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Public Funding Allocation and Firm Heterogeneity: Evidence from the Transition 5.0 Measure

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Summary

Introduction

In recent years, industrial policy has returned to the center of the economic and institutional debate, both in academic research and in the public intervention strategies adopted by major advanced economies. After a long period in which the role of the State in the economy had been progressively scaled back, technological transformations, global crises, and the problems connected to the digital and ecological transitions have reopened the discussion on the role of public policies in supporting structural change in production systems. In this context, the Italian National Recovery and Resilience Plan (NRRP) represents one of the most ambitious attempts to revive investment and to steer economic development through selective industrial policy instruments.

Within the NRRP framework, the Transition 5.0 measure is designed as an intervention aimed at supporting firms' investments in innovation, digitalization, and energy efficiency, with the stated objective of supporting the transformation of the productive structure. However, beyond its formal objectives, a crucial question concerns how public resources are actually allocated across firms that differ in size, structure, and competitive dynamics. Understanding which types of firms attract public support, and according to which implicit allocation logics this support is distributed, represents a key step in interpreting the nature and orientation of contemporary industrial policy.

This thesis is situated within this debate and aims to assess the allocation patterns of public support under the Transition 5.0 measure, adopting an explicitly non-causal perspective. The objective is not to evaluate the efficiency of the policy in terms of economic impacts, but rather to examine how the intensity of public funding is associated with pre-existing economic characteristics of beneficiary firms. In particular, the analysis is based on two central dimensions: firm size, interpreted as a proxy for processes of creative accumulation, and firm growth dynamics, interpreted as an indicator of creative destruction and competitive dynamism. While firm size and growth constitute the core analytical dimensions, additional firm characteristics—such as sector, geographic location and patent ownership—are considered in robustness analyses in order to assess the stability of the observed allocation patterns.

The main theoretical reference is provided by the Schumpeterian tradition, which conceives economic development as the outcome of the interaction between processes of accumulation and destruction. On the one hand, incumbent firms, characterized by consolidated structures, play a fundamental role in sustaining large-scale investments; on the other hand, more dynamic and fast-growing firms represent the driving force of technological renewal and structural transformation. This framework

allows the allocation of public support to be interpreted not as a neutral outcome, but as the reflection of explicit or implicit choices regarding which productive trajectories are to be supported.

From a methodological standpoint, the thesis adopts an empirical approach based on cross-sectional data on firms benefiting from the Transition 5.0 measure. The analysis relies on linear regression models estimated through Ordinary Least Squares (OLS) and interprets the estimated coefficients as conditional associations, deliberately avoiding any claim of causal identification. Particular attention is devoted to the construction of the dependent variable, which measures the intensity of public funding in relative terms, in order to ensure comparability across firms of very different sizes and to prevent the analysis from being driven exclusively by scale effects. The empirical strategy prioritizes firm-level structural and dynamic characteristics, while sectoral and technological dimensions are discussed as secondary and data-constrained aspects of the analysis.

The thesis is structured so as to gradually guide the reader from theoretical reflection to empirical evidence. After framing the renewed role of industrial policy and the main theoretical interpretations of public intervention in processes of economic transformation, the work develops the empirical strategy and provides the examination of data related to the Transition 5.0 measure. Descriptive evidence and econometric analysis make it possible to highlight systematic regularities in the criteria governing the allocation of public support, while robustness checks and heterogeneity analyses further qualify the results.

Overall, the contribution of this thesis consists in providing an empirically grounded interpretation of the Transition 5.0 measure as a non-neutral industrial policy instrument, showing how public support is distributed along the dimensions of accumulation and productive dynamism. While refraining from drawing causal conclusions about policy effectiveness, the analysis offers useful findings about the selective orientation of public intervention and its potential long-term implications for the structure of the productive system.

1. Theoretical Framework

This chapter does not consider innovation regimes as abstract theoretical categories, but rather as analytical tools useful for understanding how public funding mechanisms affect concrete industrial dynamics. This entails the need to introduce a theoretical framework capable of capturing the structural, dynamic, and heterogeneous complexity of contemporary capitalist economies. Innovation, in fact, does not follow uniform or linear trajectories, nor is it distributed homogeneously across firms and sectors. On the contrary, it is characterized by profound technological, organizational, and financial asymmetries, as well as by strategic differences in firms' ability to intercept market opportunities and to exploit public incentives. These asymmetries translate into persistent gaps in terms of innovative performance, growth paths, and the capacity to benefit from industrial policies (Dosi, 1982; Audretsch, 1997).

In this context, the Schumpeterian tradition offers a particularly effective interpretative key for analyzing the interactions between models of innovation, firm heterogeneity, and the allocation of public support. Schumpeter (1942) conceptualized innovation as an entrepreneur-driven process capable of generating new productive combinations and dynamics of creative destruction, through which new firms or new technologies replace consolidated structures. Alongside this view, subsequent contributions have highlighted the existence of processes of creative accumulation, in which large incumbent firms strengthen their competitive position through the accumulation of knowledge and capabilities, without necessarily introducing radical innovations (Nelson & Winter, 1982; Malerba & Orsenigo, 1996).

The theoretical framework adopted in this chapter integrates both perspectives, making it possible to analyze how public policies may influence paths of industrial transformation. In particular, in the context of Transition 5.0, embedded within the National Recovery and Resilience Plan (NRRP), the central issue concerns whether the allocation of funds predominantly follows a logic of accumulation, which tends to consolidate larger firms, or a logic closer to creative destruction, which favors dynamic firms with high growth potential.

The Schumpeterian approach interprets innovation as the outcome of complex interactions among firms, institutions, and the economic context, in line with the perspective of innovation systems (Edquist, 2011; Malerba, 2002). Within this framework, the role of the State goes beyond the mere provision of financial resources and includes the capacity to orient technological trajectories, coordinate investments, and reduce the uncertainty associated with processes of structural change

(Freeman & Louçã, 2001; Pérez, 2002; Rodrik, 2008). Consequently, public funding mechanisms affect not only the overall intensity of investment, but also the distribution of opportunities across heterogeneous firms.

Firm heterogeneity represents a central element of this theoretical framework. Large firms generally possess financial resources, organizational capabilities, and access to credit that facilitate participation in public support programs; by contrast, SMEs and start-ups more frequently face informational, administrative, and financial constraints. These differences in initial conditions tend to generate divergent growth trajectories, which public intervention may either reinforce or mitigate depending on the selection criteria and allocation mechanisms adopted (Audretsch, 1997; Coad et al., 2014).

The literature on technological transitions further emphasizes that phases of structural change are inherently non-linear and depend on the interaction of economic, institutional, and social factors. In this context, the availability of public capital plays a crucial role in reducing the risk of private investment and stimulating the diffusion of new technologies (Pérez, 2002; Rodrik, 2004). Transition 5.0 can therefore be interpreted not as a traditional corrective instrument aimed at remedying market failures, but rather as a large-scale program intended to support the digital and energy transformation of the national production system.

Finally, the chapter addresses a central tension in the theoretical debate on industrial policy: whether public support primarily operates as a driver of creative destruction, enhancing the emergence of dynamic firms, or whether it instead contributes to reinforcing processes of creative accumulation by consolidating the position of incumbents (Criscuolo et al., 2019). This conceptual distinction constitutes the basis of the hypotheses developed in Section 1.3 and guides the empirical analysis of the allocation criteria of Transition 5.0 funds.

1.1 Innovation Patterns and Firm Heterogeneity: A Schumpeterian Perspective

The evolution of innovation models is closely connected to market structures and to the distribution of technological capabilities across firms. The Schumpeterian literature has highlighted how innovative processes take different forms depending on the sectoral context, the degree of industrial concentration, and the available technological opportunities. From this perspective, innovation cannot be interpreted as a homogeneous phenomenon, but rather as the outcome of specific technological regimes that shape both firms' behavior and the outcomes of public policies (Dosi, 1982; Malerba, 2002).

A central contribution in this regard is the distinction between Schumpeter Mark I and Mark II innovation models. In the former, innovation is associated with processes of creative destruction, characterized by the entry of new firms, high technological turbulence, and rapid but unstable growth trajectories. In the latter, dynamics of creative accumulation prevail, with innovation concentrated within large incumbent firms endowed with organizational capabilities, financial resources, and technological competences that support cumulative and incremental innovation processes (Nelson & Winter, 1982; Malerba & Orsenigo, 1996; Audretsch, 1997).

This distinction does not imply a rigid opposition between alternative models, but rather suggests that real production systems are characterized by the coexistence of different innovative logics. In many sectoral contexts, established firms and emerging firms simultaneously contribute to technological change, albeit through different mechanisms. As a result, industrial policies operate within a structurally heterogeneous environment, in which public support instruments may generate differentiated effects depending on firms' characteristics and sectoral affiliations (Malerba, 2002; Edquist, 2011).

Within this analytical framework, the action of public policies cannot be considered impartial. As highlighted by the most recent literature on industrial policy, every public intervention inevitably entails an allocative choice, which reflects strategic priorities and implies trade-offs between objectives of efficiency, equity, and structural transformation (Rodrik, 2008; Criscuolo et al., 2019). Consequently, the modalities for identifying beneficiaries, eligibility criteria, and funding instruments may steer development along different innovation trajectories, for instance by strengthening technological accumulation processes within incumbent firms or by fostering the entry and expansion of more dynamic actors.

In light of these considerations, the analysis of Transition 5.0 funds requires interpreting resource allocation not only in quantitative terms, but also with respect to the underlying innovation logics. Understanding whether public support tends to concentrate on already consolidated firms or, conversely, to favor more dynamic and growth-oriented firms represents a crucial step in assessing the role of the measure within the broader context of ongoing technological and productive transitions.

1.1.1 Coexistence, Interaction, and Policy Implications

The distinction between creative destruction and creative accumulation represents one of the main interpretative keys of the Schumpeterian tradition; however, its empirical relevance fully emerges

only when these dynamics are traced back to the concrete mechanisms through which industrial policies operate. In contemporary economies, these two processes do not take the form of mutually exclusive alternatives, but rather tend to coexist within the same productive system, reflecting different institutional, sectoral, and policy configurations (Nelson & Winter, 1982; Malerba, 2002).

Within this framework, the role of public policy is not exhausted by the promotion of innovation in an abstract sense, but also consists in determining, often implicitly, which types of firms have a greater probability of accessing the available resources. The design of policy instruments, the selection criteria for beneficiaries, and administrative requirements in fact contribute to structuring the allocation of public support along specific dimensions of firm heterogeneity.

In particular, instruments characterized by high procedural complexity, stringent co-financing requirements, and a strong emphasis on the scale of investments tend to favor larger and more consolidated firms, endowed with robust organizational structures and higher absorptive capacity. In such contexts, public support operates predominantly along trajectories of creative accumulation, reinforcing processes of incremental innovation and industrial consolidation (Audretsch, 1997; Criscuolo et al., 2019).

By contrast, economic policy instruments aimed at lowering entry barriers or at giving greater importance to growth potential and to the innovative content of initiatives tend to support younger and more dynamic firms. In this way, such interventions can stimulate the renewal of the productive structure and encourage paths of technological experimentation. It should, however, be taken into account that strategies of this kind entail a higher degree of uncertainty and less easily predictable results, with the consequence of making risk management more complex for public authorities (Rodrik, 2004; Henrekson & Johansson, 2010).

It follows that public funding programs inevitably incorporate trade-offs between objectives of stability and objectives of transformation. An excessive focus on incumbent firms may limit the capacity for renewal of the productive system, while exclusive support for emerging firms may reduce the diffusion of innovation and undermine the long-term sustainability of interventions (Edquist, 2011).

In the Italian case, characterized by a dual productive structure in which large consolidated firms coexist with a broad population of small and medium-sized enterprises, these tensions are particularly pronounced. The Transition 5.0 measure is located precisely within this intermediate space, in which

allocation mechanisms may either reproduce existing asymmetries or contribute to rebalancing access to innovation resources.

This perspective constitutes the foundation of the empirical analysis developed in the thesis. By examining the relationship between funding intensity, firm size, and growth dynamics, the analysis aims to assess which configuration between accumulation and destruction emerges from the observed allocation patterns of Transition 5.0 funds.

1.1.2 Technological Revolutions and Transitions: Carlota Perez

While the Schumpeterian framework is essential for analyzing firm-level innovation dynamics, a full assessment of public funding programs such as Transition 5.0 requires embedding these micro-level processes within broader historical trajectories of technological and economic transformation. In this respect, Carlota Perez's theory of techno-economic paradigms provides a useful macro-level perspective to understand how clusters of interrelated technologies periodically reshape production systems and competitive conditions (Pérez, 2002).

According to Perez, capitalist development unfolds through successive technological revolutions, each driven by the emergence of enabling technologies that transform production models, industrial structures, and modes of economic coordination. Unlike traditional theories of long waves, this approach assigns a central role to institutional, financial, and social dimensions of technological change. A technological revolution is not limited to the introduction of new technologies but requires the adaptation of rules, skills, infrastructures, and financing mechanisms, eventually leading to the establishment of a new techno-economic paradigm.

A core element of Perez's framework is the distinction between an installation phase, characterized by experimentation, firm entry, and the dominance of financial capital, and a deployment phase, in which technologies mature and diffuse systematically across the productive system, supported by institutional coordination and long-term investment. Early phases tend to favor dynamics akin to Schumpeterian creative destruction, whereas diffusion phases display features closer to creative accumulation, with an increasing role for incumbent firms.

This interpretative scheme is particularly relevant for analyzing Transition 5.0. The digital technologies underlying Industry 4.0 can be considered to be in an advanced diffusion stage, while the energy transition remains largely in an installation phase, marked by technological uncertainty and experimentation. As a result, programs such as Transition 5.0 operate in a hybrid context, where

requirements for systematic deployment coexist with the need for technological exploration (Pérez, 2002; Rodrik, 2008).

Perez's main contribution lies in highlighting the active role of the state in coordinating technological transitions. Markets alone are unable to ensure alignment between private investment, infrastructure development, skill formation, and regulation. Public policy thus becomes a governance tool shaping not only the pace of technological adoption but also the distribution of its benefits across firms, sectors, and territories (Freeman & Louçã, 2001; Edquist, 2011).

In the Italian context, characterized by strong firm-size and regional dualisms, these distributional implications are particularly salient. The effectiveness of Transition 5.0 depends on its ability to support the diffusion of mature technologies without excluding SMEs and less developed areas, while simultaneously boosting experimentation and innovation in the early stages of the energy transition.

Integrating Perez's macro-level framework with the Schumpeterian analysis of firm heterogeneity therefore allows public funding allocation to be interpreted as an indicator of the industrial transformation trajectory being promoted. This theoretical synthesis provides the foundation for the empirical hypotheses developed in Section 1.3 and guides the analysis of the allocative effects of Transition 5.0.

1.1.3 The Role of the State in Technological Transitions: Freeman and Perez

The literature on technological transitions converges in emphasizing that market mechanisms, taken in isolation, are structurally inadequate to govern large-scale processes of technological change. As highlighted by Freeman and Perez (2001), phases of radical innovation and technological revolutions are characterized by long time horizons, high uncertainty, and deep coordination problems among economic, institutional, and financial actors. In such contexts, the spontaneous allocation of resources tends to be inefficient, making an active role of the state necessary to guide expectations, direct investments, and mitigate the risks associated with the adoption of new technologies.

Public intervention materializes through industrial policies and funding programs that go beyond the mere correction of market failures and directly contribute to shaping trajectories of technological and industrial development. The structure of these instruments implicitly reflects a view of which firms are considered most capable of sustaining and diffusing technological change. In particular, when access and evaluation criteria prioritize financial capacity, organizational solidity, and administrative compliance, public support tends to concentrate on larger firms, reinforcing processes of creative accumulation. Conversely, policies oriented toward experimentation, learning, and growth potential

are more compatible with supporting dynamic and innovative firms, thereby stimlating dynamics of creative destruction.

This theoretical framework provides a direct basis for the formulation of the empirical hypotheses developed in Section 1.3. The Schumpeterian approach makes it possible to translate abstract concepts into observable dimensions: creative accumulation is interpreted through firm size, while creative destruction is associated with growth dynamics. This operationalization allows assessing whether Transition 5.0 primarily functions as an instrument aimed at stabilizing existing industrial structures or as a mechanism oriented toward transforming and renewing the national production system.

The literature identifies two main channels through which public funding can influence firm behavior. On the one hand, public support may reinforce creative accumulation by channeling resources toward incumbent firms that already possess consolidated technological competences, organizational capabilities, and access to financial markets. This outcome is consistent with the Schumpeter Mark II model, in which innovation is predominantly incremental and routinized and is driven by established firms. On this basis rests Hypothesis H1, which predicts a positive relationship between firm size and the intensity of funding received under Transition 5.0.

On the other hand, public funding may operate as a lever of creative destruction by supporting firms characterized by high growth rates, which play a crucial role in processes of industrial renewal and in the introduction of more radical innovations. This scenario recalls the Schumpeter Mark I paradigm, in which innovation is driven by new entrants and dynamic firms and is inherently more risky and experimental. This logic underlies Hypothesis H2, according to which firms with stronger growth dynamics benefit from a relatively higher intensity of funding with respect to their size.

Beyond the accumulation–destruction dichotomy, Freeman and Perez emphasize that the role of the state also includes a function of systemic and intersectoral coordination. Effective policies combine financial support with investments in infrastructure, human capital, and regulatory adaptation, contributing to the construction of technological ecosystems capable of sustaining the diffusion of new technologies. This dimension is particularly relevant in the case of Transition 5.0, which lies at the intersection of the digital and energy transitions, where the selection of beneficiary firms can significantly influence the overall impact of the measure.

Overall, the conceptual framework developed in this chapter makes it possible to link theoretical dynamics of innovation with concrete choices of public intervention. It provides an interpretative

basis for understanding how funding policies affect both the direction of industrial transformation and the distribution of benefits among firms that differ in size and growth potential. This perspective naturally introduces the following section (1.2), which focuses on the mechanisms and empirical evidence related to public funding for innovation, with particular reference to instruments such as Transition 5.0 and their impact on the Italian production system.

1.2 Public Funding for Innovation

Innovation represents one of the main drivers of economic development, global competition, and the long-term adaptive capacity of productive systems. Through the use of advanced technologies, the creation of new goods and services, and the transformation of internal organizational models, firms are able to improve productive efficiency, consolidate their position in markets, and deal more effectively with changes in the economic and technological context. At an aggregate level, innovative processes contribute to the structural transformation of the economy, while at the firm level they directly affect prospects of operational continuity, expansion, and access to international markets.

Despite the crucial role of innovation, numerous contributions in the economic literature emphasize the inability of market mechanisms to independently guarantee levels of investment in research and development that are consistent with the collective interest. This issue becomes particularly clear in the case of small and medium-sized enterprises and start-ups, which face tighter constraints than large firms, both in terms of financial resources and organizational capabilities. The high level of uncertainty that characterizes the outcomes of innovative processes, together with the presence of knowledge externalities and imperfections in financial markets, ultimately leads to a reduction in private investment incentives. As a result, investment levels remain systematically below what would be socially optimal (Audretsch, 1997; Cefis et al., 2025).

In light of these critical issues, public funding takes on strategic importance as a lever of industrial policy, aimed not only at stimulating firms' innovative activities, but also at promoting the diffusion of new technologies throughout the productive system as a whole. In this sense, public intervention seeks to reduce the risks associated with innovative investments and to orient firms' strategic choices through direct grants, fiscal incentives, subsidized credit instruments, and competitive programs. These instruments do not merely increase the overall volume of investment, but also affect its composition and the distribution of opportunities across firms characterized by different endowments of resources and capabilities.

The effectiveness of public funding therefore depends to a significant extent on the modalities of resource allocation. Support for already consolidated firms can reinforce processes of creative accumulation, promoting incremental innovation and the diffusion of mature technologies. By contrast, support for young firms or firms with high growth potential can stimulate dynamics of creative destruction, facilitating the entry of new actors and the experimentation with alternative technological solutions. Innovation policy thus positions itself within a space of balance between these two logics, which are not necessarily in opposition, but reflect different objectives and time horizons (Schumpeter, 1942; Freeman & Louçã, 2001; Pérez, 2002).

In light of these considerations, the analysis of public funding for innovation requires an integrated approach, capable of linking the theoretical motivations for public intervention with the empirical observation of its outcomes. This perspective is particularly relevant in the Italian context, in which large-scale programs such as Industry 4.0 and Transition 5.0 represent explicit attempts to steer technological change and to support the digital and energy transitions of the national productive system.

1.2.1 Rationale for public intervention

Public intervention in support of innovation finds a solid theoretical and empirical foundation in the economic literature. A first element of justification lies in the very nature of innovative activity, which displays characteristics akin to those of a public good and generates positive externalities that are difficult to appropriate exclusively by the firms that innovate. New products, processes, and technologies in fact produce benefits that diffuse throughout the entire productive system and society as a whole, but are not fully incorporated into the private returns of investments in research and development. In the absence of public intervention, these mechanisms lead to a systematic underestimation of the social returns to innovation and to investment levels below the social optimum, particularly in high-technology sectors characterized by rapid knowledge diffusion and strong spillover effects (Griliches, 1957; Mansfield, 1961).

A second set of motivations concerns the high level of risk and uncertainty that characterizes innovative processes. The introduction of new technologies often requires significant initial investments, long development times, and entails outcomes that are difficult to predict—factors that tend to curb private initiative, especially in the presence of strong technological discontinuities. These critical issues affect small firms and innovative start-ups in particular, which are disadvantaged by limited financial resources and lower managerial and organizational capacity. In this context, public intervention plays a fundamental role in reducing investment risk and in making economically

sustainable projects that, in the absence of support, would not be undertaken (Hölzl, 2009; Daunfeldt & Halvarsson, 2015).

A further rationale supporting public action lies in the State's capacity to steer innovation toward long-term strategic objectives. Through mission-oriented policies, public funding can channel research and development activities toward areas considered priorities, such as digitalization, the energy transition, environmental sustainability, and territorial cohesion. From this perspective, innovation is not encouraged solely in quantitative terms, but also in qualitative ones, fostering development paths that are consistent with the structural needs of the economic system and generating multiplier effects on employment, productivity, and regional development (Freeman & Louçã, 2001; Pérez, 2002).

This view finds additional support in the innovation systems approach, according to which innovation emerges from complex interactions among firms, public institutions, research centers, and universities. Within this framework, public support assumes a central role in coordinating the various actors, reducing systemic inefficiencies, and promoting the diffusion and circulation of knowledge across sectors and territories (Edquist, 2011; Woolthuis et al., 2005). Public support for innovation, therefore, should not be understood as a mere short-term stimulus instrument, but rather as a strategic lever through which the State contributes to steering and shaping the country's industrial and technological development trajectories.

1.2.2 Additionality vs crowding-out

The assessment of the impact of public policies aimed at supporting innovation has traditionally been based on the analysis of two core concepts: additionality and crowding-out. These two dimensions make it possible to evaluate whether, and to what extent, public intervention is actually capable of generating a real increase in innovative activities, going beyond what the market would have produced autonomously. Additionality occurs when public support leads to a concrete increase in innovation-related investment compared to the counterfactual scenario in which the incentive is not available. In such cases, public funding acts as a catalyst, enabling initiatives and projects that firms would not have undertaken relying solely on private resources (Cefis et al., 2025; Bocci et al., n.d.).

This perspective is particularly relevant in the context of technological transition programs, such as Industria 4.0 and Transition 5.0, which do not merely aim to stimulate expenditure on research and development, but also seek to transform the organizational and productive structure of the industrial system. Additionality, in fact, can emerge in several ways. First, public support may translate into a

direct increase in investment in digital technologies, process innovation, or applied research, by overcoming financial or managerial constraints that would otherwise prevent project implementation. Second, incentives may foster knowledge circulation and collective learning processes, encouraging cooperation among firms, universities, and research centers, and generating multiplier effects within the national innovation ecosystem. Finally, indirect effects may also arise, such as strengthened competitiveness, the creation of new innovative firms, and greater resilience of the productive system in response to technological or macroeconomic shocks.

Conversely, crowding-out occurs when public resources end up replacing private investments that had already been planned, without producing an effective increase in overall innovative capacity. This risk becomes particularly significant in the presence of poorly designed or weakly selective policy instruments, which tend to favor firms that are already financially sound or have easy access to credit, or when allocation criteria prioritize firm size rather than project quality and innovative content. In these situations, public intervention may contribute to consolidating pre-existing industrial structures, strengthening incumbent firms and hindering the entry or growth of new entities with high innovative potential (Audretsch, 1997; OECD, 2022).

