign productive investment and the country's capacity to import, integrate, and upgrade technological intensive inputs. This logistics and industrial complementarity constitutes a central pillar of the sector's competitiveness.

According to the Economic and Financial Report 2025, imports of automotive equipment and components—classified among medium- and high-technology goods—represented 43.7% of manufacturing exports in 2023, reflecting the embeddedness of Moroccan production within global value chains where advanced inputs remain indispensable.

Industrial platforms such as Tanger Automotive City or the Kénitra free zone equipped with type of logistics integration have facilitated the routing of components from Europe and Asia, while guaranteeing efficient exportation of finished vehicles to more than 70 international destinations. The Tanger Med port plays, in this regard, a strategic role by ensuring maritime connectivity with more than 180 ports worldwide.

Industrial platforms such as Tanger Automotive City and the Kenitra free zone facilitate this dynamic by ensuring efficient routing of components sourced from Europe and Asia, while enabling the rapid export of finished vehicles to more than 70 destinations. The Tanger Med port plays a decisive role in this configuration, offering maritime connectivity to over 180 ports worldwide and thereby supporting both the importation of precision components and the international dissemination of locally assembled vehicles.

At the industrial level, this complementarity materializes through continuous interaction between technological imports and domestic upgrading. FDI imposes demanding technological and

organizational standards, which stimulate local demand for highly specialized imported inputs. In parallel, progressive capability building among domestic suppliers—supported by learning-by-doing, engineering improvements, and quality certification has allowed partial substitution of certain imported components, contributing to the steady rise in the integration rate, which now exceeds 60% according to the Ministry of Industry.

This dynamic is particularly visible in electronic and mechatronic component manufacturing. Initial reliance on imported parts enabled basic assembly operations, but the sector has gradually shifted toward activities involving local design, engineering, and pre-assembly. This trajectory aligns with institutional evidence documenting a significant increase in the technological content of Morocco's manufacturing exports, especially within medium- and high-technology segments such as automotive components and electrical equipment.

Ultimately, the complementarity between foreign industrial establishment and technological imports is not a passive relationship but the expression of a cumulative learning process. While early stages depend heavily on imported technologies, subsequent phases increasingly capitalize on domestic capabilities both technical and logistical enabling Morocco to internalize more complex production stages and consolidate its position within global automotive value chains.

4.4. Discussion

of the analytical elements presented in the previous sections, technology transfer in Morocco appears as a complex and evolving process shaped by the interaction between FDI, foreign trade, and the country's institutional and industrial environment. Understanding this dynamic requires moving beyond a linear reading of transfer channels to consider how they jointly contribute to the emergence of a national innovation ecosystem. The following discussion examines the conditions under which such an ecosystem can consolidate, the constraints that still hinder its full deployment, and the strategic levers needed to amplify technological spillovers.

- **Toward an innovation ecosystem**

Considering upstream analyses, we can affirm that Morocco is effectively at a crossroads in its technology oriented industrial development trajectory. The relationship between FDI and foreign trade does not operate as a simple juxtaposition of transfer channels, but rather as an integrated system capable of nurturing a functional innovation ecosystem, in which the growing technological demands of global manufacturers are progressively compensated by the rising national subcontracting power reflected in an integration rate exceeding 60% in 2023 indicating the emergence of structured learning dynamics within the productive fabric.

Cross-analysis of data confirms this complementarity. Between 2011 and 2020, FDI flows were predominantly directed toward sectors with medium technological content, averaging USD 10.63

billion, while imports of manufactured goods with comparable technological intensity accounted for 54% of total imports and reached USD 27.96 billion in 2020. This coupling supports the view that FDI and foreign trade form a mutually reinforcing set of mechanisms through which foreign technologies enter the economy, circulate, and fuel the upgrading of domestic capabilities.

This finding is consistent with the principles of the knowledge economy, in which the combination of embedded transfers (via imports) and organizational transfers (via FDI subsidiaries) plays a decisive role in the development of local technological capabilities. The automotive sector illustrates this dynamic particularly well: initial dependence on imported components has been progressively declined with the expansion of domestic subcontracting, allowing local firms to internalize and adapt increasingly sophisticated technologies. This trajectory reflects a cumulative learning process through which foreign technologies are absorbed, domesticated, and sustained within the national industrial base.

Finally, although aggregate cross-series data for the post 2020 period are not yet available in comparable form, updated sectoral analyses presented earlier especially for the automotive and export sectors up to 2023 confirm the continuation of these dynamics. Together, they demonstrate that the interaction between FDI and foreign trade constitutes the backbone of Morocco's emerging innovation ecosystem.

- **Structural limitations**

Despite these advances, several structural limitations continue to hinder the emergence of a fully integrated innovation ecosystem in Morocco. Local R&D remains insufficiently funded and insufficiently connected to industrial needs, which restricts the development of endogenous technological capabilities. Horizontal integration between local and multinational companies remains marginal. Indeed, technology transfer is often limited to production functions, with weak diffusion toward internal links (design, engineering) or external ones (maintenance, innovation).

Moreover, institutional assessments highlight persistent mismatches between training outcomes and the skill requirements of industrial value chains, which continue to limit the absorptive capacity of Morocco's productive system. World Bank analyses of Morocco's skills development framework underline enduring issues of relevance and quality in technical and vocational training, despite improvements in access (World Bank, 2020). At the same time, evidence from empirical research indicates that technology transfer processes remain largely shaped by the strategic choices of multinational firms, which restricts local appropriation and reduces the long-term sustainability of transferred technologies.