The literature emphasizes that the outcome of the interaction between additionality and crowding-out is mainly influenced by three factors. First, the design of policy instruments plays a decisive role: the type of incentive adopted, access conditions, and the degree of selectivity significantly affect the likelihood that public support will generate genuinely additional effects. Second, beneficiary selection criteria are decisive: instruments that emphasize project innovativeness and growth potential are more likely to stimulate creative destruction, whereas schemes based on firm size or historical performance tend to reinforce creative accumulation and increase the risk of crowding-out (Cefis et al., 2025; Edquist, 2011). Third, additionality ultimately depends on firms' capacity to effectively use the resources received, which in turn is related to their technical, managerial, and organizational capabilities.

Empirical evidence from the Italian context provides relevant evidence. Evaluations of the Industria 4.0 Plan show that public incentives have overall supported digital technology adoption and investment growth, but with heterogeneous effects across firms. Large firms, benefiting from internal resources and consolidated organizational capabilities, have been better able to exploit public support, further strengthening their competitive advantage. By contrast, many innovative SMEs, despite their high growth potential, have faced administrative barriers and skill constraints, reducing their ability

to generate additionality and increasing the risk of crowding-out (Henrekson & Johansson, 2010; Fulco et al., 2025).

Similar patterns emerge from international studies, which indicate that policies targeted at start-ups and high-growth firms can generate high levels of additionality, enhancing radical innovation and the creation of new markets, whereas generic incentives tend to strengthen already established firms without producing significant structural change (Hölzl, 2009; Daunfeldt & Halvarsson, 2015).

An additional layer concerns policy complementarity. Public support is more effective when combined with investments in human capital, digital infrastructure, and intersectoral coordination, creating conditions that allow firms to fully exploit the resources allocated. In this respect, ex post evaluation of funding schemes plays a central role in measuring additionality and crowding-out, identifying critical issues, and improving future policy design (OECD, 2022; Edquist, 2011).

Overall, the analysis of additionality and crowding-out highlights that the effectiveness of public funding depends not only on the volume of resources allocated, but also on allocation strategies, beneficiary targeting, and firms' ability to translate support into genuine innovation. For complex programs such as Transition 5.0, carefully monitoring these mechanisms is essential to ensure that public financing promotes genuine industrial renewal, benefiting both incumbent firms and young, high-growth enterprises, including so-called *gazelle* firms (Henrekson & Johansson, 2010; Fulco et al., 2025).

1.2.3 Selection mechanisms in public funding programs

As discussed before, public funding effectiveness in support of innovation does not depend exclusively on the amount of resources allocated, but also on how the resources are distributed among firms. In this context, the mechanisms for selecting beneficiaries represent a strategic dimension of innovation policies, as they directly influence both the allocation of funds and the direction of industrial transformation processes. The criteria adopted for access to public support therefore contribute to determining whether the intervention generates additionality effects or, conversely, produces crowding-out phenomena, reinforcing pre-existing productive structures.

Indeed, by favouring specific types of firms or projects, public programmes may consolidate existing productive capacities and the position of incumbent firms or promote the emergence of dynamic, innovative enterprises with high growth potential. Schumpeterian and neo-Schumpeterian literature emphasises that achieving a balance between these two dynamics is essential. In fact, on the one hand,

the stability of the industrial structure and, on the other hand, the structural renewal required to compete in rapidly changing technological and market environments (Schumpeter, 1942; Freeman & Louçã, 2001; Pérez, 2002).

From an operational perspective, mechanisms for selecting beneficiaries can be traced back to three main typologies, each of which reflects a different conception of merit, firm characteristics, and the strategic role of the State.

A first modality is represented by project-based selection**,** which focuses the evaluation on the intrinsic characteristics of the proposed initiatives. The evaluation parameters are usually based on several elements, including the level of technological innovation, economic sustainability, environmental impact, and the potential effects both on the market and on the productive system. This type of approach proves to be particularly effective in fostering dynamics of creative destruction, as it rewards initiatives capable of introducing disruptive technologies, alternative business models, or products characterized by a high degree of originality.

By privileging project quality over firm size or past performance, project-based selection increases the likelihood of generating additionality, especially to the benefit of SMEs and start-ups subject to financial and organisational constraints.

However, this modality also presents significant criticalities. It requires high levels of technical expertise within public administrations, multidisciplinary evaluation capabilities, and sophisticated tools for risk management and the analysis of expected returns. Experiences developed in the Italian context, including within the framework of the Industria 4.0 Plan, show that project-oriented mechanisms, while effective in supporting innovative firms, entail high administrative costs and a considerable degree of organisational complexity (Edquist, 2011; Woolthuis et al., 2005).

A second typology is selection based on firms' structural characteristics, which refers to predefined criteria such as firm size, sector of activity, past economic performance, technological absorption capacity, or geographical location. This approach tends to favour already consolidated firms endowed with significant internal resources, predominantly supporting processes of creative accumulation. From the policy-maker's perspective, structural selection makes it possible to direct resources towards sectors or firms considered strategic and capable of guaranteeing faster and more predictable economic returns, thereby reducing the risk of policy failure.

At the same time, this approach presents relevant limitations. The privilege granted to incumbent firms may exclude emerging enterprises with high innovative potential, reducing the space for disruptive innovation and for the entry of new actors. Empirical evidence on the Italian case indicates that many SMEs have encountered difficulties in accessing public funding not due to shortcomings in innovative capacity, but because of selection criteria that disproportionately rewarded firm size or historical performance (Cefis et al., 2025; Bank of Italy et al., 2024). Under such circumstances, public intervention risks generating crowding-out effects, substituting private investment without producing a genuine structural change.

A third modality, increasingly widespread, is represented by hybrid selection mechanisms, which combine project-based and structural criteria in an attempt to balance merit, equity, and innovative potential. This approach is particularly relevant for complex programmes such as Transition 5.0, whose objectives simultaneously include the promotion of digital and ecological transitions, support for large incumbent firms, and the encouragement of growth among SMEs and high-potential start-ups.

Hybrid selection mechanisms can be configured, for example, as evaluation systems based on weighted scores, capable of jointly considering the degree of innovativeness of projects and the characteristics of the proposing firms. Alternatively, they may take the form of differentiated evaluation pathways, in which proposals submitted by SMEs or technological start-ups are examined on the basis of specific criteria, distinct from those applied to large enterprises. The adoption of multidimensional evaluation schemes makes it possible to mitigate the risk of crowding-out effects, strengthen the additionality of interventions, and promote a more balanced allocation of resources among heterogeneous actors within the productive system (Ministry of Enterprises and Made in Italy, 2024).

Beyond the concrete selection modalities adopted, process transparency and monitoring activities constitute cross-cutting elements that have a decisive impact on the effectiveness of public policies. Clear procedures and access to detailed information make it possible to carry out accurate monitoring, reliable ex post evaluations, and continuous improvement of policy instruments. The dissemination of data in open formats, such as those made available through platforms like OpenPNRR, facilitates empirical analysis of allocations and outcomes, strengthens public accountability, and helps to contain the risk of distorted or discretionary allocations (Lucchese & Pianta, 2021). Moreover, a high level of transparency fosters the consolidation of trust among economic operators, increasing the overall credibility of public action.

In summary, the ways through which beneficiaries are identified have a decisive impact on the nature of the innovations promoted, on the balance between mechanisms of creative accumulation and processes of creative destruction, as well as on the ability of public interventions to generate additional effects while, at the same time, avoiding crowding-out phenomena. It follows that a careful and conscious policy design, based on explicit and transparent criteria and accompanied by effective monitoring tools, constitutes an essential requirement for increasing the effectiveness of public funding in the field of innovation and for strengthening the competitiveness of the national productive system in the long term.

1.2.4 Evidence from Industry 4.0 and Italian innovation policies

The National Industry 4.0 Plan marked a significant turning point in the process of transformation of Italian industrial policies, which are aimed at promoting innovation and rethinking the structure of the national productive system (Lucchese & Pianta, 2021). Launched in 2015, the initiative was based on a well-structured set of instruments — including tax incentives, direct contributions, and targeted support measures — with the aim of accelerating the adoption and diffusion of digital technologies within firms. While it promoted a significant renewal of the industrial fabric and an increase in investments, the initiative also brought to light some structural criticalities, in particular the gap between the strengthening of already established firms and the capacity to foster truly disruptive innovation processes. In this respect, the Italian case of Industry 4.0 offers a relevant field of analysis for understanding how public policies can shape innovation trajectories, especially in the context of the transition toward the Transition 5.0 program.

A defining element of the Industry 4.0 Plan was its orientation in favor of large and already consolidated firms operating in the market. These actors in fact possessed adequate financial resources, managerial competences, and advanced organizational arrangements, factors that facilitated both access to incentive mechanisms and the management of the required administrative procedures (Cefis et al., 2025). As a consequence, a significant share of public resources flowed toward incumbents, reinforcing their competitive position and contributing to the stabilization of existing productive structures. This outcome fits coherently within the Schumpeterian paradigm of *creative accumulation*, according to which innovation tends to manifest itself primarily through incremental improvements and the consolidation of the economic power of dominant firms (Schumpeter, 1942; Cefis et al., 2025).

By contrast, the effects of the program on small and medium-sized enterprises and on start-ups proved to be more limited.

In fact, despite representing central actors for radical innovation and economic dynamism, these firms often faced significant obstacles in accessing and effectively using public resources (Bank of Italy et al., 2024). Bureaucratic complexity, gaps in technical skills, and limited financial capacity reduced their ability to benefit from the available incentives. In this context, the risk of crowding-out effects proved particularly high: public support, rather than generating new innovative activity, in some cases substituted for already planned private investments, without producing a net increase in the system's innovative capacity (Cefis et al., 2025; Bank of Italy et al., 2024).

The Industry 4.0 experience clearly highlights the crucial role of beneficiary selection mechanisms in determining the distribution of public resources. Programs that privilege criteria such as financial solidity, organizational capacity, and administrative compliance tend to favor large firms, whereas schemes that value growth potential, innovativeness, and project content are more effective in supporting dynamic new entrants (Henrekson & Johansson, 2010; Cefis et al., 2025). In the Italian case, the emphasis placed on tangible investments and consolidated track records oriented the Industry 4.0 Plan toward a predominantly structural selection model, thereby reinforcing processes of creative accumulation at the expense of dynamics of creative destruction.

The Italian experience further highlights how processes of creative accumulation and dynamics of creative destruction can develop in parallel within the same economic framework. On the one hand, access to the benefits of the program proved to be largely the prerogative of large-sized firms; on the other hand, significant margins for innovation and experimentation opened up, especially in sectors characterized by low barriers to entry and high technological intensity (Audretsch, 1997). These results suggest that public policies can perform a dual function, fostering at the same time the stability of production systems and processes of change. Achieving an effective balance between these two aims, however, requires careful design of the interventions and continuous monitoring of their effects.

In conclusion, the Italian experience of Industry 4.0 represents a particularly significant analytical context for deepening the understanding of public funding allocation mechanisms and their impact on innovation processes. The program's outcomes highlight the importance of selection mechanisms, the coexistence of creative accumulation and creative destruction, and the need for policy design capable of balancing stability and renewal (Lucchese & Pianta, 2021; Cefis et al., 2025; Bank of Italy et al., 2024; Henrekson & Johansson, 2010; Audretsch, 1997; Ministry of Enterprises and Made in Italy, 2024). These elements constitute the conceptual basis for the empirical analysis of Transition 5.0, aimed at assessing whether and to what extent public funding favors incumbent firms or stimulates the entry and growth of new dynamic actors.

1.3 Hypotheses Development

The central hypothesis of this thesis is that the theoretical frameworks analyzed and the dynamics they describe find a concrete empirical manifestation in the mechanisms through which public funding is allocated. Innovation regimes, in fact, do not represent merely abstract conceptual constructions, but are reflected in an observable way in the distribution of public resources: in which firms receive support, in what amount, and under which conditions. As discussed in the previous sections, the theoretical and empirical literature shows that public policies supporting innovation can selectively influence these dynamics, depending on the design of incentives, access criteria, and the structural characteristics of beneficiary firms (Audretsch, 1997; Cefis et al., 2025; Henrekson & Johansson, 2010). In particular, complex instruments such as Transition 5.0, embedded within the framework of the National Recovery and Resilience Plan (NRRP), aim to jointly support digitalization and the green transition, but their actual impact crucially depends on how resources are distributed between incumbent firms and new dynamic actors.

The literature points out that large-sized firms are endowed with significant structural advantages: greater organizational solidity, easier access to financial markets, economies of scale in research and development activities, as well as control over strategic complementary assets such as patents, distribution networks, and well-established brands (Simonetti, 1996; Mansfield, 1961).

Thanks to these endowments, such firms prove to be particularly capable of intercepting public incentives and converting them into incremental improvements of production processes and into a strengthening of their competitive position. It follows that public support mainly concentrated on large operators tends to fuel mechanisms of creative accumulation, reinforcing existing structures and directing innovation toward relatively safe and predictable paths, although potentially less incisive in terms of structural change.

By contrast, small and medium-sized enterprises, start-ups, and high-growth firms—often referred to in the literature as *gazelle firms*—are characterized by high organizational flexibility, a stronger propensity for experimentation, and a pronounced willingness to take risks. Despite operating under financial and organizational constraints, these firms can generate innovation effects of broad scope, introducing disruptive technologies and significantly altering existing market configurations and productive structures (Coad et al., 2014; Fulco et al., 2025). When public policies facilitate access to funding for these actors, mechanisms of creative destruction are activated, through which public

resources contribute to the emergence of new technological solutions and processes of industrial restructuring.

The link between the theoretical framework and the empirical hypotheses of the thesis is operationalized through the use of two key variables: firm size, understood as an indicator of accumulation potential, and growth rate, used as a proxy for the capacity to generate disruptive innovation. The joint analysis of these dimensions makes it possible to empirically assess the ways in which the Transition 5.0 program distributes resources across firms with different characteristics, allowing a distinction to be drawn between a model of intervention oriented primarily toward industrial consolidation and one that is more dynamic and transformative.

1.3.1 H1: Accumulation hypothesis

Hypothesis 1 (H1): Established large firms are more likely to receive Transition 5.0 funding and to obtain it at higher intensity compared to smaller firms, consistent with the concept of creative accumulation.

The formulation of H1 is grounded in both Schumpeterian theory and the empirical literature on innovation. As discussed in Section 1.1, creative accumulation describes an innovative regime in which technological progress is primarily driven by large firms, which gradually accumulate knowledge and capabilities over time, developing incremental and consolidated innovations (Schumpeter, 1942; Simonetti, 1996). Within this framework, public support can reinforce incumbents' competitive positions, contributing to industrial consolidation rather than radical restructuring of the productive system. H1 is supported by three main arguments:

First, large firms generally possess solid organizational capacity and well-established expertise. They can rely on internal arrangements specifically dedicated to the management of complex projects and to the preparation of applications for access to public funding. These structures, which integrate research and development, financial administration, and project management functions, make it possible to address bureaucratic procedures and required administrative compliance more effectively (Lucchese & Pianta, 2021). This managerial advantage translates into a higher probability of being selected as beneficiaries, generating a condition of structural advantage compared to SMEs and start-ups, which are often constrained by limited resources and organizational shortcomings.

Second, large firms benefit from economies of scale and superior investment capacity. Owing to the availability of greater financial resources, they are able to complement public funding with their own

capital, thereby strengthening the economic sustainability and scope of the funded projects. This leverage effect enables a more efficient use of funds, maximizing the impact of incentives on digitalization and energy transition processes (Cefis et al., 2025). **Economies of scale** allow firms to spread fixed costs related to research and development and project management across a wider number of initiatives. This mechanism makes investments overall more sustainable and helps to limit the level of risk associated with participation in public programs.

Finally, strategic alignment with program priorities: Transition 5.0 emphasizes objectives such as digitalizing production processes, adopting advanced technologies, and improving energy efficiency. Large firms are better equipped to design investments consistent with these strategic objectives, both technologically and organizationally. Their experience in coordinating complex projects and managing industrial and technological partnerships increases the likelihood of meeting selection criteria, reinforcing their role as primary drivers of incremental innovation within the national productive system.

From an empirical perspective, H1 translates into the expectation of a positive relationship between firm size (size) and two main indicators:

- Probability of receiving Transition 5.0 funding, defined as actual program access;
- Funding intensity, measured as the amount received normalized by turnover, total investments, or other operational scale indicators.

This approach allows us to assess whether Transition 5.0 primarily functions as a tool for industrial consolidation, favoring an accumulation regime and strengthening the competitive positions of large incumbents. In this sense, H1 explores the role of public funding as a mechanism for stabilizing and accumulating existing technological capabilities, contributing to the continuity and resilience of the Italian productive system.

It is important to note that testing H1 does not imply the exclusion of creative destruction effects: firm size is only one determinant of fund allocation. However, confirmation of this hypothesis would indicate that the program tends to prioritize the growth and modernization of incumbents, suggesting the need for complementary instruments to support disruptive innovation among high-growth firms.

1.3.2 H2: Destruction hypothesis

Hypothesis 2 (H2): Small-sized firms exhibiting high growth rates benefit from a share of the resources allocated by the Transition 5.0 program that exceeds what would be implied by size alone, thereby fostering the activation of creative destruction mechanisms.

This hypothesis is placed within the Schumpeterian tradition, according to which processes of radical innovation and industrial restructuring often originate from small firms, start-ups, and rapidly growing companies. These actors are able to introduce innovative products, processes, and business models that can call into question the consolidated arrangements of incumbent firms (Schumpeter, 1942; Coad et al., 2014). From this perspective, public intervention mainly takes on an enabling role, creating the conditions that allow such firms to overcome financial, technological, and organizational constraints which, in the absence of external support, would restrict their innovative potential.

A first argument in support of hypothesis H2 concerns the strong innovative orientation and the organizational flexibility that characterize smaller firms and those experiencing rapid growth. Compared to large, mature companies, these firms generally operate with leaner structures, faster decision-making processes, and a stronger openness to experimentation. These features facilitate the adoption of emerging technologies and the development of radical forms of innovation. Public support instruments, such as those envisaged under the Transition 5.0 program, can further enhance these strengths by reducing exposure to risk and encouraging the exploration of new technological trajectories. The literature points out that so-called “gazelle” firms, although they account for only a limited share of the productive system, play a significant role in terms of job creation, technological progress, and industrial renewal (Henrekson & Johansson, 2010; Fulco et al., 2025).

A second aspect concerns the industrial policy objectives underlying the Transition 5.0 program. Embedded within the framework of the National Recovery and Resilience Plan (NRRP), the program pursues the goal of jointly supporting the digital and energy transitions of the national productive system, placing particular emphasis on interventions characterized by high technological content and a significant transformative potential. Although access to the program is formally open to firms of any size, some of the measures and incentives provided appear particularly consistent with the needs of smaller and more dynamic firms, which are capable of developing disruptive innovations despite possessing limited internal resources (Ministry of Enterprises and Made in Italy, n.d.; Carfora et al., 2025). From this perspective, H2 reflects the ability of growth-oriented policies to promote industrial renewal by breaking consolidated technological positions and stimulating the emergence of new skills and productive sectors.

A third argument supporting the hypothesis concerns the additionality effect of public funding. Numerous contributions highlight that small firms benefit more strongly from public intervention than large firms. While the latter often tend to integrate subsidies with investments that were already planned, young and high-growth firms experience a genuine increase in their innovative activity thanks to external support. This additionality effect is central to the activation of creative destruction dynamics, as it implies a real increase in innovation investment rather than a mere reallocation of resources already destined for R&D (Henrekson & Johansson, 2010; Hölzl, 2009).

From an empirical perspective, H2 implies the existence of a positive relationship between firm growth rates and funding intensity, even when controlling for firm size. From this perspective, firms that display higher growth rates should have access to forms of public support that are commensurate with their innovative capacity, regardless of the overall size of the company. An approach of this kind makes it possible to verify whether *Transition 5.0* truly performs the role of a driver of structural renewal, by favoring those high-potential entrepreneurial realities that are capable of generating disruptive innovations and contributing to the strengthening of the competitiveness of the Italian industrial system as a whole.

Finally, the examination of hypothesis H2 allows for a more articulated and in-depth analysis of the link between processes of creative accumulation and the mechanisms of creative destruction. Although these processes may coexist, empirical confirmation of the hypothesis would indicate that the program does not merely reinforce incumbent firms, but actively contributes to industrial renewal and technological transformation, in line with the digital and energy transition objectives outlined in the NRRP.

1.3.3 Interaction between Accumulation and Destruction

A crucial element for understanding the effectiveness of the Transition 5.0 program lies not exclusively in the separate analysis of the effects of firm size or growth dynamics, but above all in their interaction. Large firms, in fact, are not necessarily characterized by static trajectories: they may go through phases of rapid expansion and use public support in a dynamic way. At the same time, in case of adequate support, small firms may grow rapidly, reaching a significant scale and consolidating their competitive position.

However, it is important to highlight that the processes of creative accumulation and creative destruction do not constitute rigidly alternative dynamics, but can coexist and mutually influence one another within the same productive system. The economic literature, particularly of Schumpeterian

and neo-Schumpeterian inspiration, highlights that the most effective innovation policies are those capable of simultaneously supporting industrial stability and structural renewal. From this perspective, the strengthening of incumbents and the emergence of new high-potential actors do not represent incompatible objectives, but rather complementary dimensions of a single process of industrial transformation (Audretsch, 1997; Freeman & Louçã, 2001; Pérez, 2002). However, the balance between these two forces depends in a decisive way on the modalities of public resource allocation and on the characteristics of the beneficiary firms.

In order to empirically capture these dynamics, the analytical strategy adopted in this thesis makes use of models that include an interaction term between firm size and the growth rate. This approach allows different configurations of public funding allocation to be distinguished.

In a first configuration, characterized by the prevalence of accumulation, public support is concentrated on large firms regardless of their growth performance. In this scenario, the program primarily favors industrial consolidation and the stability of the productive system, while dynamics of creative destruction remain marginal. Innovation tends to assume a predominantly incremental nature, based on internal technological upgrading processes and low-risk investments (Simonetti, 1996; Cefis et al., 2025).

A second configuration can instead be traced back to a dominant logic of creative destruction. In this case, public resources are concentrated on firms characterized by high growth rates, regardless of their initial size. This pattern indicates an orientation of public policy toward structural renewal, favoring the entry of new competitive actors, the expansion of young and dynamic firms, and the diffusion of radical innovations. From this perspective, public funding acts as a lever of industrial transformation, supporting the emergence of new market segments and the adoption of frontier technologies (Henrekson & Johansson, 2010; Coad et al., 2014).

The most desirable configuration, from a policy design perspective, is nevertheless the one in which creative accumulation and creative destruction coexist in a balanced manner. In such a scenario, Transition 5.0 supports, on the one hand, consolidated large firms, enabling them to undertake strategic investments with high technological content, and on the other hand offers small but high-growth firms the opportunity to scale up, innovate, and compete in broader markets. Such a balance is capable of generating multiplier effects on productivity, industrial renewal, and territorial cohesion, and is consistent with the objectives of the NRRP regarding the digital and energy transitions (Lucchese & Pianta, 2021; Carfora et al., 2025).

The analysis of interactions between size and growth also makes it possible to identify potential complementarities and trade-offs in public policies. For example, support for large and high-growth firms may simultaneously amplify dynamics of accumulation and destruction, generating more substantial innovations but also increasing the risk of market concentration. However, also an exclusive focus on start-ups or dynamic SMEs may promote industrial renewal, while proving insufficient to ensure systemic stability and the broad diffusion of new technologies.

In conclusion, the inclusion of interaction terms between size and growth in the empirical analysis represents a fundamental tool for evaluating the overall impact of Transition 5.0. It allows for the identification of the policy configurations that are most effective in balancing consolidation and renewal, offering useful guidance for the design of future public interventions oriented toward sustainable, inclusive industrial development consistent with the major transitions currently underway in the Italian productive system.

1.3.4 Implications for Policy

The theoretical reflections developed in the previous sections allow industrial policy to be interpreted not as a neutral instrument, but as a factor that actively interacts with firm heterogeneity and with processes of structural transformation in the economy. From a Schumpeterian perspective, public intervention can in fact affect the balance between processes of creative accumulation, linked to the role of established firms, and dynamics of creative destruction, associated with technological renewal and competitive dynamism.

Within this framework, industrial policy measures such as Transition 5.0 acquire particular relevance, as they explicitly aim to support investments in innovation, digitalisation, and energy efficiency, directly intervening in the mechanisms that drive the transformation of the productive system. However, the presence of ambitious and formally inclusive objectives does not automatically imply that public support is allocated in a neutral manner with respect to the characteristics of beneficiary firms. On the contrary, the allocation of resources may reflect, more or less explicitly, specific selection logics and priority criteria.

From this perspective, the theoretical framework discussed in this chapter suggests that the allocation of public support may follow different trajectories. On the one hand, a logic oriented towards creative accumulation may translate into a concentration of resources on larger firms, characterised by consolidated organisational structures and a greater capacity to absorb large-scale investments. On

the other hand, a logic closer to creative destruction may favour dynamic and growing firms, even of smaller size, which are regarded as key drivers of technological change and industrial renewal.

In light of these considerations, the theoretical framework developed in this chapter naturally leads to three central questions for the evaluation of the Transition 5.0 measure and, more broadly, of contemporary industrial policies:

- To what extent does public support contribute to strengthening already established firms, sustaining processes of creative accumulation and the structural stability of the productive system?
- Does the design of the measure favour, in relative terms, more dynamic and growing firms, thereby contributing to processes of technological renewal and creative destruction?
- Or does the allocation of resources reflect a combination of both logics, configuring a balance between consolidation and productive dynamism?

These questions cannot be answered on a purely theoretical level, but require an empirical analysis capable of observing how public support is actually distributed across heterogeneous firms. In this sense, the present chapter provides the conceptual framework for the analysis developed in the subsequent sections, which aims to examine the allocation patterns of the Transition 5.0 measure and to interpret their implications in light of the main theoretical traditions in the field of industrial policy.

2. The NRRP and Transition 5.0

The study of the modalities of allocation of public resources destined to innovation should be understood in the context of the institutional, political, and economic context in which their definition and allocation are regulated. The National Recovery and Resilience Plan in the Italian context assumes the role of the spine of the post-pandemic economic recovery and, at the same time, represents an unprecedented opportunity to give an impetus to the processes of structural, digital, and sustainable change of the productive system. The NRRP, designed in full coherence with the guidelines of the Next Generation EU program, is destined to promote economic growth, reduce territorial disparities, support innovation and ecological transition, and enhance resilience in managing economic and environmental shocks.

Within this strategic framework, Transition 5.0, also referred to as Measure 408, is identified as the most relevant instrument in support of digitalization processes, industrial innovation, and the energy transition. The latter is located at the center of the NRRP missions aimed at strengthening the competitiveness of the productive fabric and promoting technological change, with the aim of activating strategic investments that can affect the innovative capacity of firms and the efficiency of the national industrial system. Transition 5.0 is not configured as a financial incentive instrument, but as a tool of industrial policy aimed at guiding technological and productive change in the long term, in accordance with the European Union's strategic orientations in the fields of sustainability, digitalization, and economic resilience.

The Italian scenario also has specific characteristics that make the assessment of the mechanisms of innovation funding particularly significant. The Italian national economy has traditionally been characterized by a fragmented structure of the productive fabric, with the coexistence of large companies with consolidated R&D capabilities and numerous SMEs and start-ups with considerable growth and innovative potential, but also limited financial and organizational capacity. The dualism of the Italian productive fabric, already discussed in Chapter 1 through the Schumpeterian approach of creative accumulation and creative destruction, makes the design of public financing instruments particularly critical, as it can affect the capacity of public funds to consolidate dominant positions or stimulate innovative dynamics of industrial change.

Moreover, the breadth and the articulated nature of the NRRP make strong alignment among the different levels of government indispensable. The management of resources is based on the interaction between central administrations, territorial authorities, and specialized bodies, which are

assigned distinct functions ranging from project assessment to the disbursement of funds, up to the verification of the results achieved. This multi-level structure and the large volume of resources generate significant challenges in terms of transparency, traceability, and optimization of economic and social impact.

From a strategic point of view, the Transition 5.0 measure aims to pursue three fundamental objectives:

1. To encourage technological investments with a high innovative content, both by already established firms and by emerging ones;
2. To direct innovation processes toward areas considered strategic for the competitiveness of the national production system, in particular the digitalization of production processes and the green transition;
3. To promote sustainable and inclusive growth, contributing to reducing the existing gaps between large firms and SMEs, as well as among the different territorial areas of the country.

In this sense, the measure can be interpreted not only as a corrective intervention for market failures but also as a tool of strategic governance capable of shaping the country's industrial development trajectory.

Finally, the NRRP and Transition 5.0 context provides an ideal ground for empirical analysis of public funding dynamics. The possibility of accessing detailed information on funded projects, thanks to sources such as the OpenPNRR dataset, makes it possible to test the hypotheses formulated in Chapter 1. In particular, it allows me to verify whether the allocation of resources mainly favors already established firms or whether it is also able to significantly reach innovative companies characterized by high growth rates. For me, the analysis of these mechanisms is essential not only to assess the effectiveness of public policies, but also to provide concrete and operational guidance for the design of future public interventions aimed at supporting the digital and energy transition and promoting a sustainable and inclusive industrial evolution.

2.1 The Italian NRRP

The National Recovery and Resilience Plan appears to be the most relevant strategic action that has been developed and implemented by Italy with the aim of tackling the effects of the pandemic on the economy and society. It has been developed within the more general framework of the European Union initiative called Next Generation EU (NGEU). This type of intervention is not based on the

distribution of financial resources, but rather on the design and implementation of a complex policy and governance intervention with the aim of orienting the recovery towards sustainability, social inclusion, and innovation. Through the National Recovery and Resilience Plan, Italy not only intends to counteract the effects of the recession, but also sets the stage for a structural transformation of the production system with a view to enhancing its capacity for adaptation and its competitiveness, and its ability to tackle structural challenges such as digitalization, the energy transition, and climate change.

The European framework within which the National Recovery and Resilience Plan has been designed and developed appears to be essential if the full meaning and ambition of the intervention are to be understood. Indeed, the Next Generation EU program, voted by the European Parliament in 2020, mobilized €750 billion with the aim not only of supporting the post-pandemic recovery, but also of facilitating the implementation of structural reforms with a strategic nature.

In this regard, it is possible to highlight that Italy has benefited from an allocation corresponding to approximately €191.5 billion in the form of grants and loans, thus configuring itself as a significant recipient of European resources. The Italian NRRP thus needs to be considered not only as a national instrument but also as a tool for a shared European strategy, which is oriented toward supporting sustainable growth, the digital transformation, and the strengthening of the economic and social resilience capacity of the Union as a whole. The structure of the National Recovery and Resilience Plan is articulated in various thematic missions that encompass investment and reform measures. These missions are designed on the basis of shared priorities at the national and European levels, thus combining long-term strategies with timely actions in support of the economic recovery. Among the missions most relevant for innovation, digitalization, and industrial competitiveness, it is possible to highlight the following:

· Digitalization, innovation, competitiveness, and culture, which includes investments in the field of digitalization, in the technological transformation of enterprises, in the development of advanced skills, and in the strengthening of scientific research;

· Green revolution and ecological transition, which supports initiatives related to the circular economy, energy efficiency, sustainable mobility, and the diffusion of environmentally friendly technologies;

· Education and research, which is designed for strengthening the university system, research centers, and training in the field of digitalization and STEM disciplines, which are considered essential for the availability of qualified human capital in support of innovation processes.

Together with the definition of strategic missions, it is possible to highlight the complex system of governance included in the NRRP. This system emphasizes the aspects of coordination between the central administration and the Regions/local authorities. The management of resources is subject to rigorous eligibility criteria, transparent procedures for project selection, and ex post controls, with the objective of ensuring that funds generate lasting effects on technological and industrial transformation, avoiding episodic or fragmented interventions.

From an economic point of view, the NRRP can be seen as a strong increase in the demand for highly innovative investments. Italian enterprises, especially those characterized by a higher level of technological intensity, can benefit from direct funding, fiscal incentives, and support tools capable of reducing the risks and uncertainties that characterize innovation processes. This context is favorable to the adoption of new technologies and to the development of growth models oriented toward sustainability. From this point of view, the NRRP assumes a clear role as an industrial and technological policy tool, according to the theories analyzed in Chapter 1 regarding the role of the State in supporting the dynamics of creative destruction and creative accumulation.

Another peculiarity of the Italian NRRP consists of the close link between investments and reforms. The intervention of the State is not limited to the allocation of resources but extends to structural interventions aimed at supporting the ability of enterprises and the system to make the most of the available resources. This approach pursues the aim of triggering chain effects on the real economy, stimulating the circulation of innovation, the creation of skilled employment, and the ability to compete on international markets.

In conclusion, it can be argued that the NRRP also has a strategic role in the field of territorial cohesion by addressing the regional disparities accumulated over time. The allocation of resources is designed to respond to the specific needs of less developed areas, promote the development of technological ecosystems in these areas, foster synergies between universities, enterprises, and research centers, and help bridge the gap between the main hubs and the periphery.

Finally, the Italian NRRP can be considered an organic and integrated tool that includes significant extraordinary financial resources, structural measures, and innovation strategies. This structure is essential for correctly contextualizing the role of the Transition 5.0 measure, which is primarily designed to support the digital and ecological transformation of the production system and which constitutes the analytical framework for analyzing the allocation of resources between large enterprises, SMEs, and innovative start-ups.

2.1.1 Objectives and Architecture

The NRRP is not limited to stating general objectives, but is based on an articulated and multi-level internal framework, designed to translate national strategies into operational, verifiable, and measurable interventions. The Plan is structured around six main missions, which are in turn divided into components and sub-components that clarify the modes of intervention, priority areas, and policy beneficiaries. This organization makes it possible to directly link financial resources to structural reforms and to systems for monitoring the effects produced.

Each mission is conceived as a unitary ecosystem, in which the different parts interact with one another through co-financing instruments, converging objectives, and shared performance indicators. This architecture allows us to effectively manage the complexity of public investments, steering the use of resources in line with national strategic priorities and with European guidelines, in particular those outlined within the Next Generation EU programme.

A central element of the NRRP's architecture is the interaction between investments and reforms. Access to many financial resources is subject to the achievement of clearly defined reform milestones. By way of example, progress in the digitalisation of public administration or in reducing the complexity of bureaucratic procedures represents an essential requirement for unlocking the funds allocated to strategic sectors. From this perspective, the Plan goes beyond the mere financing of individual initiatives and acts on the strengthening of institutional capacities and governance mechanisms, which are decisive elements for ensuring the effectiveness of interventions and their long-term sustainability.

The main missions of the NRRP are:

· Digitalisation, innovation, competitiveness, and culture: this mission focuses on the strengthening of ICT infrastructures, the promotion of the digitalization of companies, the development of research and innovation activities, and the promotion of the development of

highly technological skills. The various lines of intervention are focused on the promotion of the integration of digitalization and the improvement and efficiency of production processes.

· Green revolution and ecological transition: this line of intervention focuses on the promotion of initiatives regarding the improvement of energy efficiency, the promotion of renewable sources, the strengthening of sustainable mobility, and the reduction of emissions in industrial processes. The public action complements the incentive tools directed towards firms with the aim of supporting technological innovation and the promotion of the emergence of new sectors with a green economy.

· Infrastructural systems for sustainable mobility: this line of intervention focuses on the modernization of the transport and logistics infrastructure with the aim of containing the territorial gaps and the improvement of the connections between the main urban centers and peripheral and rural areas.

· Education and research: the action focuses on the strengthening of the university system, research, and specialized training with the aim of fostering the development of highly qualified human capital.

· Social inclusion and health protection: the mission focuses on the strengthening of social and territorial cohesion through the promotion of the intervention in the healthcare system, the development of welfare policies, and the promotion of the integration of the most fragile parts of the social system.

· Horizontal reforms: this line of intervention focuses on the simplification of the administration, the digitalization of the public administration, the adjustment of the existing regulatory framework, and the strengthening of the governance and management capacities.

The NRRP's governance model provides for a system of continuous monitoring and transparent reporting. For each mission, quantitative and qualitative indicators are used to assess the progress of activities and the impact of investments. This framework ensures accountability toward European institutions and provides a solid informational basis for empirical analyses of public policies, such as in the case of the allocation of *Transition 5.0* resources.

Moreover, the structure of the NRRP encourages strong integration among the different levels of government—central, regional, and local—allowing for more effective management of resources and the design of interventions that are consistent with the specific characteristics of territories. This

approach proves to be decisive both in ensuring a fair distribution of funding and in enhancing the effects on the national productive system, with particular reference to the sectors of innovation and digital transformation.

2.1.2 Missions Relevant to Digitalization and Innovation

Within the NRRP, several missions play a strategic role in fostering technological development and strengthening the competitiveness of Italian firms, thereby providing the broader operational context in which Transition 5.0 is embedded. Among these, Mission 1 – Digitalization, Innovation, Competitiveness, and Culture – represents the core framework for promoting the digital transformation of the productive system, enhancing firms' innovative capacity, and supporting the creation of national technological ecosystems. Rather than acting through isolated tools, this mission is articulated through a set of integrated interventions that combine direct investments with incentive-based measures targeting the business sector.

A first line of action concerns the digital transformation of enterprises and the diffusion of innovation-related technologies. Financial resources are directed toward initiatives associated with the Industry 4.0 paradigm — including process automation, collaborative robotics, cloud-based solutions, and artificial intelligence applications. In practical terms, these measures are intended to reduce the technological divide between large firms and SMEs, encouraging the adoption of digital instruments that can enhance productivity, improve operational efficiency, and strengthen firms' capacity to adapt to changing competitive environments. A second area of intervention relates to the reinforcement of research and development activities. Planned investments involve scientific and technological infrastructures such as laboratories, incubators, universities, and research centers, with particular attention to cooperation among academia, private actors, and public institutions. From this perspective, the objective is not only to finance individual projects, but to consolidate an innovation-oriented ecosystem, support the emergence of high-tech start-ups, and facilitate the translation of scientific knowledge into industrial applications.

Finally, considerable importance is assigned to training and to the development of digital skills. The programs envisaged aim to upgrade the technological competences of the workforce while addressing existing digital disparities across territories and sectors. The availability of adequately skilled human capital, in this sense, constitutes a necessary condition for making the digital transition effective and for ensuring that investments in innovation can be fully absorbed and productively utilized.

Besides Mission 1, other missions are also instrumental in achieving digitalization and innovation goals:

· Mission 2: Green Revolution and Ecological Transition: The incentives in this mission support green technologies and processes. Green technologies and digitalization are two sides of the same coin. Digitalization can be an instrument of ecological transition, and ecological transition can be an instrument of digitalization.

· Mission 4: Education and Research: This mission supports investments in universities and centers of excellence. This can be an instrument of innovation in industries.

The importance of digitalization in the NRRP can be understood from various aspects, including the selection of projects and providing incentives. The funding programs, such as Transition 5.0, support projects that are based on innovative technologies and have achieved results in increasing competitiveness and sustainability. Although this ensures that resources are being provided to companies that are at the forefront of industrial revolution, there are challenges in this regard, including ensuring equal distribution of funds and monitoring.From a theoretical perspective, the NRRP's emphasis on digitalization and innovation is well suited to applying the Schumpeterian framework from Chapter 1. The distribution of financial resources highlights the delicate balance between processes of creative accumulation and dynamics of creative destruction. On the one hand, large firms possess the means necessary to carry out complex initiatives and to access incentive mechanisms; on the other hand, high-potential SMEs and start-ups can leverage public support as a catalyst for renewal and as a lever for the introduction of radical innovations.

In conclusion, Mission 1 and the missions connected to it give rise to a coordinated ecosystem in support of innovation, in which public resources take on a strategic role in promoting digitalization, sustainability, and competitiveness. This framework constitutes the institutional and empirical context within which to analyze the allocation mechanisms of Transition 5.0 funds and to assess whether the program predominantly fosters accumulation, destruction, or a combination of both.

2.2 Transition 5.0

Transition 5.0 is one of the central instruments in the Italian NRRP for promoting technological innovation, digitalization, and the energy transition of businesses. Its main objective is to support the transformation of the national production system by combining financial incentives for digitalization

with measures aimed at energy efficiency and environmental sustainability (Ministry of Enterprises and Made in Italy, 2024; Carfora et al., 2025).

Transition 5.0 falls under Mission 7, RepowerEU, which aims to strengthen Italy's energy resilience by encouraging strategic investments that reduce reliance on fossil fuels and boost the competitiveness of Italian firms (Lucchese & Pianta, 2021). The measure started with about €6.3 billion and, with additional national funding, is expected to reach €12.7 billion for 2024–2025 (Ministry of Enterprises and Made in Italy, 2024). Theoretically, Transition 5.0 is more than a response to market failures in R&D and technology adoption. It plays an active role in managing the technological transition. As Freeman and Pérez (2001) and Pérez (2002) argue, large-scale technological shifts require state intervention to coordinate resources, lower uncertainty, and encourage the spread of new technologies. Transition 5.0 applies this approach to the Italian context.

The measure's approach is twofold: it provides financial support to established firms with the capacity to implement complex projects, and it also seeks to stimulate disruptive innovation and the growth of SMEs and start-ups—fostering creative destruction in line with Schumpeterian theory (Audretsch, 1997; Henrekson & Johansson, 2010). This dual strategy aims for an inclusive industrial transformation that balances stability and renewal. In fact, Transition 5.0 offers grants, tax incentives, and low-interest loans, all structured to reward projects that fit the NRRP's goals for digitalization and sustainability (Cefis et al., 2025; Fulco et al., 2025). Selective access criteria are intended to maximize the additional impact of public investments, avoid crowding-out, and ensure that resources create real value for the production system (Hölzl, 2009; Daunfeldt & Halvarsson, 2015).

Empirically, Transition 5.0 provides a natural laboratory for analyzing how public funds are distributed among firms of different sizes and abilities. The analytical framework makes it possible to assess whether the modes of allocation of public resources tend to strengthen processes of creative accumulation, by favoring already established firms, or instead promote dynamics of creative destruction, by supporting companies characterized by high growth rates (Lucchese & Pianta, 2021; Carfora et al., 2025). Examining these mechanisms is essential in order to evaluate the instrument's ability to stimulate the digital and energy transitions and to foster sustainable and inclusive industrial development.

Overall, Transition 5.0 can be understood as an advanced form of industrial policy. Public action is not limited to the mere transfer of financial resources, but also contributes to shaping strategic trajectories, stimulating innovative activity, and supporting the structural transformation of the Italian

productive system (Freeman & Louca, 2001; Pérez, 2002; Ministry of Enterprises and Made in Italy, 2024). It is precisely these features that make the measure particularly well suited to empirical analysis, as they allow for an examination of the relationship between firm characteristics and the intensity of the funding received.

2.2.1 Goals and Policy Logic

Transition 5.0 is situated within a clearly structured public policy framework, designed to guide in an integrated manner the digital and energy transformation of the Italian productive system, in line with the intervention guidelines set out by the *NRRP*. The main objective of the initiative is to encourage projects with a high level of innovation, capable of accelerating technological progress and strengthening competitiveness in international markets, supporting both the technological modernization of large enterprises and the growth of SMEs with the greatest development prospects (Ministry of Enterprises and Made in Italy, 2024; Lucchese & Pianta, 2021).

The architecture of the measure is articulated along three main industrial policy directions.

First, the digitalization and automation of production processes represent a central axis of the measure. The Transition 5.0 program promotes the introduction of next-generation digital technologies, including artificial intelligence, the Internet of Things (IoT), robotics, and additive manufacturing. The combined adoption of these tools allows firms to achieve significant improvements in terms of productive efficiency and quality, to make production systems more adaptable, and to strengthen the integration and alignment among business processes and value chains (Cefis et al., 2025; Carfora et al., 2025).

A second pillar concerns energy efficiency and environmental sustainability. The measure supports interventions aimed at reducing energy consumption and emissions, promoting the adoption of green technologies and the use of renewable energy sources. This area of intervention contributes to the achievement of national decarbonization objectives, in line with NRRP Mission 7 and European strategies on environmental sustainability (Lucchese & Pianta, 2021; Bank of Italy et al., 2024).

The third policy axis is dedicated to strengthening innovation ecosystems and strategic value chains. Transition 5.0 seeks to encourage forms of structured cooperation among firms, universities, and research centers, fostering knowledge circulation and the development of shared competencies. This setting reflects the innovation systems approach, according to which technological progress emerges from continuous interaction among a plurality of actors and requires collaborative environments capable of sustaining long-term growth (Edquist, 2011; Woolthuis et al., 2005).

From a public policy perspective, the measure integrates two complementary intervention logics. On the one hand, it acts to mitigate financial and organizational constraints that hinder established firms, enabling them to strengthen their competitive positioning according to a creative accumulation model. On the other hand, it supports small enterprises and start-ups, stimulating processes of creative destruction through incentives targeted at high-technology projects with strong growth prospects (Audretsch, 1997; Henrekson & Johansson, 2010).

A core element of the policy framework is the principle of additionality, according to which public funding should generate an effective increase in innovation investment, avoiding substitution effects with respect to private resources. Compliance with this principle requires carefully designed incentive mechanisms, rigorous selection criteria, and effective monitoring systems, in order to maximize the economic and technological impact of the funded projects (Hölzl, 2009; Daunfeldt & Halvarsson, 2015; Fulco et al., 2025).

Finally, the policy logic highlights the State's role as a coordinator of technological transitions, as argued by Freeman and Pérez (2001) and Pérez (2002). Transition 5.0 does not limit itself to distributing financial resources, but also performs a strategic steering function: it guides firms' choices, reduces investment uncertainty, and promotes the adoption of technologies and processes consistent with the long-term objectives of industrial policy. For this very reason, the measure is particularly well suited to an empirical analysis aimed at assessing whether the funding encourages processes of accumulation, dynamics of destruction, or a combination of the two. In summary, Transition 5.0's policy logic integrates digitalization, sustainability, and ecosystem support, balancing attention between established and emerging firms. This provides a strong foundation for analyzing the effects of public funding on Italy's industrial transformation (Ministry of Enterprises and Made in Italy, 2024; Lucchese & Pianta, 2021; Carfora et al., 2025).

2.2.2 Incentive Structure and Eligibility Requirements

The incentive architecture envisaged by the Transition 5.0 programme is designed to pursue a dual objective: on the one hand, to foster the digital and ecological transformation of the Italian productive system; on the other, to ensure a targeted and efficient use of public resources. To this end, the measure makes available a structured set of instruments, each with specific characteristics, aimed at supporting both gradual modernisation processes and more radical innovation projects (Hölzl, 2009; Cefis et al., 2025).

The main channel of support is represented by non-repayable grants, which make it possible to directly cover part of the costs incurred for investments in digital and sustainable technologies. This instrument plays a crucial role especially for SMEs and start-ups, which are often penalised by difficulties in accessing credit or by liquidity constraints. Alongside direct contributions, Transition 5.0 provides tax credits, which allow firms to recover a significant share of eligible expenditures by reducing their overall tax burden. The combination of direct and indirect incentives therefore strengthens firms' propensity to invest in research, development, and advanced technologies, in line with the evidence emerging from previous Industry 4.0 policies (Cefis et al., 2025; Lucchese & Pianta, 2021). Completing the set of instruments, the programme also includes **soft loans**, granted by accredited financial intermediaries at reduced interest rates, which enable firms to integrate public and private resources and expand their investment capacity.

Eligible expenditures must comply with clearly defined requirements. These include investments in tangible and intangible assets aimed at digitalisation, automation, and the adoption of smart technologies; interventions intended to improve energy efficiency, such as energy-saving systems, smart management solutions, and renewable energy installations; research and development activities directly connected to technological investments, including experimentation and pilot projects; as well as training programmes for personnel involved in digitalisation processes and new production models. Projects must also demonstrate their sustainability through a detailed reporting system, which ensures transparency and allows for ex post verification of the actual implementation of the interventions (Ministry of Enterprises and Made in Italy, 2024).