- **Strategic opportunities**

To overcome these limitations, strategic reorientation is imperative. It involves:

- Public authority initiative in terms of fiscal encouragement of FDI that generates technological and integrated value-added, through real competence or know-how or property transfer
- Strengthening public private partnerships in technical and vocational training where companies play a principal co-constructor role of curricula destined for technical and technological trades.
- Creating sectoral innovation poles around very large contractors (Renault or STMicroelectronics for example) as open innovation catalysts for local SMEs.
- Improving technological governance, making better coordination between industrial, commercial, and educational policies, while simultaneously reinforcing national innovation capabilities by supporting applied research, technology upgrading, and collaborative R&D programs that enable domestic firms to gradually internalize and sustain transferred technologies.
- Strengthened leverage of bilateral and multilateral agreements (European Union for example) that should allow, on the one hand, greater integration into global value chains, but also privileged access to strategic or innovative technologies

The following table presents strengths, weaknesses, opportunities, and threats (SWOT) relative to technology transfer in Morocco, based on the previous analysis. This strategic diagnosis has allowed appreciating levers to activate as well as structural risks to attenuate to further strengthen the impact of FDI and foreign trade in the national industrial innovation dynamic.

Strengths	Weaknesses
<ul style="list-style-type: none"> • strong complementarity between FDI and foreign trade n technological diffusion 	<ul style="list-style-type: none"> • Limited funding and weak institutional anchoring of local R&D
<ul style="list-style-type: none"> • High local integration rate in automotive (>60%) 	<ul style="list-style-type: none"> Persistent mismatch between available skills and technological needs
Opportunities	Threats
<ul style="list-style-type: none"> • Targeted fiscal incentives to attract high-tech FDI • Creation of sectoral innovation hubs around major lead firms 	<ul style="list-style-type: none"> • Strategic dependence on the decisions of foreign parent companies

Source: Authors

Overall, the analysis shows that Morocco has initiated a genuine technological upgrading trajectory, but that stronger coordination, enhanced R&D, and deeper capability building are still required to consolidate an integrated innovation ecosystem. These insights set the stage for the concluding reflections on the strategic implications of FDI- and trade-led technology transfer.

Conclusion

The analysis conducted in this article has revealed the structuring role of technology transfer in Morocco's industrial transformation effort, from two channels deemed major: foreign direct investment and foreign trade. Far from functioning in isolation, these two levers interact in an additional and complementary manner, generating training effects, skill upgrading, and strategic repositioning of the productive fabric. The automotive industry case, examined as a flagship sector, has thus allowed concretely illustrating this virtuous dynamic, both through deeper integration into global value chains and through the progressive strengthening of domestic technological capabilities.

However, the limitations highlighted in the discussion namely insufficient national R&D effort, the structural fragility of technological bases, and enduring mismatches between training outcomes and industrial requirements confirm the necessity of more integrated technology transfer governance. Optimizing synergies between FDI and foreign trade should not be confined to influencing multinational investment decisions alone; it must also be accompanied by proactive industrial policies, aligned with long-term objectives of technological development and productive sovereignty.

Three essential axes are identified to strengthen technology transfer performance:

1. Targeting FDI with high technological intensity, supported by fiscal and regulatory incentives linked to commitments in training, local R&D, and intellectual property sharing.
2. Structuring local innovation ecosystems that foster partnerships between large companies, SMEs, research centers, and training organizations, notably under the aegis of sectoral competitiveness clusters.
3. Strengthening national absorption of imported technologies through sustained improvement of human capital, technological infrastructure, and standardization and certification mechanisms that enable firms to internalize and stabilize advanced industrial processes.

This article makes a dual contribution to the literature on the interactions between foreign direct investment, international trade and technological diffusion in emerging economies. From a theoretical perspective, the study highlights the strategic complementarity between FDI flows and trade exchanges, which act as joint vectors of knowledge transfer and technological upgrading. From an empirical standpoint, the Moroccan automotive sector provides a particularly illustrative case of the mechanisms through which the synergy between the presence of transnational firms, the import of capital goods, and the strengthening of local industrial capabilities fosters export

sophistication. This study thus demonstrates how a coherent articulation of these different levers enables deeper integration into global value chains.

Notwithstanding its contributions, this research presents several limitations that should be acknowledged for a cautious interpretation of the findings. The analysis primarily relies on the use of aggregated institutional and sectoral data, while restricted access to firm-level microdata limits a more granular examination of the mechanisms of technological diffusion.

Furthermore, the incomplete nature of certain statistical series related to technological flows and FDI over time constitutes an additional constraint. These methodological limitations suggest that the findings should be interpreted as an analysis of structural dynamics rather than as a comprehensive assessment of the impacts of technology transfer.

To conclude, several avenues could deepen and extend this research. An econometric assessment of technological spillover effects, from company data, would allow empirically testing revealed complementarities. A comparative sectoral analysis (aeronautics, electronics, chemicals...) should allow isolating logics specific to each sector. Finally, examining technology transfer governance models in comparable emerging economies such as Tunisia, could provide valuable insights to further inform Morocco's strategic orientation.

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