In order to benefit from the incentives, firms are finally required to meet a set of conditions, both of a formal and of a substantive nature. Formal requirements include registration with the Business Register, having an operational office in Italy, and compliance with tax and social security obligations. Substantive requirements involve submitting projects aligned with the measure's objectives, demonstrating sufficient organizational skills, and ensuring the investment's financial sustainability—either through their own or complementary resources (Ministry of Enterprises and Made in Italy, 2024; Lucchese & Pianta, 2021).

Project selection is competitive and merit-based. In the evaluation process, several key elements are taken into account, including the degree of technological innovation, the potential effects on the production system, consistency with the strategic priorities of the NRRP, and the adequacy of the project's governance mechanisms. The aim is to select interventions capable of generating widespread benefits, not only for the beneficiary firm but also for the entire reference production

fabric (Carfora et al., 2025; OECD, 2021). The measure also provides for an articulated control system based on monitoring and reporting obligations. Firms are required to submit detailed documentation of the expenses incurred, periodic reports on the state of project implementation, and to accept subsequent checks by the competent authorities. These procedures are essential to ensure transparency, responsibility in the use of public resources, and the construction of solid information bases useful for assessing the effectiveness and impact of the adopted policies (Edquist, 2011; Freeman & Louca, 2001).

Overall, the incentive system provided by the Transition 5.0 programme is configured as a tool capable of supporting a broad range of firms and types of investment, combining economic efficiency with the pursuit of digitalisation and energy transition objectives. The mix of grants, tax incentives, and soft loans—paired with merit-based selection and capacity requirements—makes it a sophisticated industrial policy tool with strong potential to drive innovation and structural transformation in Italy's production system (Pérez, 2002; Lucchese & Pianta, 2021; Carfora et al., 2025).

2.2.3 Target Beneficiaries and Sectors

The success of Transition 5.0 depends on clearly defining its target beneficiaries and priority sectors. The intervention is conceived to target firms characterized by a high innovative potential, capable of playing a driving role in the processes of digital and ecological transition of the Italian production system (Ministry of Enterprises and Made in Italy, 2024; Carfora et al., 2025).

While adopting an inclusive approach with respect to firm size, the measure takes into account differences in terms of organizational strength and financial availability. Within this framework, large and well-established firms represent one of the main recipients of the policy, as they possess the resources required to rapidly initiate complex investments and to trigger diffusion effects along production chains. Their ability to integrate new technologies, coordinate large-scale projects, and combine public and private resources makes them particularly suitable actors to benefit from industrial policies, contributing to the strengthening of processes of creative accumulation (Lucchese & Pianta, 2021; Cefis et al., 2025).

At the same time, the Transition 5.0 program recognizes the central role of small and medium-sized enterprises and high-growth firms, valuing their function within processes of creative destruction. These companies, often young and characterized by a high degree of organizational flexibility, play a leading role in introducing radical innovations, experimenting with new business models, and

renewing the economic fabric (Henrekson & Johansson, 2010; Coad et al., 2014). Public support allows them to overcome financial and managerial constraints that would otherwise limit their potential, generating significant additionality effects and a level of investment in innovation higher than what could be achieved in the absence of public intervention (Hölzl, 2009; Fulco et al., 2025).

Transition 5.0 also concentrates resources on productive areas considered strategic and consistent with the objectives of the NRRP, prioritizing sectors with a high technological, industrial, and environmental content. In particular, attention is directed toward advanced manufacturing processes, especially in their dimensions related to digitalization, industrial automation, and the use of robotics. A further priority axis concerns energy and environmental technologies, including the development of renewable sources, the improvement of energy efficiency, and the adoption of solutions aimed at emissions reduction. Finally, a central role is assigned to information and communication technologies, with reference to cybersecurity, intelligent data management, cloud infrastructures, and the application of artificial intelligence within production processes. This sectoral focus is consistent with a mission-oriented policy logic, in which public action does not merely aim to incentivize marginal progress but seeks to trigger large-scale structural transformations, characterized by high technological content and significant implications in terms of environmental and economic sustainability (Freeman & Louca, 2001; Pérez, 2002; OECD, 2021).

A qualifying feature of the measure is represented by the emphasis placed on the coherence between industrial policy objectives and the capacity of beneficiary firms to absorb and effectively use the funded technologies. Companies are in fact required to demonstrate their ability to incorporate the introduced solutions into their production cycles, transforming the investments received into concrete improvements both in terms of competitiveness and environmental performance. As a result, while formally maintaining an inclusive approach with respect to firm size, the intervention tends to favor companies endowed with consolidated technical competencies, adequate project management capabilities, and a high potential to generate positive diffusion effects across the entire production system (Lucchese & Pianta, 2021; Carfora et al., 2025).

Overall, Transition 5.0 pursues the objective of balancing support for established firms with the promotion of high-potential innovative entities, concentrating public action on key sectors for the dual digital and green transition. The definition of clear priorities and well-defined objectives is essential in order to maximize the effectiveness of public spending, strengthen the national innovation system, and steer industrial transformation in line with the NRRP's goals of competitiveness,

sustainability, and resilience (Ministry of Enterprises and Made in Italy, 2024; Pérez, 2002; Carfora et al., 2025).

2.3 Transparency and Implementation Challenges

Transparency and effective management are vital for the success of public funding programs and to minimize distortions in fund allocation. Given the complexity of the interventions, the number of potential beneficiaries, and the variety of financial tools, monitoring the selection of the beneficiaries of the interventions and the use of funds is critical in the context of Transition 5.0. Transparency is more than a bureaucratic requirement; it is a way to evaluate the fairness, effectiveness, and economic impact of interventions while limiting the risks of political influence or favoritism.

Transparency ensures the availability of detailed information about eligibility criteria, allocation rules, amounts allocated, and results. Only through the availability of accessible information is it possible to carry out rigorous empirical research to link the characteristics of firms, the allocation of funds, creative destruction, and accumulation. Transparency also helps to foster a sense of responsibility among institutions and beneficiaries.

However, implementing complex programs like Transition 5.0 brings major challenges. Standardizing data and ensuring information quality are difficult: incomplete data, slow updates, and varying financial instruments make it hard to analyze effectiveness and assess firms' innovation capacity (OECD, 2022; Lucchese & Pianta, 2021). Further, regulatory and procedural complexity can create barriers for SMEs and start-ups, affecting fund distribution and potentially favoring large, established firms. Another key challenge is balancing accountability and flexibility. While it's essential to monitor fund usage and document results, excessive bureaucracy can discourage the most innovative and agile firms from participating. This balance is especially delicate in programs promoting digital and green transitions, which require rapid action and adaptability (Edquist, 2011; Freeman & Louca, 2001).

In summary, transparency and effective management are vital to maximize the impact of Transition 5.0 and ensure public funds truly support innovation and industrial renewal. The next section examines the OpenPNRR dataset, the main tool for tracking funding distribution and beneficiary characteristics, enabling rigorous empirical analysis.

2.3.1 OpenPNRR dataset

The OpenPNRR dataset is the primary public source of information about projects funded under the Italian National Recovery and Resilience Plan, including those related to Transition 5.0. The platform, available at https://openpnrr.it, offers organized data that enables users to track the progress of measures, the amounts allocated and disbursed, and the characteristics of projects and beneficiaries (Ministry of Enterprises and Made in Italy, 2024; Lucchese & Pianta, 2021).
From a transparency perspective, OpenPNRR gives access to essential information, such as fund allocation by measure, showing budget distribution in line with NRRP objectives; project progress, indicating how much has been disbursed and how much remains; aggregated data on sectors and beneficiary types, providing an overview of territorial and sectoral funding distribution

However, the dataset has practical limitations. First, it is not updated in real time—the data represent periodic snapshots, which may not match the current status of disbursements and commitments. This makes it challenging to dynamically analyze fund distribution and impacts, especially in fast-changing fields like digitalization and the green transition (OECD, 2022; Lucchese & Pianta, 2021). Second, the platform has limited data export options. Many reports are only available as interactive graphs or summaries, and downloadable Excel or CSV datasets are partial and sometimes fragmented. Researchers must therefore clean and integrate the data for detailed analysis, especially when linking funded projects to firm characteristics (Carfora et al., 2025; Bank of Italy et al., 2024).

Despite these limitations, OpenPNRR remains essential for evaluating fund distribution and public resource access. It offers a transparent basis for sectoral and territorial analysis. The data help researchers spot concentration or dispersion patterns, see which firms and regions benefit most, and estimate funding's impact on innovation (Lucchese & Pianta, 2021; OECD, 2022). For complex measures like Transition 5.0, the dataset enables observation of:

- Which firms access funds, broken down by size, sector, and location;
- The amount of funding disbursed versus approved projects;
- How well fund distribution matches policy objectives.

To conduct rigorous econometric analysis, OpenPNRR data must be combined with other sources, like firm-level databases (e.g., Orbis), to provide detailed information on firm size, growth, and performance. Only then can researchers empirically test creative accumulation and destruction hypotheses, linking theory to real-world evidence (Henrekson & Johansson, 2010; Coad et al., 2014).

In summary, the OpenPNRR dataset is a cornerstone of transparency for NRRP measures. It enables monitoring of fund disbursement and evaluation of how resources are distributed among beneficiaries. Its limitations, however, mean careful data cleaning, integration, and updating are essential to turn raw data into useful knowledge for analysis and policy evaluation.

2.3.2 Why studying funding allocation matters

To assess the impact of complex policies such as Transition 5.0, it is essential for you to examine how public resources are used. The allocation of funds, in itself, is not sufficient to stimulate innovation: the decisive factor is the criterion according to which these resources are assigned. Effective allocation can drive creative destruction by helping high-potential new firms emerge, or promote creative accumulation by reinforcing the advantages of large incumbents (Audretsch, 1997; Henrekson & Johansson, 2010).

Studying fund allocation helps researchers identify whether resources are concentrated or spread out, and whether selection mechanisms favor certain firms. For example, detailed analysis can show if SMEs and innovative start-ups access funding as easily as large firms, or if bureaucracy creates barriers (Cefis et al., 2025; Carfora et al., 2025). This evaluation is essential for understanding the impact of funding and estimating the social and economic returns on public investment—assessing whether policies achieve their goals for digital transformation, sustainability, and growth.

Another reason to analyze fund allocation is transparency and accountability. Systematic examination of distribution reduces the risk of political capture, favoritism, or inefficiency, and encourages responsible behavior from institutions and beneficiaries. Empirical evaluation also offers insights to improve program design, making policies more inclusive, effective, and innovative (Lucchese & Pianta, 2021; OECD, 2022).

For Transition 5.0, analyzing fund allocation is strategically important for understanding how firm size, growth, and innovation capacity interact. Only project-level data analysis enables empirical testing of the hypotheses from Chapter 1—showing whether public resources mainly benefit incumbents, high-growth firms, or both in a balanced way. This discussion leads to Chapter 3, which presents the empirical methodology. The next chapter will detail data sources, cleaning and integration of the OpenPNRR and Orbis datasets, and the statistical models used to test creative accumulation and destruction hypotheses. Bridging theory and data construction is key to evaluating public policies, setting the stage for the results and analysis that follow.

3. Data and Methodology

The previous chapters have outlined the theoretical and institutional framework within which the Transition 5.0 measure is situated, interpreted as an explicitly non-neutral industrial policy instrument aimed at supporting processes of technological transformation in the Italian productive system. In particular, Chapter 1 discussed the role of Schumpeterian processes of creative accumulation and creative destruction, while Chapter 2 reconstructed the architecture of the National Recovery and Resilience Plan and the operational features of the Transition 5.0 measure, highlighting its selective nature.

Building on this conceptual framework, the present chapter introduces the data and the methodological approach adopted to analyse how public resources under the Transition 5.0 measure are allocated among beneficiary firms. The objective of the analysis is not the evaluation of the causal effectiveness of the policy, but rather the examination of patterns in the allocation of public funding and their associations with pre-existing economic characteristics of firms. From this perspective, the analysis aims to understand whether, and to what extent, public support is associated with firms characterised by consolidated processes of accumulation, by greater competitive dynamism, or by specific combinations of both dimensions.

This analytical choice reflects both informational constraints—related to the implementation stage of the measure and to data availability—and a deliberate political economy perspective on industrial policy. Although additional structural characteristics—such as sectoral affiliation—can be introduced in extended specifications as control variables, the core empirical strategy is intentionally centered on firm-level structural and dynamic features. Furthermore, in the absence of a credible control group and of a sufficiently long-time dimension to adopt counterfactual research designs, the analysis deliberately focuses on the allocative side of the policy. In this context, understanding which firms intercept public resources, and to what extent, represents a fundamental preliminary step for assessing the potential structural orientation of technological transition policies.

The chapter adopts a firm-level empirical approach, consistent with the Schumpeterian theoretical framework and with the microeconomic logic underlying the Transition 5.0 measure. The unit of observation consists of beneficiary firms, for which information on received public funding is integrated with economic, financial, and structural data. Firm size and pre-treatment growth dynamics are used as operational proxies for processes of creative accumulation and creative destruction,

respectively, allowing abstract theoretical concepts to be translated into empirically observable indicators.

The construction of the dataset and of the variables reflects methodological choices aimed at balancing empirical rigour and institutional realism. The integration of public administrative data with private financial databases makes it possible to provide a microeconomic perspective on the allocation of NRRP resources, which remains relatively underexplored in the literature. At the same time, the use of relative measures and appropriate functional transformations helps to mitigate the mechanical correlation between firm size and the amount of funds received, thereby making the analysis more informative from an economic standpoint.

The chapter is structured as follows. Section 3.1 describes the data sources and the process of constructing the firm-level dataset. Section 3.2 illustrates the construction of the key variables used in the analysis and presents the main descriptive statistics. Finally, Section 3.3 introduces the empirical strategy, based on linear regression models estimated on cross-sectional data, including the baseline specification, robustness exercises, and heterogeneity analysis.

Overall, this chapter represents the methodological bridge linking the theoretical and institutional framework developed in the previous chapters to the empirical evidence presented in Chapter 4. Through a coherent and transparent empirical design, it provides the analytical tools necessary to interpret the allocation of the Transition 5.0 measure as the outcome of specific selection criteria operating along the dimensions of accumulation and productive dynamism.

3.1 Data Sources and Dataset Construction

In line with the structure of the chapter, this subsection is exclusively devoted to the description of the data sources, the construction of the dataset, and the process of data integration, while the definition of variables, the descriptive analysis, and the empirical strategy are developed in the subsequent sections.

The empirical analysis is based on a firm-level dataset obtained through the integration of public administrative data and private financial databases, with the aim of examining how funds under the Transition 5.0 measure are distributed among beneficiary firms and to what extent this distribution is associated with pre-existing economic characteristics. This approach makes it possible to move beyond purely aggregate analyses of the territorial distribution of NRRP resources and to focus

instead on the microeconomic profile of firms, which represents the level of observation most consistent with the research question of this work.

Information on public funding is drawn from the OpenPNRR portal, the official monitoring platform of the National Recovery and Resilience Plan. The dataset employed in the empirical analysis refers specifically to projects financed under the Transition 5.0 measure (tax credit scheme) and is updated as of 31 August 2025. For each funded project, the OpenPNRR database provides detailed information on the beneficiary firm, including the company name, the firm's sectoral classification (ATECO code), its geographic location, and the total amount of funding granted. In order to focus on public transfers that have been effectively disbursed, the dataset includes exclusively projects for which payments are reported as 100 per cent completed, thereby excluding expenditure commitments or planned allocations.

Based on this information, funding amounts were aggregated at the firm level by summing all Transition 5.0 projects attributable to the same beneficiary. This procedure allows for the reconstruction of the total public support received by each firm, which constitutes the basis for the construction of the funding intensity measures discussed in Section 3.2.

Economic, size-related, and organisational characteristics of firms are obtained from the Orbis database (Bureau van Dijk), which provides harmonised information on company accounts and key structural features. In particular, time series on operating revenues and number of employees are extracted from Orbis and used to characterise, respectively, firms' growth dynamics and size. Although longer time series are available for a subset of firms, the analysis focuses on the 2017–2024 period, which exhibits greater data completeness and allows for the observation of medium-term dynamics relevant to the analysis.

The integration of OpenPNRR and Orbis data required a careful firm-level matching procedure, as the administrative dataset does not report standardised identifiers. The linkage was therefore carried out based on firm names in the Latin alphabet. To reduce the risk of missed matches due to formatting differences, abbreviations, or punctuation, firm names were subjected to a cleaning and standardisation process, including conversion to uppercase, removal of punctuation, and normalisation of spacing.

Automatic matching was complemented by a manual validation of correspondences, documented in a supporting file, in order to verify the associations between firms across the different sources and to

avoid linkage errors. This step proved crucial for ensuring the reliability of the final dataset, given the absence of common unique identifiers and the heterogeneous nature of the information sources.

Following the integration of data sources and an initial data cleaning phase, the original sample of beneficiary firms was further restricted based on the availability and quality of the economic information required for the empirical analysis. Specifically, only firms for which it was possible to reconstruct sufficiently continuous series of revenues and employment over the 2017–2024 period were retained. In the presence of limited missing information, missing values were treated using a simple imputation procedure based on the value observed in the temporally closest year, in order to preserve series continuity without introducing strong structural assumptions. Firms characterised by excessively fragmented data availability were instead excluded from the analysis.

The data selection and cleaning process results in a final dataset comprising 138 beneficiary firms under the Transition 5.0 measure, for which coherent and comparable information on public funding, firm size, and growth dynamics is available. The final dataset takes the form of a cross-section of funded firms, matched with measures capturing their structural characteristics and pre-existing economic performance.

In addition to firm-level data, OpenPNRR also provides aggregate information on the territorial distribution of resources. Although this information is not directly incorporated into the firm-level empirical analysis, it offers useful interpretative context and is referenced in the discussion of results and policy implications.

Finally, it is appropriate to highlight several limitations of the data used. First, the update of OpenPNRR data as of 31 August 2025 implies that the analysis provides a partial snapshot of the implementation of the Transition 5.0 measure. Second, name-based matching may introduce potential selection bias if unmatched firms systematically differ from those included in the final sample. Lastly, the absence of information on non-beneficiary firms prevents the construction of a control group, limiting the analysis to the study of allocation patterns rather than the estimation of causal effects. These limitations deliberately shape the adopted empirical strategy and motivate the focus on firms' pre-existing economic characteristics and on relative measures of public support, as developed in the subsequent sections of the chapter.

3.2 Variable Construction

The construction of variables represents a central step in linking the theoretical framework developed in the previous chapters to the empirical analysis of the allocation of resources under the Transition 5.0 measure. Since the objective of this work is not the estimation of causal effects, but rather the analysis of the implicit selection criteria associated with an explicitly non-neutral industrial policy, measurement choices reflect a precise analytical stance: interpreting the distribution of public funds as the outcome of an allocation process among heterogeneous firms, rather than as a simple mechanical function of their productive scale.

Within this perspective, the dependent variable is represented by the intensity of public funding received by each beneficiary firm. Operationally, funding is constructed as the total amount of Transition 5.0 resources associated with the firm, obtained by aggregating all funded projects at the beneficiary level. Although this variable is expressed in monetary levels, its interpretation is oriented towards a relative reading of public support, aimed at understanding how resources are distributed across firms with different economic characteristics, rather than at explaining the absolute level of funding per se.

The main explanatory variables are selected to operationalise two conceptually distinct dimensions of the Schumpeterian process: creative accumulation and creative destruction. In line with the adopted theoretical framework, the analysis does not assume ex ante that a technological transition policy favours either small or large firms, nor that it automatically rewards either consolidated or dynamic firms. Variable construction is therefore designed to allow for an open empirical assessment of the allocation criteria of public support along these two dimensions.

Firm size is used as a proxy for processes of creative accumulation. It is measured through the number of employees, drawn from the Orbis database, and constructed as a pre-treatment structural indicator based on information available for the 2017–2024 period. This choice reflects the intention to capture long-term cumulative outcomes, such as the expansion of productive capacity, the accumulation of organisational capabilities, and the positioning of the firm within the productive structure. The size variable is not interpreted as a direct indicator of innovative capacity, but rather as a synthetic measure of the firm's accumulation trajectory prior to public intervention.

Firm dynamism is instead captured through a measure of economic growth, constructed on the basis of operating revenue dynamics. Specifically, growth is measured using the compound annual growth rate (CAGR) of revenues over the 2017–2024 period. The use of the CAGR allows the medium-term

evolution of the firm's economic activity to be summarised in a single indicator, mitigating the influence of transitory fluctuations or short-term shocks. This measure is interpreted as a proxy for processes of creative destruction, insofar as it reflects the firm's ability to expand, reorient, or reconfigure its activity within a transforming competitive environment.

The construction of explanatory variables is consistent with a pre-treatment perspective of the analysis: both size and growth are measured over a time horizon preceding the disbursement of funding, in order to avoid capturing directly the effects of the policy under study. This choice allows empirical associations to be interpreted in terms of the selection of beneficiary firms, rather than as responses to treatment.

Finally, the empirical specification accounts for the high degree of heterogeneity in both size and dynamics among beneficiary firms. Beyond the analysis of marginal associations between funding intensity, size, and growth, the inclusion of interaction terms allows exploration of how the two theoretical dimensions considered may combine in the process of public resource allocation. In this way, the empirical analysis remains consistent with the theoretical approach of the study, without imposing an a priori hierarchy between accumulation and dynamism.

Overall, the construction of variables reflects a deliberate balance between theoretical coherence, informational constraints, and institutional realism. It provides a transparent and interpretable empirical basis for the analysis of the allocation of the Transition 5.0 measure, while deferring the discussion of empirical evidence and results to the subsequent sections.

3.2.1 Dependent variable: log(Funding)

The dependent variable of the analysis is represented by the total amount of public funding received by firms benefiting from the Transition 5.0 measure. In line with the objective of the study, the analysis does not aim to assess the causal effectiveness of the policy, but rather to examine how public resources are allocated across firms that are heterogeneous in their structural and dynamic characteristics. Consequently, the dependent variable is constructed so as to allow for a comparable reading of public support across firms of very different sizes, avoiding an analysis driven exclusively by scale differences.

As will be shown below, from a statistical standpoint the distribution of funding is highly skewed, raising potential issues in terms of comparability and the influence of outliers. To address these aspects, the analysis uses the logarithm of the total amount of funding as the measure of public support intensity. The adoption of a logarithmic transformation responds to a dual objective. First, it reduces

distributional asymmetry and mitigates the influence of extreme values, improving the statistical properties of the variable both in the descriptive analysis and in subsequent econometric estimations. Second, the logarithm of funding allows for a more informative interpretation of differences across firms, as it emphasises relative variations rather than absolute differences, thereby enhancing comparability among firms operating at very different economic scales.

In this sense, although not formally constructed as a ratio with respect to a scale variable, the logarithmic measure of funding performs a function analogous to that of a relative intensity measure: it enables the analysis of how public support is distributed along the productive structure, without the results being mechanically driven by the absolute size of beneficiary firms.

Therefore, the dependent variable constitutes the empirical tool through which the allocation criteria of the Transition 5.0 measure are analysed in relation to firms' pre-existing characteristics, while the discussion of observed associations and their economic implications is deferred to the subsequent sections.

3.2.2 Independent variables: creative accumulation, creative destruction

The independent variables of the analysis are constructed with the aim of translating into empirically observable indicators two central dimensions of the Schumpeterian framework discussed in Chapter 1: creative accumulation and creative destruction. Given the complex and multidimensional nature of these processes, the analysis adopts operational proxies that allow for a systematic exploration of how resources under the Transition 5.0 measure are distributed across firms characterised by different positions within the productive structure and by different development trajectories in the period preceding public intervention.

From this perspective, the independent variables are not interpreted as causal determinants of funding allocation, but rather as pre-existing characteristics of beneficiary firms, useful for reading the implicit criteria that guide the process of selection and distribution of public resources.

Creative accumulation: firm size

Creative accumulation is operationalised through a measure of firm size, defined as the average number of employees observed over the 2017–2024 period. Employment size is interpreted as a structural characteristic that synthesises long-term cumulative processes, such as the expansion of productive capacity, the accumulation of human and organisational capital, and the consolidation of tangible and intangible assets.

Within this framework, larger firms are regarded as the outcome of historically consolidated accumulation paths, which may translate into a greater capacity to absorb complex investments, manage articulated projects, and interact with industrial policy instruments characterised by high administrative and technological requirements. Firm size is therefore not interpreted as a direct indicator of innovative capacity or dynamic efficiency, but rather as a signal of the firm's position within the productive structure and of the cumulative mechanisms that have supported its development over time.

The choice to use the number of employees, rather than monetary indicators such as revenues or value added, reflects the need to adopt a relatively stable measure that is less sensitive to cyclical fluctuations or temporary shocks. Moreover, computing an average over a multi-year period helps to attenuate the influence of transitory variations and allows firm size to be interpreted as the expression of a medium-term consolidated accumulation process, rather than as a contingent condition observed in a single year.

Creative destruction: firm growth

Creative destruction is instead operationalised through a measure of firms' economic growth dynamics (Firm growth), defined as the compound annual growth rate (CAGR) of revenues over the 2017–2024 period. Revenue growth is used as an indicator of competitive dynamism, as it reflects the firm's ability to expand economic activity, increase sales, or reorient production in response to technological and market changes.

In a context of technological transition, such dynamics can be interpreted as a signal of resource reallocation towards more efficient firms or those better adapted to new productive paradigms, in line with the Schumpeterian view of creative destruction as a process of structural transformation of the economic system.

The decision to base the measure of dynamism exclusively on revenues reflects a precise conceptual and methodological choice. In the presence of digitalisation and automation processes, economic expansion does not necessarily translate into a proportional increase in employment. On the contrary, revenue growth may capture qualitative changes in productive organisation, technological intensity, or market positioning that are not fully reflected in employment-based indicators. The use of revenues therefore allows for the identification of forms of dynamism consistent with capital-intensive technological transformations, which are particularly relevant in the context of the Transition 5.0 measure.

The adoption of the CAGR, rather than point-in-time annual changes, further allows the evolution of revenues to be summarised over a relatively broad time horizon, reducing sensitivity to short-term fluctuations or exceptional shocks. In this way, the Growth variable is interpreted as an indicator of a medium-term structural growth trajectory, rather than as the outcome of contingent dynamics observed in a single year. It is important to emphasise that growth, as measured here, is not interpreted as an outcome of public policy, but as a pre-existing characteristic of beneficiary firms, used to analyse funding allocation patterns.

Joint interpretation of accumulation and destruction

A central element of the empirical approach is the recognition that creative accumulation and creative destruction do not represent mutually exclusive dimensions. On the contrary, the two dynamics may coexist within the same firm, giving rise to heterogeneous combinations of structural size and economic dynamism. The construction of independent variables is therefore designed to enable a joint analysis of these dimensions, avoiding a dichotomous reading that mechanically opposes "large and consolidated" firms to "small and dynamic" ones.

From this perspective, the focus is not on establishing which configuration is preferable in the abstract, but rather on understanding how the Transition 5.0 measure is distributed along these two axes and whether public support tends to concentrate on firms characterised predominantly by consolidated accumulation processes, by greater competitive dynamism, or by specific combinations of both characteristics. The operational modalities of variable construction and their statistical properties are discussed in the subsequent sections, which present the descriptive evidence and the econometric analysis.

3.2.3 Descriptive statistics and data quality

Before proceeding to the econometric analysis, the study includes a descriptive analysis phase aimed at providing a systematic overview of the characteristics of the sample of beneficiary firms and of the main variables used in the analysis. In line with the overall approach of the chapter, this phase seeks to understand the structure of the data, the degree of heterogeneity across firms, and the statistical properties of the variables of interest. This step represents an essential prerequisite for the interpretation of the econometric analyses developed in the subsequent sections and for the reading of the evidence presented in Chapter 4.

The descriptive analysis serves a predominantly exploratory and contextual function. First, it allows the profile of beneficiary firms to be outlined in terms of structural and dynamic characteristics,

clarifying which segments of the productive structure are most represented within the sample. In particular, attention is devoted to the distribution of firm size and growth dynamics, in order to assess the degree of dispersion along the dimensions of creative accumulation and creative destruction and to verify the presence of any relevant concentrations or asymmetries.

Second, the descriptive analysis focuses on the public funding variable, examining its distribution and main statistical properties. In a context of selective industrial policy such as the Transition 5.0 measure, the amount of public support tends to display substantial heterogeneity across firms, with the potential presence of extreme values. Examining the distribution of funding therefore makes it possible to identify asymmetries, heavy tails, or concentrations that may affect the interpretation of empirical results and justify the use of variable transformations in subsequent stages of the analysis.

A further step involves the exploration of bivariate relationships between public funding and key firm characteristics. Through simple descriptive comparisons and measures of association, this phase allows observation of how public support is distributed along the dimensions of accumulation and dynamism, providing a first reading of observable regularities in the data. These exercises are purely exploratory and non-inferential in nature: they do not aim to identify causal relationships, but rather to contextualise the subsequent econometric analysis and to inform model specification choices.

Alongside the analysis of distributions and descriptive relationships, the section also devotes attention to data quality. In particular, it discusses the temporal coverage of economic and financial variables, the presence of missing values, and the internal consistency of the information obtained through the integration of OpenPNRR and Orbis sources. The construction of the final sample required a data cleaning and harmonisation phase aimed at ensuring the comparability of information and the reliability of the indicators used, even at the cost of reducing the sample size. This choice reflects a deliberate trade-off between dataset breadth and data quality, prioritising internal consistency and measurement robustness over the maximisation of the number of observations.

Overall, the descriptive analysis and the assessment of data quality constitute an essential preliminary step linking variable construction to the empirical strategy illustrated in Section 3.3. They provide the empirical context necessary for the correct interpretation of the evidence presented in Chapter 4 and for reading econometric results in light of the statistical properties of the data, thereby contributing to the transparency, coherence, and credibility of the study's overall empirical design.

3.3 Empirical Strategy

The empirical analysis is conducted on cross-sectional data referring to firms benefiting from the measure. The choice of this approach reflects both informational constraints—related to the stage of policy implementation and the absence of a credible control group—and a deliberate analytical stance. The objective of the study is in fact to uncover empirical regularities in the criteria governing the allocation of public support, rather than to evaluate the average impact of the measure through counterfactual research designs.

The empirical strategy relies on linear regression models estimated using Ordinary Least Squares (OLS), which allow for a transparent analysis of conditional associations between funding intensity and the characteristics of beneficiary firms. The use of OLS responds to the need to maintain a parsimonious and easily interpretable model structure, consistent with the sample size and the exploratory nature of the analysis.

A central element of the empirical strategy concerns the definition of the dependent variable, which captures the public funding in relative terms. In the baseline specification, funding is proxied by the logarithm of the total amount of funding received by each firm. This transformation emphasizes relative rather than absolute differences across firms and mitigates the influence of extreme values, thus performing a role analogous to a normalization with respect to firms' economic scale. An explicitly scale-normalized measure of funding intensity, defined relative to firm revenues, is introduced in robustness checks. This choice makes it possible to attenuate the mechanical correlation between firm size and absolute funding amounts and to focus the analysis on differences in the relative distribution of public support across heterogeneous firms.

The analysis unfolds in three main steps. First, a baseline model is estimated, relating funding to firm size and growth dynamics, considered as proxies for processes of creative accumulation and creative destruction, respectively. Second, robustness exercises are conducted to assess the stability of results with respect to alternative specifications of the dependent variable and functional transformations of the main variables. These exercises also include the introduction of additional firm-level controls, such as geographic location and patent ownership, aimed at capturing potential contextual and innovative heterogeneity without altering the core structure of the baseline model. Finally, the analysis explores heterogeneity in public funding allocation patterns through the interaction between size and growth, in order to understand how these two dimensions combine within the implicit selection criteria of the measure.

Overall, the adopted empirical strategy prioritises theoretical coherence, methodological parsimony, and interpretative transparency. It provides the analytical framework within which the descriptive evidence and econometric analysis presented in Chapter 4 are situated, allowing results to be interpreted as systematic associations between the intensity of public funding and the structural characteristics of beneficiary firms.

3.3.1 Baseline OLS regression model

The starting point of the empirical analysis is a linear regression model that relates the intensity of public funding received by firms benefiting from the Transition 5.0 measure to two pre-existing economic characteristics considered central within the adopted theoretical framework: firm size and growth dynamics. This baseline model serves a predominantly exploratory and interpretative purpose, aimed at identifying the main conditional associations characterising the allocation patterns of public support. The reference specification is the following:

$$\log(Funding_i) = \beta_0 + \beta_1 \log(Size_i) + \beta_2 Growth_i + \sum_{s=1}^{S-1} \gamma_s Sector_{is} + \varepsilon_i$$

where *log(Funding)* denotes the logarithm of the total amount of Transition 5.0 funding received by firm i. This variable captures the relative intensity of public support and is adopted as the baseline specification, as it mitigates the strong right-skewness observed in the funding distribution, as documented in Section 4.1. The variable *Size* measures firm size in the pre-treatment period and is interpreted as a proxy for processes of creative accumulation, while *Growth* captures firm growth dynamics, measured by the CAGR, and is interpreted as an indicator of creative destruction. In addition, the specification includes a set of sector fixed effects (ATECO classification) to control for structural differences in funding intensity across industries, thereby isolating the associations attributable to firm-level characteristics from those driven by sectoral composition. The error term εi incorporates unobserved factors affecting the allocation of public funding that are not explicitly modeled. Estimated coefficients are interpreted as conditional associations rather than causal effects.

The choice to estimate a linear model using OLS reflects several considerations. First, OLS provides a clear and easily interpretable representation of the associations between variables, which is central in an analysis that does not aim to identify causal effects but rather to describe empirical regularities in the data. Second, given the sample size and the cross-sectional nature of the dataset, the adoption of more complex models would not be justified either from an informational or an institutional

standpoint. Finally, OLS allows the separate contribution of size and growth to be assessed, preventing one of the two dimensions from dominating the interpretation of results.

The coefficient β_1 measures the association between firm size and the intensity of public funding, conditional on growth dynamics. A positive value of β_1 would indicate that, conditional on growth, larger firms receive more intense public support relative to their economic scale, suggesting an orientation of the measure towards productive structures characterised by consolidated accumulation. Conversely, a zero or negative value would indicate that size does not represent a relevant selection criterion in terms of funding.

The coefficient β_2 instead captures the association between economic growth and funding, conditional on firm size. A positive value of β_2 would be consistent with the hypothesis that the Transition 5.0 measure tends to favour firms characterised by greater competitive dynamism, interpreted as a signal of adaptive and transformative capacity. Also in this case, interpretation remains descriptive: the coefficient does not measure the effect of funding on growth, but rather the reverse relationship between pre-existing growth and funding allocation.

Overall, the baseline OLS model plays an orienting role and is used as an initial reference point, while substantive interpretation of results relies on the extended specifications presented in the following sections. It allows assessment of whether public support is more strongly associated with processes of creative accumulation, with dynamics of creative destruction, or with a combination of both, thereby laying the groundwork for the robustness and heterogeneity analyses developed thereafter.

3.3.2 Robustness checks

To assess the robustness of the associations estimated in the baseline OLS model, the empirical analysis is complemented by a set of robustness checks aimed at verifying that the results do not depend on specific measurement choices for the dependent variable or on particular assumptions regarding the functional form of the model.

Alternative measure

In the baseline model, the dependent variable is measured as the logarithm of the total amount of Transition 5.0 funding received by each firm. While this measure allows for a direct analysis of the distribution of public resources, it may partly reflect purely scale-related differences across beneficiary firms. To verify that the results are not driven exclusively by firms' economic size, an

alternative measure of funding is adopted, normalising the amount received by firm revenues. Specifically, funding intensity is defined as:

$$\text{FundingIntensity}_i = \frac{\text{Funding}_i}{\overline{\text{Revenues}}_{i,2017-2024}}$$

where *Funding* represents the total amount of Transition 5.0 funding received by firm *i*, while *Revenues 2017–2024* denotes the firm's average revenues over the period 2017–2024. Using average revenues over an extended time horizon helps mitigate the influence of short-term cyclical fluctuations and provides a more stable measure of the firm's economic scale.

This specification allows public funding to be interpreted in relative terms, expressing the support received as a share of the firm's economic capacity, and makes it possible to assess whether the associations with size and growth persist once funding is normalised by scale. The estimated model takes the following form:

$$Funding\ Intensity_i = \alpha + \beta_1 \log(Size_i) + \beta_2 Growth_i + \gamma_s Sector_s + \varepsilon_i$$

Logarithmic transformation of funding intensity

A further robustness exercise concerns the functional form of the dependent variable. In line with well-established practice in the empirical literature on public funding allocation and firm-level incentives, the distribution of funding intensity is likely to be highly skewed and characterised by the presence of extreme observations, reflecting the concentration of resources among a limited number of beneficiaries (Howell, 2017; Criscuolo et al., 2019). The logarithmic transformation reduces the influence of extreme values, improves the statistical properties of the dependent variable, and facilitates interpretation of estimated coefficients in terms of approximate percentage changes. This transformation is particularly appropriate in the presence of substantial heterogeneity among beneficiary firms. Consistently, firm size is also introduced in logarithmic form, leading to the following specification:

$$\log(Funding\ Intensity_i) = \alpha + \beta_1 \log(Size_i) + \beta_2 Growth_i + \gamma_s Sector_s + \varepsilon_i$$

Geographic controls

As an additional robustness check, the baseline specification based on the logarithm of funding intensity is augmented by introducing controls for firms' geographic location. The inclusion of geographic dummy variables aims to account for potential territorial heterogeneity in the allocation of public support, reflecting structural differences across Italian macro-areas in terms of productive structure, institutional capacity, and access to public programmes.

Specifically, the model includes a set of dummy variables identifying firms located in the Centre, South and Islands, with firms located in the North serving as the reference category. The North is chosen as the baseline category in line with standard econometric practice and reflects its role as the macro-area characterised, on average, by higher productive density and more developed industrial and institutional infrastructures. The estimated specification is therefore given by:

$$\log(\text{FundingIntensity}_i) = \alpha + \beta_1 \log(\text{Size}_i) + \beta_2 \text{Growth}_i + \gamma_1 \text{Centre}_i + \gamma_2 \text{South+Islands}_i + \sum_s \delta_s \text{Sector}_{is} + \varepsilon_i$$

where the coefficients associated with the geographic dummies capture differences in funding intensity relative to firms located in the North, conditional on firm-level characteristics.

The introduction of geographic controls is intentionally restricted to the specification based on the logarithm of funding intensity. This choice reflects the objective of the robustness exercise, which is not to explain the absolute level of funding received, but to verify whether the relationships identified between funding intensity, firm size, and growth persist once potential territorial heterogeneity is accounted for, while abstracting from scale effects.

Innovation and patent ownership

A further robustness exercise investigates the role of firms' innovative activity, proxied by patent ownership. Within the analysed sample of 138 beneficiary firms, 28 firms hold at least one registered patent. Although these firms do not represent the majority of observations, they constitute a non-negligible share of the sample and allow for an assessment of whether the relative allocation of public support is associated with observable innovation outputs.

To this end, the model based on the logarithm of funding intensity is extended by introducing a binary variable equal to one if the firm holds at least one registered patent and zero otherwise. The estimated specification is given by:

$$\log(Funding\ Intensity_i) = \alpha + \beta_1 \log(Size_i) + \beta_2 Growth_i + \delta PatentDummy_i + \sum_{s=1}^{S-1} \theta_s Sector_{is} + \varepsilon_i$$

where *PatentDummy* equals one if the firm holds at least one patent and zero otherwise. The coefficient δ captures the association between patent ownership and funding intensity, conditional on firm size and growth dynamics.

The inclusion of patent ownership serves a dual purpose. On the one hand, patents represent a widely used and observable indicator of firms' innovative activity. On the other hand, their interpretation within a Schumpeterian framework is inherently ambiguous. Patent ownership may reflect processes of creative accumulation when associated with incumbent firms characterised by consolidated research capabilities, but it may also signal dynamics of creative destruction when linked to firms undergoing more radical technological transformation. Precisely because of this theoretical ambiguity, patent ownership is introduced as a robustness control rather than as a central explanatory variable.

Role of robustness checks

Taken together, these robustness exercises are not intended to identify a single preferred specification, but rather to evaluate the qualitative stability of the estimated relationships across alternative and plausible modelling choices. The persistence of the associations between funding intensity, firm size, and growth after introducing geographic controls, innovation-related variables, and alternative definitions of the dependent variable suggests that the main findings are not driven by a specific measurement strategy or by omitted observable heterogeneity.

In this sense, the robustness checks reinforce the interpretation of the results as reflecting systematic patterns in the allocation of public support under the Transition 5.0 measure, rather than artefacts of a particular specification. This strengthens the empirical credibility of the analysis while remaining fully consistent with its descriptive and non-causal scope.

Additionally, while sectoral controls are introduced in the baseline specification expressed in levels in order to account for structural differences in capital intensity and project scale across industries, the additional controls for geography and patent ownership are included in the specifications based on funding intensity. These variables are conceptually related to the relative economic relevance of public support rather than to its absolute distribution, and are therefore more appropriately examined when funding is normalized by firm scale.

3.3.3 Heterogeneity analysis: accumulation vs destruction dynamics

The final step of the empirical strategy is devoted to the analysis of heterogeneity in public funding allocation patterns, with particular attention to the interaction between firm size and growth dynamics. This exercise addresses the need to move beyond a purely additive reading of processes of creative accumulation and creative destruction, in order to explore how these two dimensions combine within the implicit selection criteria of the Transition 5.0 measure.

From a theoretical perspective, the Schumpeterian debate suggests that accumulation and destruction do not necessarily operate as independent forces. On the contrary, processes of structural transformation often emerge from the interaction between consolidated productive bases and dynamic adaptive capabilities. Translating this intuition into the empirical domain, it is plausible that the relationship between pre-existing growth and the intensity of public funding differs depending on firm size, and vice versa. The heterogeneity analysis is designed precisely to test this hypothesis.

For this reason, the empirical specification is extended to include an interaction term between firm size, introduced in logarithmic form, and growth dynamics:

$$\log(FI_i) = \beta_0 + \beta_1 \log(Size_i) + \beta_2 Growth_i + \beta_3 (\log Size_i \times Growth_i) + Sector\ FE + \varepsilon_i$$

where the dependent variable is defined consistently with the baseline model as public funding intensity, and the estimates are replicated using the alternative specifications discussed in the previous section as robustness checks.

The inclusion of the interaction term makes it possible to assess whether the association between growth and funding intensity varies systematically along the firm size distribution. In particular, the coefficient β_3 captures whether and to what extent competitive dynamism is rewarded differently across small- and large-scale firms. A positive coefficient would indicate that growth is more strongly associated with higher funding intensity among larger firms, suggesting a policy orientation towards entities combining consolidated accumulation with dynamism. Conversely, a negative coefficient would signal that growth is relatively more rewarded among smaller firms, consistent with a reading more closely aligned with creative destruction.

This analysis does not aim to establish which combination of characteristics is “optimal” from a normative perspective, but rather to make explicit the selection logic embedded in the Transition 5.0 measure. In other words, the interaction between size and growth allows one to explore whether funding allocation is more consistent with dynamic incumbents or with smaller but rapidly expanding firms.

From a methodological standpoint, the heterogeneity analysis represents a natural extension of the previous models and does not introduce additional identifying assumptions. The results are interpreted as conditional associations and should be read jointly with the baseline specifications and robustness exercises. However, precisely because it makes explicit the interactive dimension of accumulation and destruction processes, this analysis provides a particularly relevant interpretative lens for the discussion of policy implications.

Overall, the heterogeneity analysis closes the empirical strategy by reconnecting the quantitative evidence to the theoretical framework developed in the preceding chapters. It allows the Transition 5.0 measure to be interpreted not only in terms of “who receives more”, but more importantly in terms of which combinations of productive characteristics are most closely aligned with the selective orientation of industrial policy.

4. Empirical Results

This chapter presents the results of the empirical analysis on the allocation of resources under the Transition 5.0 measure across beneficiary firms. The focus is on patterns of public support allocation, understood as empirical regularities reflecting implicit selection criteria embedded in industrial policy. In this sense, the empirical analysis serves a primarily descriptive and interpretative function: it allows for the identification of firm profiles that are more strongly associated with higher funding intensity and for an assessment of how these profiles are positioned along the dimensions of productive scale and competitive dynamism.

The chapter follows a gradual analytical path. First, descriptive evidence is presented in order to frame the profile of beneficiary firms and to observe how funding intensity is distributed across the dimensions of interest. Subsequently, multivariate econometric analysis examines the conditional associations between funding intensity, firm size, and firm growth. An additional section then evaluates the robustness of the results with respect to alternative specifications of the dependent variable and functional forms, in line with the empirical strategy outlined in Chapter 3. Finally, the heterogeneity analysis explores the role of the interaction between accumulation and dynamism, offering a more articulated interpretation of allocation patterns. An additional set of results assesses the robustness of these associations to alternative specifications of the dependent variable and to the inclusion of additional firm-level controls, such as geographic location and innovation-related characteristics.

Overall, the chapter aims to provide an empirical basis for interpreting the Transition 5.0 measure as a non-neutral industrial policy instrument, contributing to clarifying which types of firms are more likely to capture public support in this phase of productive system transformation. The results that follow do not provide a causal evaluation of the policy's effects, but they offer useful insights for understanding the direction and potential long-term implications of the observed allocation choices.

4.1 Descriptive Evidence

This section presents the descriptive evidence related to firms benefiting from the Transition 5.0 measure and to the main variables used in the empirical analysis. In line with the discussion in Chapter 3, the descriptive analysis serves an exploratory and contextual function, aimed at understanding the structure of the sample, the degree of heterogeneity across firms, and the statistical properties of

public funding intensity. It does not have inferential purposes, but represents an essential preliminary step for the correct interpretation of the regression analyses presented in the subsequent sections.

The focus is, first, on the structural and dynamic characteristics of beneficiary firms, in order to situate them within the productive structure and to assess the extent to which the Transiton 5.0 measure reaches firms with heterogeneous profiles in terms of creative accumulation and creative destruction. Second, the descriptive analysis considers the distribution of public funding intensity, with the aim of observing how support is allocated in relative terms across firms that differ in size and growth. Finally, summary statistics and bivariate relationships among the main variables are presented, in order to provide an overall picture of the associations observable in the data.

Overall, the descriptive evidence presented in this section provides the empirical context necessary to understand the regression analyses developed in Section 4.2. It allows the analysis to move from a qualitative description of the allocation criteria underlying the measure to a more systematic quantitative assessment, while maintaining a clear distinction between descriptive observation and econometric interpretation.

4.1.1 Distribution of Transition 5.0 beneficiaries by firm characteristics

This section provides a systematic description of the main characteristics of firms benefiting from the Transition 5.0 measure, with the aim of outlining the composition of the sample and highlighting the degree of heterogeneity along the dimensions relevant for the empirical analysis. In line with the theoretical framework of the study, the focus is on firm size, interpreted as a proxy for processes of creative accumulation, and on growth dynamics, measured through the compound annual growth rate (CAGR), as an indicator of creative destruction. This is complemented by an analysis of the distribution of public funding, in order to assess its statistical properties and the degree of concentration among beneficiaries.

Variable	Mean	Median	SD	Min	Max
Firm size	43,839	22,062	76,604	1,000	714,875
CAGR	0,052	0,037	0,080	-0,100	0,396
Funding (€)	76.138.806	166.982,5	406.020.243	13.065,5	3.733.755.843

Table 1 – Descriptive statistics of Transition 5.0 beneficiary firms

Table 1 reports summary descriptive statistics for a sample of 138 beneficiary firms, including firm size, CAGR, and the total amount of funding received. Firm-level characteristics are obtained from Orbis, while information on public funding derives from the OpenPNRR database.

Overall, the table highlights substantial heterogeneity both in firms' structural and dynamic characteristics and in the intensity of public support received. For all variables considered, there is a marked difference between mean and median values, suggesting asymmetric distributions and the presence of extreme observations. This evidence provides an initial context for the interpretation of the subsequent analyses.

With respect to firm size, the distribution is strongly right-skewed. The average firm employs approximately 44 workers, while the median is slightly above 22, indicating that the majority of beneficiary firms are small- and medium-sized enterprises. At the same time, the presence of a limited number of very large firms, with a maximum value close to 715 employees, substantially increases both the mean and the standard deviation. From a distributional perspective, 75% of firms have a size equal to or below approximately 43 employees, confirming a sample structure characterised by pronounced size heterogeneity and the coexistence of medium-small firms alongside a small number of large beneficiaries.

Growth dynamics, measured by the CAGR, also display considerable dispersion. The average growth rate is positive, at around 5%, while the median is approximately 3.7%, suggesting a prevalence of expanding firms within the sample. However, the distribution includes both firms experiencing contraction, with negative growth rates, and firms characterised by particularly strong growth dynamics, with maximum values close to 40%. The relatively high standard deviation thus reflects the coexistence of highly differentiated growth trajectories, consistent with the notion of a heterogeneous sample in terms of competitive dynamism.

Heterogeneity is even more pronounced when considering the distribution of public funding. The average amount of funding exceeds €76 million, while the median is approximately €167 thousand, highlighting a difference of several orders of magnitude between the two indicators. The distribution is strongly right-skewed and characterised by extremely high variance, with a maximum value exceeding €3.7 billion. This configuration indicates that, alongside a large number of firms receiving relatively modest amounts, a very limited subset of beneficiaries captures a substantial share of total resources.

Overall, the descriptive evidence points to strong heterogeneity in firm size, growth dynamics, and the intensity of public support among beneficiaries of the Transition 5.0 measure. In particular, the highly asymmetric distribution of funding and the presence of extreme values suggest the need to adopt appropriate variable transformations—such as the logarithmic transformation of funding—in the subsequent econometric analyses. These results provide the baseline empirical context for the analysis of funding allocation along the dimensions of creative accumulation and creative destruction developed in the following section.

4.1.2 Funding intensity across destruction-based and accumulation-based firm profiles

This section examines how the public support provided by the Transition 5.0 measure is distributed across firms characterised by different structural profiles, which can be traced back to the Schumpeterian distinction between processes of creative accumulation and creative destruction. In line with the theoretical framework of the study, firm size is interpreted as a proxy for accumulation capacity, while growth dynamics—measured by the compound annual growth rate (CAGR)—capture heterogeneity in processes of creative destruction. Firms are classified along both dimensions using thresholds derived from the empirical distribution of the observed variables, as documented in Section 4.1.1. In particular, firms are grouped according to quantile-based classes, which ensure comparable group sizes and reflect the actual structure of the beneficiary sample, avoiding the use of externally imposed administrative thresholds.

Given that the distribution of public funding is highly asymmetric and characterised by the presence of extreme values, the analysis refers to the logarithm of the total amount of funding received. This choice allows for a more informative representation of differences across groups and reduces the influence of outliers in descriptive comparisons.

Funding intensity and firm size (creative accumulation)

To analyse the role of firm size, beneficiary firms are classified into quartiles based on the distribution of the firm size variable. This classification makes it possible to compare public funding intensity across firms with different accumulation capacities, without imposing a prior functional relationship between size and the amount of support received.

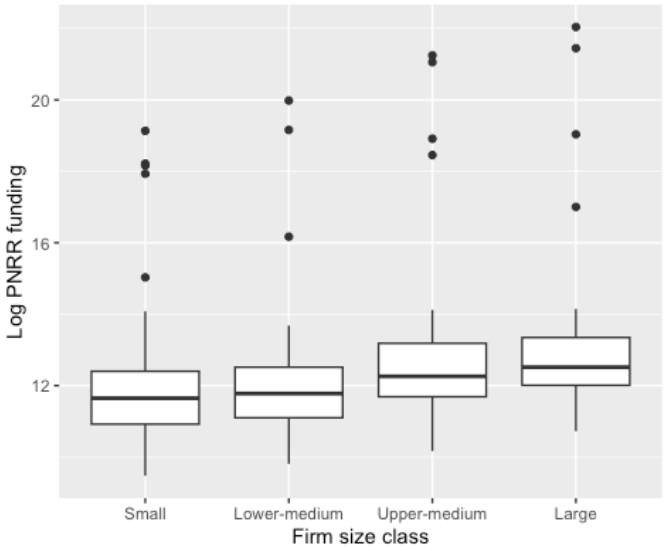

Figure 2 –Funding and firm size

Figure 2 shows the distribution of Transition 5.0 funding across firm size classes. The evidence suggests a positive relationship between firm size and funding intensity: firms belonging to higher size classes exhibit, on average, higher levels of funding and greater dispersion than smaller firms. At the same time, the substantial overlap between distributions indicates that funding is not exclusively concentrated among large firms, but also reaches medium-sized and smaller firms, albeit with lower average amounts.

This configuration suggests that public support associated with the Transition 5.0 measure is more strongly concentrated among firms characterised by higher accumulation capacity, consistent with the idea that larger firms possess greater organisational and project-management resources to access complex funding programmes. At the same time, the significant overlap across distributions indicates that firm size does not constitute an exclusive allocation criterion.

Funding intensity and firm growth (creative destruction)

A similar analysis is conducted with respect to the growth profile of beneficiary firms. Firms are classified into quartiles based on the empirical distribution of the CAGR, distinguishing between firms with low or negative growth and firms characterised by stronger growth dynamics. This dimension captures the degree of competitive dynamism and renewal typically associated with processes of creative destruction.

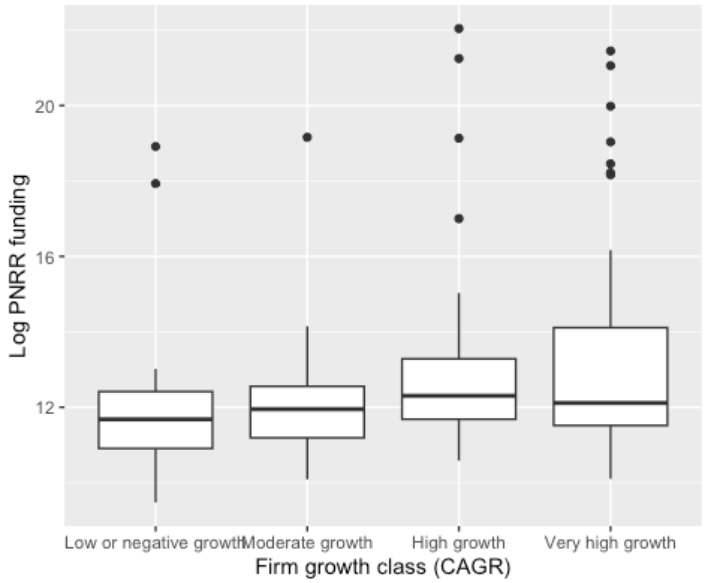

Figure 3 –funding and firm growth (CAGR)

Figure 3 reports the distribution of public funding across different growth profiles, defined on the basis of the empirical distribution of the CAGR. Here again, significant heterogeneity emerges: firms characterised by higher growth dynamics tend, on average, to receive higher levels of funding than firms with stagnant or negative growth. However, the overlap between distributions remains substantial, suggesting that growth, while relevant, does not represent a unique criterion for allocating public support.

Overall, growth dynamics appear to be less discriminating than firm size in the distribution of funding. The presence of high-growth firms receiving relatively modest amounts, as well as firms with moderate growth benefiting from large allocations, points to considerable heterogeneity in beneficiary profiles.

Quantitative summary by firm profiles

Tables 4 and 5 complement the graphical evidence by providing a quantitative summary of mean and median funding levels across different firm profiles. With respect to firm size (Table 4), a clear positive gradient emerges between size classes and the amount of funding received: firms in the upper quartiles display significantly higher average funding levels than smaller firms. However, the comparison between mean and median values highlights strong asymmetry within each group, suggesting that even among larger firms funding is concentrated among a limited number of beneficiaries.

Firm size class	Mean funding (€)	Median funding (€)	N
Q1 (Smallest)	12.331.627	114.450	35
Q2	20.050.617	130.266	35
Q3	98.828.378	210.883	34
Q4 (Largest)	176.870.938	272.720	34

Table 4 – Firm size classes (creative accumulation)

A similar, albeit less linear, pattern emerges when considering growth profiles (Table 5). Firms in the upper quartile of the CAGR distribution receive, on average, higher levels of funding than firms with lower growth. However, differences in median values are more limited than those observed for firm size, indicating greater overlap across groups.

Firm growth class	Mean funding (€)	Median funding (€)	N
Q1 (Lowest growth)	6.577.364	118.325	35
Q2	6.235.599	154.723	35
Q3	16.648.892	220.795	34
Q4 (Highest growth)	129.355.252	182.324	34

Table 5 – Firm growth classes (creative destruction)

Overall, the descriptive evidence indicates that the distribution of Transition 5.0 funding reflects both processes of creative accumulation and dynamics of creative destruction, with a particularly pronounced role for firm size. While these results are not inferential, they provide initial evidence consistent with the hypothesis that public support allocation favours firms with greater structural capacity and motivate the econometric analysis developed in the following sections. That analysis aims to assess more formally the relationship between firm characteristics and funding intensity, as well as the interaction between size and growth.

4.1.3 Summary statistics and correlation matrix

This section provides a summary of the main variables used in the econometric analysis and of the basic linear relationships among them. The objective is twofold: first, to offer a compact representation of the statistical properties of the regression variables; second, to explore the correlation structure in order to assess the presence of potential multicollinearity issues and to justify the specification choices adopted in the models estimated in the subsequent sections.

In continuity with the descriptive evidence presented above, particular attention is paid to the transformation of variables characterised by strong asymmetry and to the conceptual distinction between firm size and growth dynamics, which represent the two central dimensions of the empirical analysis.

Summary statistics of regression variables

Table 6 reports summary statistics for the variables included in the regression models. Public funding intensity is measured as the logarithm of the total amount of funding received by each firm, while firm size is expressed in logarithmic terms. The growth rate (CAGR) is instead kept in levels, as it is already defined as a compound annual percentage change.

Variable	Mean	SD	Min	Max
log(funding)	12,741	2,516	9,478	22,041
log(Firm size)	3,156	1,070	0,000	6,572
CAGR	0,052	0,080	-0,100	0,396

Table 6 – Summary statistics of regression variables

The use of logarithmic transformations for variables expressed in levels responds to the need to reduce the strong asymmetry observed in the distributions of funding and firm size, mitigating the influence of extreme values and improving the interpretability of estimated coefficients in elasticity terms. The reported statistics confirm that, after transformation, the variables display more contained dispersion and values consistent with their use in a linear regression framework.

Overall, Table 6 provides a technical representation of the regression variables, distinct from the general descriptive analysis presented in Section 4.1.1, and constitutes the quantitative basis for the multivariate analysis developed in Section 4.2.

Correlation matrix

Differently from the previous descriptive comparisons by firm profiles, which focused on unconditional differences in funding across size and growth classes, the correlation matrix adopts a model-oriented perspective and therefore includes sectoral, territorial, and innovation-related controls that enter the regression specification. This shift reflects the transition from descriptive evidence to the joint structure of variables relevant for multivariate analysis.

Table 7 presents the correlation matrix including not only the core variables of interest — the logarithm of funding, the logarithm of firm size, and the CAGR — but also additional control

variables used in the regression models: a sectoral dummy (manufacturing), a macro-regional indicator (firms located in Southern regions and Islands), and a patent dummy capturing innovative capacity. The matrix allows observation of the sign and magnitude of bivariate linear relationships, providing a first diagnostic assessment of the structure of associations among structural, dynamic, sectoral, territorial, and innovation-related firm characteristics.

	log(Funding)	**log(Firm size)**	**CAGR**	**Sector**	**Geography**	**Patents**
log(Funding)	1,000	0,138	0,210	-0,070	0,008	-0,023
log(Firm size)	0,138	1,000	-0,117	-0,017	-0,144	0,333
CAGR	0,210	-0,117	1,000	-0,233	-0,050	-0,184
Sector (Manufacturing)	-0,070	-0,017	-0,233	1,000	-0,023	0,115
Geography (South+Islands)	0,008	-0,144	-0,050	-0,023	1,000	0,020
Patents	-0,023	0,333	-0,184	0,115	0,020	1,000

Table 7 – Correlation matrix

The matrix highlights generally low to moderate pairwise correlations, with no coefficient approaching conventional critical thresholds for multicollinearity. The highest association is observed between firm size and patent ownership (0,333), reflecting the greater innovative capacity typically associated with larger firms, yet remaining well below problematic levels. This confirms that structural size and innovative activity capture related but distinct dimensions of firm heterogeneity.

Funding intensity displays only weak positive correlations with both firm size (0,138) and growth (0,210), suggesting that the allocation of Transition 5.0 resources is not mechanically driven by dimension alone, nor exclusively by short-term expansion dynamics. The very modest correlation between funding and the manufacturing sector dummy (-0,070), as well as with the macro-regional indicator (0,008), indicates that sectoral specialization and territorial location do not dominate the bivariate structure of funding allocation.

Particularly relevant from an econometric perspective is the negative association between growth and the manufacturing sector (-0,233), suggesting that sectoral specialization is linked to different growth trajectories. This result provides a first indication of the importance of controlling for sector in the regression models. Similarly, the weak correlation between firm size and growth (-0,117) confirms that the two variables capture distinct processes, consistent with the conceptual distinction between creative accumulation and creative destruction.

Overall, the evidence does not point to significant multicollinearity concerns and supports the joint inclusion of structural, dynamic, sectoral, territorial, and innovation-related variables in the multivariate analysis developed in Section 4.2.

Graphical evidence and econometric implications

To complement the tabular evidence, Figure 8 graphically represents the relationship between firm size, growth dynamics, and public funding intensity through a scatterplot linking the logarithm of the funding and the logarithm of firm size, with observations distinguished by growth classes defined on the basis of the CAGR distribution.

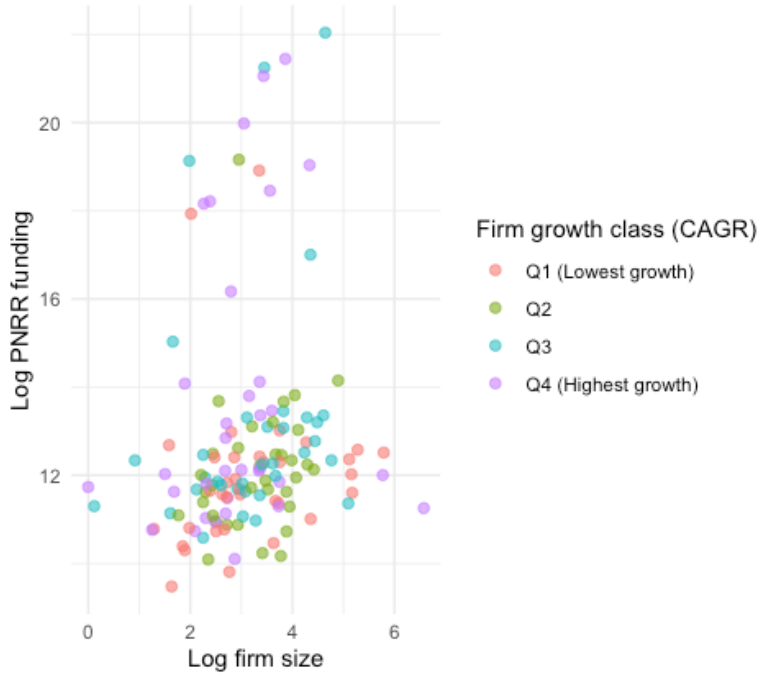

Figure 8 – Relationship between firm size, growth and funding

The figure highlights a positive but relatively weak relationship between size and funding intensity, in line with the low correlation coefficients reported in Table 7. At the same time, a substantial dispersion of observations emerges: firms with similar size levels receive very different amounts of public funding, suggesting that firm size alone is not sufficient to explain the allocation patterns. Moreover, the strong overlap across growth classes indicates that high-growth firms are distributed along the entire size spectrum and are not systematically associated with higher funding levels compared to firms with more moderate growth.

Overall, the descriptive and graphical evidence does not point to major multicollinearity concerns and supports the joint inclusion of firm size and growth in multivariate regression models. This

evidence justifies the specification of the econometric models presented in Section 4.2, in which funding intensity is simultaneously related to firm size, growth dynamics, and their possible interactions, while maintaining a clear distinction between empirical associations and causal inference.

4.2 Regression Results

This section presents the results of the regression analysis aimed at systematically examining the associations between the intensity of public funding received by firms benefiting from the Transition 5.0 measure and their pre-existing economic characteristics. In line with the empirical strategy outlined in Chapter 3, the analysis does not seek to identify causal effects of the policy, but rather to describe and interpret the allocation patterns of public support along the dimensions of creative accumulation and creative destruction.

In the baseline specification, the dependent variable is defined as the logarithm of the total amount of funding received by each firm. As discussed in Chapter 3 and motivated by the descriptive evidence presented in Section 4.1, this transformation mitigates the strong right-skewness in the distribution of funding and allows the analysis to focus on relative differences in funding intensity, thereby reducing the influence of extreme observations.

The section is structured as follows. Section 4.2.1 presents the results from the baseline OLS model, relating funding intensity to firm size and growth. Section 4.2.2 discusses a set of robustness checks designed to assess the stability of the results with respect to alternative specifications of the dependent variable and functional form. The analysis of heterogeneity, which explicitly explores the interaction between firm size and growth dynamics, is developed in Section 4.3.

Overall, the regression results extend and formalize the descriptive evidence presented in Section 4.1 by providing a more systematic quantitative assessment of the implicit allocation patterns of the Transition 5.0 measure. While remaining within a descriptive and non-causal framework, the econometric analysis offers useful insights into whether—and to what extent—public support is associated with firms characterized by consolidated accumulation, greater competitive dynamism, or specific combinations of these two dimensions. The analysis does not identify the criteria used by the policy maker, but only documents systematic associations between pre-treatment firm characteristics and observed funding allocation.

4.2.1 Baseline OLS results

This section presents the results of the baseline OLS regression model, aimed at analyzing the associations between the intensity of public funding received by firms benefiting from the Transition 5.0 measure and their pre-existing economic characteristics. The baseline specification relates the logarithm of the total amount of funding received by the firm to the logarithm of firm size and to pre-treatment growth dynamics, measured by the compound annual growth rate (CAGR). Firm size is interpreted as a proxy for processes of creative accumulation, while growth captures the degree of competitive dynamism associated with creative destruction.

Baseline specification

Table 9 reports the results of the OLS regression estimated on the sample of 138 beneficiary firms. The model includes sector fixed effects based on ATECO classification, so that comparisons are drawn among firms operating within the same industry.

	Dependent variable: Log(Funding)
Log(Firm size)	0,276 (0,207)
CAGR	7,419** (2,843)
Constant	10,862*** (2,520)
Observations	138
R^2	0,115
Adjusted R^2	0,045
Residual Std. Error	2,467
F-statistic	1, 644

Table 9 – Baseline OLS results.

*Notes: Standard errors in parentheses. * $p < 0,10$, ** $p < 0,05$,*** $p < 0,01$.*

By contrast, the coefficient on firm growth (CAGR) is positive and statistically significant at the 5 percent level. Holding constant firm size and sector, firms characterized by stronger pre-treatment growth trajectories tend to receive higher levels of public funding. CAGR captures pre-treatment revenue expansion, which may reflect growth dynamics, market conditions, or sector-specific cycles. In economic terms, firms already on a growth path appear more likely to obtain larger amounts of funding, consistent with a policy framework that is responsive to expansion potential and investment momentum.

The inclusion of sector fixed effects plays a key methodological role. It controls for structural differences across industries—such as capital intensity, technological regimes, and typical project scale—ensuring that the estimated relationships reflect within-sector variation rather than compositional differences in the sample. The results therefore highlight growth performance as the main firm-level characteristic associated with funding allocation, while firm size per se does not appear to operate as an independent selection criterion.

The R-squared of the model is 0.115, while the adjusted R-squared is 0.045. These values indicate that, although sectoral controls improve the explanatory capacity of the model, a substantial share of the variation in funding levels remains driven by factors not explicitly observed in the data, such as project characteristics, administrative selection procedures, or policy priorities that extend beyond measurable firm attributes.

As in the rest of the analysis, the estimated coefficients should be interpreted as conditional associations rather than causal effects. The model does not assess the impact of funding on firm performance, but instead examines how pre-existing firm characteristics are related to the allocation of public support under the Transition 5.0 measure.

4.2.2 Robustness checks

This section assesses the robustness of the baseline results by introducing alternative measures of public funding intensity. In particular, the analysis replaces the absolute level of funding with a measure normalized by firm scale, defined as the ratio between total funding received and average pre-treatment revenues. The objective is to verify whether the associations observed in the baseline specification merely reflect scale effects or whether they persist when public support is measured in relative terms.

Funding intensity in levels

As a first robustness exercise, an OLS model is estimated using funding intensity expressed in levels as the dependent variable. This specification provides limited inferential value, as the strong skewness of funding intensity in levels leads to imprecise estimates and very low explanatory power. It is therefore used only to motivate the logarithmic transformation.

$$Funding\ Intensity_i = \alpha + \beta_1 \log(Size_i) + \beta_2 Growth_i + \gamma_s Sector_s + \varepsilon_i$$

However, as documented in Section 4.1, the distribution of funding intensity is highly right-skewed and characterized by the presence of extreme values. As a result, the estimated coefficients in this specification are strongly influenced by outliers and are difficult to interpret in economic terms. The results of this estimation are reported in column (2) of Table 11. This specification performs poorly both statistically and economically and is reported only to document the distortion induced by extreme observations.

Logarithmic transformation of funding intensity

As a second and main robustness exercise, the analysis employs the natural logarithm of funding intensity (log funding intensity) as the dependent variable. This transformation below reduces the influence of extreme observations and yields more stable and economically interpretable coefficients.

$$\log(Funding\ Intensity_i) = \alpha + \beta_1 \log(Size_i) + \beta_2 Growth_i + \gamma_s Sector_s + \varepsilon_i$$

The estimated specification is reported in column (3) of Table 11. Relative to the specification in levels, the logarithmic transformation results in a higher explanatory power of the model, as indicated by the increase in the R-squared, and produces coefficients that are more precisely estimated.

	(1) Log(Funding)	(2) Funding intensity	(3) Log(Funding intensity)
Log(Firm size)	0,276	430,8	−0,784***
	(0,207)	(3108,1)	(0,213)
Growth (CAGR)	7,419**	110,509*	7,174**
	(2,843)	(42,722)	(2,921)
Constant	10862***	−7,599	6,424
	(2,520)	(37,872)	(2,589)
Sector fixed effects	Yes	Yes	Yes
Observations	138	138	138
R^2	0,115	0,077	0,180
Adjusted R^2	0,045	0,004	0,115
Residual Std. Error	2,467	37,070	2,534
F Statistic	1,644	1,055	2,770***

Table 11 – OLS results: baseline model and robustness checks on funding intensity.

*Notes: Standard errors in parentheses. Significance levels: * p < 0,10,* **p < 0,05, *** p < 0,01.*

A comparison across the three specifications highlights several key findings. First, the positive coefficient on firm size in the baseline model primarily reflects scale effects: larger firms receive higher levels of public funding in absolute terms. When funding is normalized by firm revenues, however, this relationship weakens in the level specification and reverses sign in a clear and statistically significant manner in the logarithmic specification.

This result indicates that, conditional on growth dynamics, larger firms receive a lower relative intensity of public funding compared to smaller firms. By contrast, the coefficient associated with firm growth remains positive and statistically significant in the logarithmic specification, confirming that the allocation of public support is systematically associated with pre-treatment economic dynamism, independently of how funding is measured.

Overall, the robustness analysis shows that the main results do not hinge on the functional form of the dependent variable. While the absolute level of funding is positively correlated with firm size, the relative intensity of public support is more strongly associated with smaller and more dynamic firms. This pattern is consistent with an interpretation in which the Transition 5.0 measure combines elements of creative accumulation and creative destruction.

These findings are further supported by the graphical evidence presented in Figure 12, which illustrates the relationship between firm size and funding intensity normalized by economic scale, distinguishing firms by growth terciles. The figure shows a negative relationship between firm size and funding intensity across all growth groups, in line with the results from the logarithmic regression. At the same time, for any given firm size, firms in higher growth terciles systematically display higher levels of funding intensity, reinforcing the central role of growth dynamics in the allocation of public support.

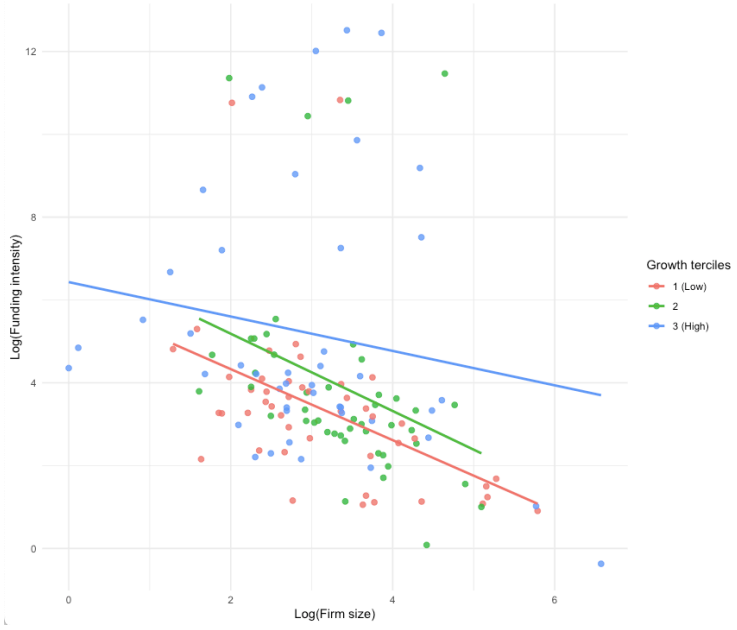

Figure 12 – Funding intensity, firm size, and growth dynamics

Taken together, the robustness analysis confirms that the core empirical patterns are not driven by a specific functional form of the dependent variable. While firm size is associated with the absolute amount of funding received, the relative intensity of public support is more closely linked to smaller and more dynamic firms. This combination of evidence suggests that the Transition 5.0 measure integrates both creative accumulation and creative destruction mechanisms, providing a solid interpretative basis for the heterogeneity analysis developed in the subsequent section.

Geographic heterogeneity

Building on the preferred specifications discussed in the previous section, the robustness analysis is extended by introducing controls for the geographic heterogeneity of beneficiary firms. In order to account for potential territorial differences, the baseline specification is augmented by including dummy variables for macro-geographic areas. The estimated model is specified as follows:

$$\log(\text{FundingIntensity}_i) = \alpha + \beta_1 \log(\text{Size}_i) + \beta_2 \text{Growth}_i + \gamma_1 \text{Centre}_i + \gamma_2 \text{South+Islands}_i + \sum_s \delta_s \text{Sector}_{is} + \varepsilon_i$$

To avoid excessive fragmentation of territorial categories relative to sample size, firms located in Southern regions and Islands are grouped into a single macro-area. The baseline specification is therefore augmented by including two geographic dummy variables, Centre and South+Islands, while the North constitutes the reference category. The coefficients γj therefore measure differences in the

relative intensity of funding with respect to firms located in the North, conditional on firm-level characteristics.

The choice to employ the logarithm of funding intensity also in this extension reflects a precise interpretative objective. The purpose of the robustness check is not to explain the absolute level of funding received—which inevitably reflects strong scale effects—but rather to verify whether the relationships identified between public support intensity, firm size, and growth remain valid when the allocation of resources is measured in relative terms and made comparable across heterogeneous firms. From this perspective, the inclusion of geographic controls is consistent with an interpretation of funding allocation that abstracts from firm size differences and focuses instead on potential structural heterogeneity related to territorial context.

Using the North as the reference category allows the estimated coefficients for the other macro-areas to be interpreted as deviations from an area that is, on average, characterized by higher productive density and stronger infrastructural and institutional endowments. This choice follows standard econometric practice and makes it possible to assess whether, conditional on firm characteristics, the intensity of public funding displays systematic differences associated with geographic location.

The results of the geographic extension are reported in Table 13, which compares the baseline specification with models including territorial and innovation-related controls. The evidence shows that the inclusion of macro-area dummies does not substantially alter the main findings of the analysis. Firm size retains a negative and statistically significant coefficient, confirming that, conditional on growth, larger firms receive a lower relative intensity of funding. At the same time, pre-treatment growth remains positively and significantly associated with the intensity of public support.

With regard to geographic controls, the coefficients associated with the macro-area dummies are not statistically significant. This result indicates that, once firm-level structural characteristics (size) and dynamic conditions (growth) are taken into account, the *relative intensity* of public funding does not display systematic territorial differences. In econometric terms, geographic location does not emerge as an independent explanatory factor in the allocation of funding intensity.

However, this evidence should not be interpreted as implying a territorially neutral distribution of public support. The absence of statistical significance concerns the conditional relationship between geography and funding intensity, not the overall spatial distribution of beneficiaries. In fact, the sample itself shows a strong concentration of firms located in Northern regions, reflecting the

underlying structure of the Italian productive system and the geographical distribution of firms with the organizational and financial capacity required to access the measure.

Overall, the introduction of geographic controls reinforces the interpretation that the Transition 5.0 measure operates primarily along microeconomic dimensions related to firms' structural scale and growth dynamics. At the same time, the territorial concentration of beneficiaries suggests that access to the policy is indirectly mediated by structural features that are themselves unevenly distributed across regions.

Innovation and patent ownership

An additional robustness exercise investigates the role of firms' innovative activity, captured through patent ownership. Within the analyzed sample of 138 beneficiary firms, 28 hold at least one registered patent. Although they do not represent the majority of observations, these firms constitute a non-negligible share of the sample and allow exploring whether the allocation of public support is associated, even in relative terms, with direct indicators of innovative output.

To this end, the model based on the logarithm of funding intensity is extended by introducing a dummy variable that takes the value of one if the firm holds at least one registered patent and zero otherwise, as specified below:

$$\log(Funding\ Intensity_i) = \alpha + \beta_1 \log(Size_i) + \beta_2 Growth_i + \delta PatentDummy_i + \sum_{s=1}^{S-1} \theta_s Sector_{is} + \varepsilon_i$$

where *PatentDummy* equals one if the firm holds at least one patent and zero otherwise. The coefficient δ captures the association between patenting activity and the intensity of public funding, conditional on firm size and growth.

The inclusion of this control serves a dual purpose. On the one hand, patent ownership represents a widely used and observable proxy for firms' innovative activity. On the other hand, its interpretation within a Schumpeterian framework is inherently ambiguous. Patent ownership may reflect processes of creative accumulation when associated with incumbent firms endowed with established research capabilities, but it may also capture dynamics of creative destruction when linked to trajectories of rapid growth and more radical technological renewal. Precisely because of this theoretical ambiguity, the inclusion of patents is particularly informative as a robustness exercise, without assigning them a central interpretative role.

	(1) Log(Funding Intensity)	(2) +Geography	(3) +Patents
Log(Firm size)	−0,784***	−0,747***	−0,689***
	(0,212)	(0,216)	(0,228)
Growth (CAGR)	7,174**	7,332**	7,009**
	(2,921)	(2,935)	(2,968)
Centre		0,357	0,313
		(0,568)	(0,571)
South + Islands		1,488	1,574
		(1,509)	(1,516)
Patent dummy			−0,465
			(0,590)
Constant	6,424**	4,842	4,642
	(2,589)	(3,045)	(3,060)
Sector fixed effects	Yes	Yes	Yes
Observations	138	138	138
R^2	0,180	0,189	0,193
Adjusted R^2	0,115	0,110	0,107

Table 13 – Robustness checks with geographic and innovation controls

*Notes: Dependent variable is the logarithm of funding intensity. Reference category for geography is North. Patent activity is measured as a binary indicator. *p<0,1; **p<0,05; ***p<0,01.*

The estimation results, reported in Table 13, show that the inclusion of the patent dummy does not significantly alter the relationships of interest. Firm size remains negatively and significantly associated with funding intensity, while pre-treatment growth retains a positive and statistically significant coefficient. The coefficient associated with patent ownership is not statistically significant, indicating that, conditional on size and growth, patent-holding firms do not receive systematically higher (or lower) levels of public support in relative terms.

This evidence suggests that the allocation of funding under Transition 5.0 is not directly driven by observable innovation outputs such as patenting activity. Rather, public support appears to be associated with more structural firm characteristics and with growth dynamics, reinforcing the interpretation of the policy as operating along the dimensions of productive scale and competitive dynamism, rather than explicitly selecting firms based on direct indicators of innovation.

In support of the econometric evidence, Figure 14 presents a boxplot of funding intensity for firms with and without patents. The graphical representation shows a substantial overlap between the two

distributions, with no systematic differences in median values or dispersion. This visual evidence is fully consistent with the regression estimates and further supports the interpretation of patent ownership as a non-discriminating characteristic in the allocation criteria of public support.

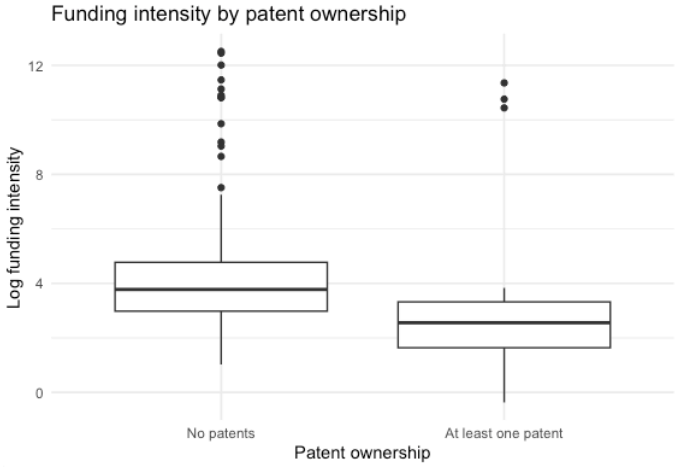

Figure 14 – graphical comparison of funding intensity between firms with and without patents

Overall, the absence of a significant effect of patent ownership strengthens the theoretical interpretation developed in the previous chapters, but it should be interpreted carefully. Patent ownership captures only a formal and codified dimension of innovation, linked to legally protected technological outputs, while firms' innovative activity can also take less formal forms such as process innovation, organizational change, digital upgrading, and incremental improvements embedded in production routines. The evidence therefore suggests that Transition 5.0 does not explicitly reward innovation as measured by patenting activity. Rather, public support appears to be associated with broader processes of productive transformation, in which innovation is reflected indirectly through firm growth dynamics and structural characteristics, assigning patent ownership a secondary and non-selective role.

4.2.3 Heterogeneity Analysis

This section extends the empirical analysis by introducing a heterogeneity dimension in the allocation of public support, with the aim of assessing whether the relationship between firm size and funding intensity depends on the degree of pre-treatment economic dynamism. In particular, the focus is on the interaction between firm size and growth, in line with the theoretical framework contrasting processes of creative accumulation and creative destruction.

Consistent with the specifications discussed in Section 4.2.2, the dependent variable is defined as the logarithm of funding intensity, allowing scale effects to be isolated and ensuring greater stability of the estimated coefficients. The estimated specification is the following:

$$\log(FI_i) = \beta_0 + \beta_1 \log(Size_i) + \beta_2 Growth_i + \beta_3 (\log Size_i \times Growth_i) + Sector\ FE + \varepsilon_i$$

Interaction between size and growth

The estimation results are reported in Table 15. In line with the evidence emerging from the previous analyses, firm size exhibits a negative and statistically significant coefficient, indicating that, conditional on growth, larger firms receive a lower relative intensity of public funding compared to smaller firms.

The coefficient associated with firm growth is not statistically significant once the interaction term is included, suggesting that the average effect of growth is not homogeneous across the firm size distribution. The interaction term between size and growth is positive but not statistically significant, indicating the absence of robust evidence of a moderating effect of growth on the relationship between firm size and funding intensity.

	(1) Log(Funding intensity)
Log(Firm size)	−0,870 *
	(0,256)
Growth	1,872
	(9,170)
Log(Firm size) × Growth	1,784
	(2,639)
Constant	6,696**
	(2,634)
Observations	138
R^2	0,183
Adjusted R^2	0,111
Residual Std. Error	2,541
F Statistic	2,54 *

Table 15 – OLS results: heterogeneity analysis

*Notes: Standard errors in parentheses. Significance levels: * p < 0,10,* ** p < 0,05, *** p < 0,01.

Interpretation of heterogeneous effects

The lack of a statistically significant interaction term suggests that the scale-related penalty in funding intensity is relatively uniform across the growth distribution. In other words, larger firms tend to receive a lower intensity of public support regardless of their degree of pre-treatment economic dynamism.

Overall, the heterogeneity analysis confirms and reinforces the findings from the baseline and robustness specifications. While the absolute level of funding is positively associated with firm size, the relative intensity of public support displays a robust and negative relationship with firm size, which is not substantially altered by the inclusion of growth as a source of heterogeneity.

Compared to the baseline results, heterogeneity along the growth dimension therefore appears limited. The absence of a significant interaction term suggests that the negative association between firm size and funding intensity is relatively stable across different growth levels, rather than being concentrated among specific size–growth combinations. These findings suggest that the Transition 5.0 measure does not implement a strongly differentiated selection along the growth dimension when funding intensity is considered, and is consistent with a policy design aimed at balancing support between consolidated productive structures and more dynamic firms, without strongly favoring specific size–growth combinations.

4.3 Discussion

The empirical analyses presented in Section 4.2 have provided a systematic description of the patterns of public support allocation under the Transition 5.0 measure, by relating the intensity of funding received by firms to two central structural characteristics: firm size and pre-treatment growth dynamics. The results show that the absolute level of Transition 5.0 funding is positively associated with firm size, while the relative intensity of support—once normalized by the firm's economic scale—is negatively correlated with size and positively associated with growth. By contrast, the heterogeneity analysis does not reveal statistically robust evidence of these relationships being significantly moderated along the growth dimension.

Taken together, these findings suggest that the mechanisms governing the allocation of public support cannot be reduced to a one-dimensional logic. On the one hand, allocation in absolute terms inevitably reflects scale effects and a concentration of resources on larger productive structures. On the other hand, the distribution of funding intensity appears more favorable to smaller firms and to firms

characterized by stronger economic dynamism. This combination of results points to the coexistence of allocation criteria that can be traced back to different economic logics, rather than to the dominance of a single selection principle. Importantly, these patterns remain largely unchanged when controlling for firms' macro-geographic location. The absence of statistically significant territorial differences suggests that, once firm-level structural and dynamic characteristics are taken into account, the allocation of public support primarily reflects microeconomic heterogeneity rather than geographic factors.

In light of these considerations, this section discusses the empirical results from a broader interpretative perspective. Subsection 4.3.1 revisits the evidence through a Schumpeterian lens, assessing the extent to which the observed patterns are consistent with processes of creative accumulation and creative destruction. Subsection 4.3.2 instead reflects on the policy implications of the observed allocation patterns, focusing on the institutional trade-offs embedded in the design of the measure and on the role of public support in balancing objectives of productive consolidation and economic dynamism.

4.3.1 Interpretation in light of Schumpeterian theory

The empirical results presented in the previous sections can be interpreted in a particularly informative way through a Schumpeterian perspective, which assigns a joint role to processes of creative accumulation and creative destruction in economic development. Within this framework, the dimensions of firm size and pre-treatment growth dynamics represent two conceptually distinct yet interrelated dimensions through which the observed patterns in the allocation of public support can be understood.

The evidence showing that the absolute level of Transition 5.0 funding is positively associated with firm size is consistent with a logic of creative accumulation. In line with a neo-Schumpeterian interpretation, larger firms tend to possess more consolidated organizational, financial, and technological capabilities, which make them better able to absorb substantial volumes of public resources. In this sense, allocation in absolute terms reflects a concentration of support on productive structures characterized by ongoing accumulation processes, without necessarily implying an intentional selection based on efficiency or innovativeness.

However, when funding is expressed in relative terms with respect to the firm's economic scale, the relationship with size reverses. The evidence of a negative association between firm size and funding intensity indicates that, once scale effects are isolated, public support is relatively more relevant for

smaller firms. This finding is consistent with an interpretation in which funding intensity follows a rebalancing logic, potentially playing a compensatory role with respect to size-related constraints, rather than exclusively reinforcing already consolidated firms.

In this context, the absence of a statistically significant association between patent ownership and funding intensity is particularly informative. Patents represent only a formal and codified form of innovation, linked to legally protected technological outputs, while firms' innovative activity may also manifest through process innovation, organizational change, digitalization, and incremental improvements embedded in production routines. The evidence therefore suggests that the Transition 5.0 measure does not explicitly select firms on the basis of formal innovation indicators. Rather, public support appears to be oriented toward broader processes of productive transformation, in which innovation is captured indirectly through growth dynamics and structural characteristics.

At the same time, the relationship between pre-treatment growth and funding intensity is consistently positive and statistically significant in the main specifications without interaction terms, both in the baseline and in the robustness models, indicating that economic dynamism constitutes an informative dimension in the allocation of public support. From a Schumpeterian standpoint, this result is consistent with the idea that firms exhibiting higher growth rates reflect processes of creative destruction, associated with adaptation capacity, experimentation, and technological transformation. This association does not imply that public support generates these dynamics, but rather that they are correlated with the relative distribution of funding.

The heterogeneity analysis further refines this interpretation. The absence of a statistically significant interaction term between firm size and growth suggests that the two mechanisms do not operate in a strongly complementary or substitutive way within the analyzed sample. There is therefore no robust evidence that economic dynamism systematically mitigates the size-related penalty in funding intensity, nor that firm size structurally amplifies or weakens the role of growth. This indicates that creative accumulation and creative destruction coexist as partially independent dimensions in the observed allocation patterns.

Overall, the empirical evidence does not support a univocal interpretation of public support allocation as being oriented exclusively toward incumbent firms or, conversely, toward highly dynamic firms. Rather, the results point to a mixed configuration: allocation in absolute terms primarily reflects accumulation processes, while the relative intensity of support appears more sensitive to economic dynamism, in the absence of a strong interaction between the two dimensions. This coexistence is consistent with a "hybrid" Schumpeterian reading, in which public support is embedded in a

productive system characterized by the simultaneous presence of established firms and more dynamic firms, without a clear prioritization of either mechanism.

4.3.2 Policy implications of observed distribution patterns

The distribution patterns of public support emerging from the empirical analysis offer several relevant insights for reflecting on the policy implications of the Transition 5.0 measure, while fully acknowledging that the results do not allow for causal evaluations of effectiveness. From this perspective, the observed evidence should be interpreted as indicative of the underlying logics shaping the design and implementation of the measure, rather than as normative judgments on its outcomes.

A first relevant aspect concerns the role of firm size. The positive association between firm size and funding in absolute terms suggests that resource allocation is inevitably influenced by scale effects, reflecting the greater ability of larger firms to propose large-scale projects and to absorb substantial volumes of public funding. This feature appears consistent with administrative and institutional constraints typical of investment-oriented policies and does not necessarily imply a distortion in the policy design. However, the evidence that funding intensity is negatively associated with firm size indicates that these scale effects do not translate into a proportional advantage for larger firms.

From this perspective, the measure appears to implicitly incorporate a rebalancing mechanism, whereby public support carries a relatively greater economic weight for smaller firms. This configuration suggests that the policy design is not exclusively oriented toward reinforcing already consolidated productive structures, but also allows smaller firms to benefit from a level of support that is significant relative to their economic scale. This aspect is particularly relevant in contexts where smaller firms may face greater difficulties in accessing alternative sources of financing for innovative investments.

A second dimension of reflection concerns the role of pre-treatment economic growth. The positive association between growth and funding intensity observed in the baseline and robustness specifications suggests that competitive dynamism may function as an informative, albeit not formalized, criterion in the distribution of public support. From a policy standpoint, this indicates that the Transition 5.0 measure does not appear neutral with respect to firms' past performance, but tends to channel a relatively larger share of resources toward firms characterized by stronger expansion and adaptive capacity.

At the same time, the absence of a statistically robust interaction between size and growth in the heterogeneity analysis suggests that the policy design does not implement a sharply differentiated selection along specific combinations of scale and dynamism. In other words, there is no evidence of explicit targeting toward firms that are simultaneously large and dynamic, nor toward small but high-growth firms. This result can be interpreted as indicative of a relatively neutral approach, in which public support does not systematically amplify specific development trajectories, but is instead distributed across multiple structural dimensions of the productive system.

Overall, the empirical evidence suggests that the Transition 5.0 measure is characterized by a balance between potentially competing objectives: on the one hand, the need to support large-scale investments, often associated with larger firms; on the other hand, the need to avoid penalizing smaller and more dynamic firms, for which the relative intensity of public support may be economically more consequential. This configuration appears consistent with a policy design oriented more toward the diffusion and consolidation of productive transformation processes than toward the targeted selection of specific industrial "champions."

Finally, the absence of sharp discontinuities in the observed distrbution patterns suggests that any future interventions aimed at strengthening the targeting of the measure should be evaluated with caution. In particular, a stronger selective orientation toward specific categories of firms may involve trade-offs in terms of allocative equity and absorptive capacity. In this sense, the results presented here indicate that the current configuration of the measure allows—at least at a descriptive level—for a balance between efficiency considerations, inclusiveness, and institutional neutrality.

5. Conclusions

This thesis has analyzed the Transition 5.0 measure as an instrument of industrial policy, with the aim of understanding how public support is allocated among firms characterized by different structural and dynamic profiles. Positioned within the broader debate on the return of industrial policy in advanced economies and within the institutional framework of the NRRP, the study has focused not on the effects of the policy, but on the empirical logics underlying the distribution of public resources.

The analysis has adopted an explicitly descriptive perspective, based on the idea that the allocation of public support is not a neutral outcome, but reflects implicit criteria, administrative constraints, and institutional priorities. In this sense, the intensity of public funding has been interpreted as an informative variable, useful for understanding which types of firms intercept public support and along which dimensions it is distributed.

The theoretical reference to the Schumpeterian tradition has provided a unifying interpretative key for the analysis. The distinction between creative accumulation and creative destruction has made it possible to interpret firm size and growth dynamics as expressions of two complementary modes of participation in processes of structural change, rather than as simple economic controls.

The empirical results show that the Transition 5.0 measure is characterized by a complex allocation logic. On the one hand, funding tends to concentrate in absolute terms on larger firms; on the other hand, the relative intensity of support appears more favorable to smaller firms and to those displaying greater economic dynamism. This configuration suggests that the measure is not oriented according to a single selective principle, but reflects a balance between different logics.

The sections that follow systematically summarize the main empirical findings (Section 5.1), provide an explicit answer to the research question and to the hypotheses formulated (Sections 5.1.1 and 5.1.2), discuss the limitations of the analysis (Section 5.2), and outline possible directions for future research (Section 5.3).

5.1 Summary of Findings

The empirical analyses developed in the previous chapters make it possible to outline a structured and coherent picture of the distribution patterns of public support under the Transition 5.0 measure. While maintaining an explicitly descriptive and non-causal perspective, the results show that the

distribution of public resources is not random, but instead reflects systematic regularities linked to pre-existing economic characteristics of beneficiary firms.

A first key element emerging from the analysis concerns the need to distinguish between the absolute level of funding and its relative intensity, that is, the economic weight of public support with respect to firm scale. This distinction proves crucial for correctly interpreting the empirical evidence and for avoiding partial readings based solely on the amounts received. In absolute terms, NRRP funding associated with the Transition 5.0 measure is positively correlated with firm size: larger firms tend to capture higher volumes of public resources. This result is consistent with the descriptive evidence and reflects scale mechanisms widely documented in public investment policies, related to the greater project, organizational, and financial capacity of larger firms.

However, the analysis shows that this relationship changes substantially when funding is expressed in relative terms with respect to the firm's economic scale. Once funding is normalised by pre-treatment revenues and a logarithmic transformation is adopted to reduce the influence of extreme values, the intensity of public support is negatively associated with firm size. This finding indicates that, net of scale effects, public support carries a relatively greater economic weight for smaller firms, suggesting the presence of an distribution mechanism that does not proportionally reinforce already consolidated structures.

Alongside firm size, pre-treatment growth dynamics emerge as a second relevant factor in the distribution of public support. In the baseline specifications and in the robustness checks, the compound annual growth rate (CAGR) of revenues shows a positive association with funding intensity. This result suggests that firms characterised by greater economic dynamism tend to receive relatively higher levels of public support, independently of their size. Growth, in this sense, appears as an informative dimension in the selection of beneficiaries, consistent with the idea that more dynamic firms reflect processes of adaptation, renewal, and productive transformation.

The heterogeneity analysis, which explicitly introduces the interaction between size and growth, further qualifies these results. The absence of a statistically significant interaction term indicates that the two factors do not operate in a strongly complementary or substitutive way in determining funding intensity. In other words, the size-related penalty observed in the relative intensity of public support is not systematically attenuated or amplified by the firm's growth performance. This finding suggests that size and economic dynamism represent two distinct dimensions of firm heterogeneity, which influence the distribution of public support without generating strong joint effects.

Taken together, these results portray an industrial policy measure characterised by a non-unidimensional allocation logic. On the one hand, distribution in absolute terms reflects unavoidable scale effects and a concentration of resources on larger firms; on the other hand, the distribution of relative funding intensity appears more favourable to smaller firms and to those characterised by greater economic dynamism. This combination of evidence suggests that the Transition 5.0 measure incorporates elements consistent with both creative accumulation processes and creative destruction dynamics, without a clear predominance of either mechanism.

In sum, the empirical section of the thesis shows that public support does not merely reinforce incumbent firms mechanically, nor does it exclusively target highly dynamic firms. Rather, it is distributed along multiple structural dimensions of the productive system. This configuration provides the interpretative basis for answering the research question and for assessing the degree of consistency between the observed patterns and the hypotheses formulated, issues that are addressed in the following subsections.

5.1.1 Answer to the research question

The research question guiding this work concerns how public support under the Transition 5.0 measure is allocated across firms that differ in size and growth dynamics, and to what extent these patterns reflect logics related to processes of creative accumulation and creative destruction. More specifically, the objective was not to establish whether public funding produces economic effects on beneficiary firms, but rather to understand which pre-existing characteristics are systematically associated with a higher intensity of public support and what interpretative implications follow for the understanding of contemporary industrial policy.

In light of the empirical evidence presented in Chapters 3 and 4, it is possible to provide a structured answer to this question. The results first show that the allocation of public funding is not neutral with respect to the structure of the productive system. In absolute terms, the Transition 5.0 measure tends to concentrate a significant share of resources on larger firms, suggesting that productive scale represents a relevant factor in the ability to access large amounts of public funding. This result is consistent with the idea that larger firms possess greater organizational resources, administrative competences, and project-design capacities, which facilitate access to complex and selective policy instruments.

However, an interpretation based solely on absolute amounts would risk providing an incomplete and potentially misleading picture of the distribution criteria of the measure. When public funding is

expressed in relative terms with respect to firm economic scale, a substantially different picture emerges. Funding intensity is negatively associated with firm size, indicating that, net of scale effects, public support carries a greater economic weight for smaller firms. This result suggests that the measure does not merely proportionally reinforce already consolidated firms, but also allows smaller firms to benefit from relatively more significant support.

Alongside size, pre-treatment growth dynamics represent a second key element in answering the research question. The positive association between growth and funding intensity, observed in the baseline specifications and confirmed by robustness exercises, indicates that firms characterized by greater economic dynamism tend to capture a relatively higher share of public support. This finding is consistent with a reading of the policy that is sensitive to processes of renewal, adaptation, and productive transformation, typically associated with the Schumpeterian notion of creative destruction.

Overall, the empirical evidence suggests that the Transition 5.0 measure is not exclusively oriented toward a single type of firm. The distribution of public support instead reflects a combination of criteria: on the one hand, a concentration in absolute terms on larger firms, coherent with logics of creative accumulation; on the other hand, a distribution of funding intensity that is more favorable to smaller and more dynamic firms, compatible with processes of creative destruction. This configuration indicates that public support is positioned in an intermediate area between reinforcing existing productive structures and supporting competitive dynamism.

An additional element emerging from the analysis concerns the absence of a strong interaction between size and growth. The results do not provide robust evidence of a differentiated effect of growth along the firm size distribution, nor of a systematic modulation of the size-related penalty as a function of economic dynamism. This suggests that the two factors operate as relatively independent dimensions in the observed distribution patterns, without a targeted selection toward specific combinations of scale and growth.

In light of these findings, the answer to the research question can be summarized as follows: the Transition 5.0 measure can be interpreted as an industrial policy instrument characterized by a selective but not univocal orientation, in which public support is allocated along multiple structural dimensions of the productive system. Distribution in absolute terms primarily reflects scale effects and accumulation processes, while the relative intensity of funding is more sensitive to firms' economic dynamism. This combination of patterns suggests that the policy does not make a sharp

choice between incumbent and emerging firms, but operates within a heterogeneous productive context, attempting to balance consolidation needs with processes of transformation.

5.1.2 Hypotheses verification

The empirical work developed in this thesis has been guided by a set of interpretative hypotheses formulated on the basis of the Schumpeterian theoretical framework and the recent literature on the return of industrial policy. These hypotheses were not intended to be tested in a causal sense, but rather to provide a conceptual grid through which to interpret the distribution patterns of public support associated with the Transition 5.0 measure. The assessment of the hypotheses should therefore be understood as an evaluation of the coherence between the observed empirical evidence and the theoretical expectations formulated ex ante.

The first hypothesis concerned the role of firm size as a proxy for processes of creative accumulation. In particular, it was hypothesized that larger firms would tend to capture higher levels of public funding, reflecting an distribution logic favorable to consolidated productive structures. The empirical results confirm this hypothesis when funding is considered in absolute terms. The positive and statistically significant association between firm size and the total amount of NRRP funding indicates that productive scale represents a relevant factor in the distribution of resources. This result is consistent with a view of industrial policy in which incumbent firms play a central role in absorbing large public investments, especially in the context of complex and project-intensive programs such as Transition 5.0.

However, the assessment of this hypothesis changes substantially when funding is expressed in relative terms. The evidence of a negative relationship between firm size and funding intensity, once funding is normalized by revenues, suggests that scale effects do not translate into a proportional advantage for larger firms. This result does not invalidate the initial hypothesis, but rather delimits its scope of application: size matters in explaining the concentration of resources in absolute terms, but it does not imply a higher intensity of public support relative to economic scale. In this sense, the hypothesis related to creative accumulation is partially confirmed and must be interpreted conditionally on the measure of funding adopted.

The second hypothesis concerned the role of growth dynamics as an indicator of processes of creative destruction. It was hypothesized that firms characterized by higher pre-treatment growth would tend to receive a higher intensity of public support, reflecting a selection favorable to dynamic and transforming firms. The empirical results consistently support this hypothesis. In all main

specifications, growth shows a positive association with funding intensity, suggesting that economic dynamism represents a relevant informational dimension in the allocation of resources.

It is important to emphasize that this evidence does not imply that public funding promotes growth, nor that growth is the result of the support received. The interpretation remains explicitly non-causal. However, the fact that firms with stronger growth trajectories capture a relatively larger share of resources indicates that the policy is not neutral with respect to past performance and tends to interact with renewal dynamics already underway. In this sense, the hypothesis linked to creative destruction can be considered substantially confirmed at the descriptive level.

A third, more exploratory hypothesis concerned the possible interaction between size and growth. In particular, it was hypothesized that economic dynamism might moderate the role of productive scale, for example by attenuating the size-related penalty in funding intensity or by reinforcing the advantage of large and dynamic firms. The heterogeneity analysis, however, does not provide robust evidence in support of this hypothesis. The interaction term between size and growth is not statistically significant, and the analysis of marginal effects indicates that the negative relationship between size and funding intensity is relatively stable along the growth distribution.

This result suggests that creative accumulation and creative destruction operate as largely independent dimensions in the observed distribution patterns. The absence of strong complementarity or substitutability between scale and dynamism implies that the Transition 5.0 measure does not engage in explicit targeting toward specific combinations of productive characteristics. Consequently, the hypothesis of a strongly interactive selection between size and growth does not find empirical support in the analyzed sample.

Overall, the assessment of the hypotheses confirms the relevance of the adopted theoretical framework, while also highlighting its non-dichotomous nature. The evidence does not support an interpretation of industrial policy as being oriented exclusively toward consolidated incumbents, nor, alternatively, as an instrument aimed solely at supporting emerging and high-growth firms. Instead, the results indicate a hybrid configuration, in which different allocation logics coexist without one clearly prevailing over the others.

This conclusion reinforces the interpretation of the Transition 5.0 measure as a selective but not rigidly directed industrial policy instrument, capable of interacting with the heterogeneity of the productive system without imposing a single development trajectory. In this sense, the assessment of the hypotheses not only concludes the empirical path of the thesis, but also clarifies the interpretative

role of Schumpeterian theory as a useful analytical lens for understanding the underlying logics of public support allocation.

5.1.3 Institutional interpretation of distribution patterns: insights from policy design

To interpret more comprehensively the empirical results presented in the previous sections, it is useful to compare them with the policy logics emerging from the design and implementation of the Transition 5.0 Plan. In this regard, a relevant qualitative contribution is provided by the interview conducted with Dr. Raffaele Spallone, Head of Division II "Policies for the Digitalization of Firms, Innovation and Analysis of Productive Sectors" at the Ministry of Enterprises and Made in Italy (MIMIT), who is directly involved in the implementation and communication of the measure to firms and institutional stakeholders.

This institutional perspective makes it possible to link quantitative observations with the mechanisms that informed the design and management of the measure. In particular, the interviewee confirms that Transition 5.0 was conceived as a horizontal measure, without binding sectoral or territorial selection criteria, aimed at promoting investments in digital technologies, energy efficiency, and training through a tax credit mechanism.

The interview highlights the absence of explicit ex ante targeting toward specific categories of beneficiaries. As emphasized by the interviewee, Transition 5.0 was designed as a general measure, based on a tax credit mechanism rather than on discretionary selection of beneficiaries. From this perspective, there was no explicit trade-off across size, sectoral, or territorial categories, nor any prior estimate of the distribution of beneficiaries. However, the absence of formal selective criteria does not imply substantive neutrality of the measure. On the contrary, the design of the instrument introduces a set of implicit requirements related to project complexity, administrative capacity, and the ability to anticipate investments, which tend to favor firms endowed with a stronger pre-existing accumulation base.

This institutional reading is consistent with the empirical results presented in Chapters 3 and 4, which show that firm size is strongly associated with the probability of accessing funding and with the absolute amount of resources received. In this sense, accumulation does not emerge as a normative selection criterion, but rather as a de facto condition for access to the instrument. As highlighted in the interview, this feature is common to industrial policy measures based on complex tax incentives, where the absorptive capacity of firms represents a crucial factor.

At the same time, the interview helps interpret the result that smaller and more dynamic firms receive a relatively higher funding intensity. According to Dr. Spallone, despite the absence of an explicit redistributive design, the measure eventually reached a broad set of firms, including many SMEs, also thanks to specific regulatory adjustments introduced during the implementation phase. Among these, an important role was played by the simplification of energy certification requirements and by the introduction of the "obsolete asset" clause, which reduced the technical complexity of access and expanded participation to less structured firms.

In this framework, the reward to dynamism observed in the empirical results can be interpreted as an emergent effect of the structure of the measure rather than as an explicit targeting objective. Firms characterized by stronger growth trajectories appear better able to translate the incentive into investment projects consistent with policy objectives, thus obtaining relatively more intense support compared to their economic scale. However, as also emphasized by the empirical evidence, this mechanism is not sufficient to offset structural asymmetries related to size: dynamism operates on the intensity of support, but within an access structure that remains strongly conditioned by prior accumulation.

The interview also provides useful elements to interpret the absence of a significant correlation between patent activity and access to funding. According to the interviewee, the decision not to use formal innovation indicators as a central criterion reflects both the intention not to excessively restrict the pool of beneficiaries and the horizontal nature of the measure, which is oriented toward investments in capital goods functional to digitalization and energy savings rather than to research and development projects in a strict sense. This helps explain why, unlike more targeted measures such as the R&D tax credit, Transition 5.0 reaches a heterogeneous set of firms, not necessarily characterized by high patenting activity.

Overall, the comparison between empirical evidence and the institutional perspective reinforces the interpretation of Transition 5.0 as an industrial policy characterized by a dual logic of selectivity: accumulation represents a necessary condition for access to the instrument, while economic dynamism is rewarded in terms of the relative intensity of support. However, this combination does not substantially alter the structural hierarchy of the productive system, but operates within pre-existing constraints. In this sense, the observed results do not appear as an unexpected or distortive outcome, but rather as a coherent consequence of the policy's design and implementation conditions.

5.2 Limitations

While offering a systematic and coherent reading of the distribution patterns of public support under the Transition 5.0 measure, the present work is subject to several limitations that should be made explicit, both for a correct interpretation of the results and for situating the contribution of the analysis within its methodological and informational boundaries.

A first limitation concerns the nature of the data used. The empirical analysis is based on a cross-sectional sample of beneficiary firms observed at a single point in time. This data structure does not allow for the analysis of firms' dynamic evolution, nor does it permit observation of how public support may interact over time with trajectories of growth, investment, or productive restructuring. Consequently, the study is not able to capture possible medium-long term effects of the policy, nor to distinguish between transitory dynamics and persistent structural changes.

A second limitation, strictly connected to the previous one, concerns the absence of a control group. The analysis focuses exclusively on the firms benefiting from the measure and does not include comparable non-beneficiary firms. This choice is consistent with the descriptive objective of the work, but implies that it is not possible to compare the observed patterns with those of firms excluded from support, nor to evaluate whether the implicit allocation criteria differ in a systematic way with respect to the overall universe of firms. Therefore, the results do not allow to infer anything about the selectivity of the measure in a causal or counterfactual sense.

A third limitation concerns the measurement of the key variables. Although firm size and growth dynamics are widely used proxies in the literature to capture, respectively, processes of creative accumulation and competitive dynamism, they do not exhaust the complexity of these concepts. Other relevant dimensions — such as innovation intensity, the quality of submitted projects, or firms' organizational and managerial characteristics — are not observable in the data used and therefore cannot be included in the analysis. In particular, patent ownership is used as a proxy for innovative activity, but it represents only a partial measure that does not capture forms of process, organizational, or digital innovation, which may be central for a measure such as Transition 5.0.

A further limitation concerns the possible presence of unobserved factors influencing the allocation of public support. Elements such as administrative criteria and procedural constraints may play a relevant role in the distribution of resources but are not explicitly modeled. Although the analysis interprets the estimated coefficients as conditional associations, the presence of such unobserved

factors further limits the possibility of assigning a strong structural meaning to the identified empirical relationships.

It is moreover important to highlight that the analysis focuses on a single industrial policy measure, placed within a specific institutional and temporal context. Consequently, the results obtained cannot be automatically extended to other policies, to other countries, or to different historical phases. The Transition 5.0 measure in fact presents distinctive features, linked both to the NRRP framework and to the objectives of digital and ecological transition, which give the analysis a strongly contextualized character.

Taken together, these limitations do not reduce the relevance of the contribution offered, but rather define in an appropriate way its interpretative boundaries, strengthening the coherence of the work with its explicit descriptive and non-causal orientation.

5.3 Directions for Future Research

The results presented in this work, despite their descriptive and non-causal nature, open several avenues for future research that can contribute to a deeper understanding of the role of contemporary industrial policy and, more generally, of the mechanisms through which public support interacts with firm heterogeneity. The evidence that has emerged suggests that the Transition 5.0 measure does not simply distribute resources in a neutral manner, but reflects complex allocation logics that deserve to be further explored using complementary tools and data.

A first direction for future research concerns extending the analysis into a temporal perspective. The present study is based on cross-sectional data, a choice driven both by data constraints and by the analytical objective of focusing on the initial allocation patterns of the measure. However, as the implementation of the NRRP progresses and longitudinal data become available, it would be possible to develop panel analyses capable of observing the evolution of beneficiary firms over time. This would not only strengthen the descriptive analysis, but also allow movement toward more ambitious empirical designs, aimed at more clearly distinguishing between ex ante selection and potential dynamic effects of public funding.

Within this perspective, a particularly relevant line of research would consist in examining whether, and to what extent, the observed allocation patterns translate into differentiated performance trajectories in the medium term. Without necessarily adopting a fully rigorous causal approach, future studies could analyze the persistence of growth, investments in physical and intangible capital, or

changes in firms' employment structures, relating these dynamics to the intensity of support received. This would make it possible to connect more directly the allocation logics of the policy to the structural transformations of the productive system.

A second line of research concerns the comparison between Transition 5.0 and other industrial policies, both within the NRRP and in analogous international contexts. The use of a comparative perspective would make it possible to understand whether the allocation patterns that emerged are peculiar to the measure examined or instead express more general orientations in the way industrial policies are conceived today. In particular, a comparison with similar programs adopted in other European countries could help clarify the degree of convergence or divergence in public support strategies, offering useful insights also in terms of policy coordination at the supranational level.

Finally, a more conceptual research direction concerns the dialogue between empirical analysis and industrial policy theory. The empirical evidence presented makes it possible to identify certain regularities in the distribution mechanisms of the Transition 5.0 measure, while at the same time highlighting the limits of an exclusively descriptive approach in fully representing the complexity of the processes through which public support intertwines with the structure of the productive system.

From this perspective, the main contribution of the thesis consists in having promoted a reflection on industrial policy as a non-neutral factor, capable of interacting with firm heterogeneity and of incorporating, even implicitly, choices concerning the orientation of economic development. Continuing along this research direction implies analyzing more systematically how such policies may affect, over time, the evolution of productive trajectories, the relationships between established firms and emerging dynamics, and the balance between consolidation objectives and structural transformation. In this sense, the work is situated within a broader stream of studies aimed at understanding the role of contemporary industrial policies in shaping long-term processes of economic change.

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Appedix A - Dataset Construction and Matching

A.1 Data sources

The dataset used in the empirical analysis is constructed through the integration of two main information sources:

1. Public administrative data from the OpenPNRR portal, relating to projects financed under the Transition 5.0 measure;
2. Firm-level economic-financial and structural data from the Orbis database (Bureau van Dijk).

The OpenPNRR database provides information at the project and beneficiary-firm level, including: firm name, sector of activity (ATECO code), geographical location, and total amount of funding granted.

The Orbis database instead provides harmonized information on firms' financial statements and structural characteristics, in particular historical series of operating revenues and number of employees, used for the construction of size and growth dynamics variables.

A.2 Firm-level Matching Procedure

The two datasets do not share a unique firm identifier (such as tax code or VAT number). For this reason, the integration was carried out through a matching procedure based on the firm name.

The procedure was structured in three main stages:

1. Standardization of firm names
2. Automatic matching
3. Manual validation of results

A.3 Standardization of Firm Names

To reduce differences due to graphical formats, punctuation, or legal designations, firm names were subjected to a cleaning and normalization procedure, including:

- conversion of all characters to uppercase;
- removal of punctuation marks (dots, commas, hyphens, etc.);

- elimination of legal forms (e.g., S.R.L., S.P.A., SRL, SPA, LTD, etc.);
- removal of multiple spaces and special characters.

This procedure made the text strings more homogeneous and increased matching accuracy.

A.4 Matching automatico e controllo manuale

After standardization, an automatic matching based on exact name correspondence between the two sources was performed.

The results obtained were subsequently subjected to manual validation, in order to:

- avoid false positives (different firms with similar names);
- identify any missed matches due to minor residual differences in names.

This phase proved particularly relevant given the absence of common unique identifiers across the two datasets.

A.5 Sample Selection Criteria

Following the integration of the sources, the initial sample of beneficiary firms was further restricted based on the availability and quality of economic data.

Only firms for which the following conditions were met were included in the analysis:

- sufficiently continuous revenue series were available for the period 2017–2024;
- data on the number of employees were available for the same period;
- the matching between OpenPNRR and Orbis was unambiguous.

Firms characterized by highly fragmented or inconsistent series were excluded.

A.6 Treatment of Missing Values

In the presence of a limited number of missing values in revenue or employee series, missing values were treated through a simple imputation rule, replacing them with the value observed in the temporally closest year.

This choice allows the preservation of series continuity without introducing strong structural assumptions or complex estimation models, maintaining coherence with the descriptive and allocative objective of the analysis.

Appendix B - Variable Definitions

B.1 Dependent Variables

Funding (Funding)

It represents the total amount of public resources received by each beneficiary firm under the Transition 5.0 measure. It is calculated as the sum of all funded projects associated with the same firm in the OpenPNRR database. The unit of measurement is the euro.

Log(Funding)

Given the strong asymmetry in the distribution of funding, the dependent variable used in the econometric models is the natural logarithm of the total amount received:

$$\log(\text{Funding})_i = \ln(Funding_i)$$

The use of the logarithmic transformation allows to reduce the distortion due to extreme values, improve the statistical properties of the distribution and interpret the results in terms of relative rather than absolute variations.

B.2 Main Independent Variables

Firm Size (Size) *— proxy of creative accumulation*
Size is measured through the average number of employees observed in the period 2017–2024:

$$Size_i = \frac{1}{T} \sum_{t=2017}^{2024} Employees_{it}$$

where T represents the number of years with available data. This variable is interpreted as a structural indicator of:

- consolidated productive capacity;
- accumulation of organizational and human capital;
- positioning of the firm in the productive structure.

It does not directly measure innovative capacity, but the outcome of cumulative growth paths.

Firm Growth (Growth) *— proxy of creative destruction*

Dynamism is measured through the compound annual growth rate of revenues (CAGR) in the period 2017–2024:

$$Growth_i = \left(\frac{Revenue_{i,2024}}{Revenue_{i,2017}} \right)^{\frac{1}{7}} - 1$$

This measure summarizes medium-term economic dynamics, attenuating the effect of temporary shocks or isolated annual variations. Revenue growth is interpreted as a signal of:

- expansion of economic activity;
- competitive adaptation;
- potential capacity for restructuring and productive transformation.

B.3 Interaction Variables

To capture the possible coexistence between accumulation and creative destruction dynamics, the models include an interaction term:

$$Size_i \times Growth_i$$

This variable allows to verify whether the effect of growth on funding varies according to firm size, distinguishing between dynamic large firms, high-growth small firms, stable large firms, and low-growth small firms.

B.4 “Pre-treatment” Nature of the Variables

The variables Size and Growth are constructed using information referring to the period preceding the full disbursement of funding, in order to avoid capturing effects of public policy and to interpret the observed associations as an expression of implicit allocation criteria.

Appendix C - Econometrics Specifications

C.1 Baseline Model

The reference model is a linear regression estimated through Ordinary Least Squares (OLS):

$$\log(Funding_i) = \beta_0 + \beta_1 \log(Size_i) + \beta_2 Growth_i + \sum_{s=1}^{S-1} \gamma_s Sector_{is} + \varepsilon_i$$

where:

- log(Fundingi) is the natural logarithm of the total amount of funding received by firm *i*;
- Sizei is the average firm size (average number of employees in the period 2017–2024);
- Growthi is the compound annual growth rate of revenues (CAGR) in the period 2017–2024;
- Sectoris is a set of sector dummy variables (ATECO classification) taking value 1 if firm I belongs to a sector s and 0 otherwise (manufacturing sector is taken as a reference group);
- ys represents sector fixed effects, capturing structural differences across industries;
- εi is the error term.

This model allows to analyze whether the intensity of public support is associated separately with firm size (accumulation) and economic dynamism (creative destruction).

C.2 Robustness Checks

For robustness purposes, alternative specifications are estimated including additional control variables, where available, such as:

- funding intensity;
- log(funding intensity;
- geographical location (macro-area);
- indicators of technological structure, in this particular case patents.

C.3 Interaction Model

To capture the possible coexistence between accumulation and creative destruction dynamics, a specification including an interaction term is estimated:

$$\log(FI_i) = \beta_0 + \beta_1 \log(Size_i) + \beta_2 Growth_i + \beta_3 (\log Size_i \times Growth_i) + Sector\ FE + \varepsilon_i$$

The coefficient β3 measures whether the association between growth and funding varies with firm size. This specification allows to distinguish between different allocative configurations, for example:

- prevalence of accumulation logics (funding concentrated on large firms);
- prevalence of creative destruction logics (funding associated with growth independently of size);
- coexistence of the two dynamics.

C.4 Associative Nature of the Analysis

It is appropriate to underline that a control group of non-beneficiary firms is not present, the data are observed in cross-section and causal identification strategies are not adopted.

Consequently, the estimated coefficients are not interpreted as causal effects of the policy, but as conditioned associations that allow the reading of the implicit allocation criteria of the Transition 5.0 measure.

C.5 Interpretations of the Coefficients

Given the use of the dependent variable in logarithmic form, the coefficients can be interpreted as approximate percentage variations in funding associated with unit variations in the explanatory variables. Furthermore, attention is focused on the sign and statistical significance of the coefficients, in relation to the theoretical hypotheses H1 (accumulation) and H2 (creative destruction).