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# **LEGALITY AND ECONOMIC GROWTH: THE IMPACT OF WHITE LISTS ON TUSCAN BUSINESSES**

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## **Introduction**

The relationship between legality and firm performance has become an increasingly important topic in current economic and policy research. In a globalised economy characterised by complex supply chains and intense competition, the quality of legal and institutional frameworks strongly influences how firms operate, invest, and grow. When the rule of law is weak or inconsistently enforced, markets are distorted, competition becomes unfair, and public trust deteriorates. Conversely, in environments where legal compliance is effectively promoted and monitored, businesses benefit from greater stability, transparency, and access to resources. Legality, therefore, is not only a normative or moral principle; it is an economic asset and a key determinant of sustainable development.

The pervasive infiltration of organised crime in the economy has long posed substantial challenges to market integrity, economic development, and public trust in institutions.

In recent years, the question of how legality interacts with economic activity has attracted growing attention in public debate and academic inquiry. Across Europe, policymakers have increasingly recognised that economic growth cannot be sustained without strong institutions capable of ensuring transparency, fairness, and the rule of law. There is a large body of literature exploring this nexus, demonstrating that the quality of the environment in which firms operate is a decisive factor in sustainable territorial growth. It is widely documented that illicit behaviour (crime, corruption, organised crime infiltration) has economic and social costs. Widespread illegality curbs investment and growth, exacerbates firms' financial constraints, and reduces public revenue; moreover, the resulting damage extends beyond public finances, as it also erodes social trust, discourages investment, and weakens competitiveness. Operating in legal environments, by contrast, would produce evident improvements in public accounts and promote healthy competition among economic actors.

Governments, therefore, implement measures to mitigate the adverse effects of illegality. The Italian Parliament's Antimafia Commission estimated that the illicit turnover linked to organised crime reached approximately €150 billion in 2012, underscoring the gravity of this issue for both national and regional economies. In response, Italian authorities have implemented a range of preventive and punitive policies aimed at curtailing mafia influence and fostering legality in business operations. Certainly, the most significant intervention in Italy was the approval of the new Antimafia Code enacted in 2011, which introduced a series of significant innovations and modifications to the previous code to enhance the efficacy of the fight against organised crime. Among these innovations, legal certifications have emerged as strategic tools to promote compliance, transparency, and trust in economic transactions.

One such mechanism is the so-called *White Lists* (WL), which are the focus of this study. These are lists of companies established in each Italian prefecture by Law 190/2012. Any firm operating in the sectors considered to be at highest risk of mafia infiltration can apply for registration. Inclusion in a White List certifies a firm's freedom from any form of criminal infiltration; only firms that meet the prescribed legality requirements may be registered. In this sense, WL registration can be considered a sort of government certification of legality. The purpose of the White Lists is precisely to facilitate anti-mafia controls, particularly for business activities especially vulnerable to criminal infiltration. For this reason, enrolment in a White List is strongly recommended (and in many cases mandatory) for specific categories of firms wishing to obtain contracts or subcontracts with public authorities. For these businesses, the certification streamlines procedures, eliminating the need for additional anti-mafia documentation. However, even for companies that do not intend to participate in public procurement or work with government bodies, registration serves as a safeguard in dealings with third parties, including relations between private entities.

This research arises from the need to better understand how public policies designed to promote legality translate into concrete outcomes for businesses. The objective is to investigate whether registration in the White Lists confers measurable advantages to firms, not only in the context of public procurement but also in broader business operations. In environments where illegality is widespread, official certification of a firm's legitimacy serves as a powerful mechanism. It signals legal compliance and strengthens trust among external stakeholders, including potential business partners and suppliers. Legality certifications thus function as third-party assurances that reduce information asymmetry and facilitate access to key resources such as credit and markets. The existing literature on legality certifications underscores their importance in enhancing market transparency, promoting fair business practices, and deterring criminal infiltration and corruption. Although recent contributions have begun to explore the impact of legality certifications, such as the White Lists, evidence on their actual effects on firms and market behaviour remains limited. This thesis contributes to the debate by examining whether and how legality relates not only to ethics and governance but also to measurable improvements in business outcomes.

The primary hypothesis of this study is that inclusion in the White Lists is associated with improved firm performance among certified firms compared with eligible but non-certified ones. To address this issue, the thesis investigates the economic impact of white list certification on firms, using Tuscany as a case study.

Tuscany was selected because it is a region characterized by a dense network of small and medium-sized enterprises embedded in traditional industrial districts but also exposed to organised crime's subtler forms of economic infiltration. While Tuscany is often perceived as relatively insulated from mafia dominance compared to Southern Italy, its economic fabric remains vulnerable to illicit activities, especially in sectors including construction, tourism, and environmental services. Tuscany presents a particularly relevant case, as it combines a socio-economic model rooted in trust and cooperation, yet exposed to the risks of criminal infiltration. Within this context, inclusion in the White Lists is more than a bureaucratic requirement; it embodies a strategic decision reflecting a firm's commitment to transparency and lawful conduct.

By constructing a unique firm-level dataset merging white list registration records from Tuscan Prefectures with detailed financial data from the AIDA database, this study employs econometric techniques, including linear regression analysis and propensity score matching, to assess whether certified firms demonstrate higher economic performance relative to comparable non-certified firms. Specifically, data are collected on all firms registered in the White Lists in Tuscany, from their introduction until 2023. After selecting a suitable treatment group, propensity score matching is used to select a control group of firms with the same characteristics as the WL firms. The regression model compares WL and non-WL companies, using *EBITDA per employee* as indicator of economic performance. This measure is defined as earnings before interest, taxes, depreciation, and amortisation (EBITDA) divided by the number of employees. It is a size-neutral metric that captures operating profitability relative to workforce productivity. While the literature employs diverse alternatives, such as profitability ratios, credit access indicators, or sales over total assets<sup>1</sup>, this analysis uses EBITDA per employee as the main outcome. Compared with alternative indicators that are potentially influenced by capital intensity and fixed-asset structures, especially in SME-dominated districts such as those in Tuscany, EBITDA per employee offers a more suitable measure of firm performance.

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<sup>1</sup> The existing literature adopts a variety of alternative performance measures, including profitability ratios and indicators of access to credit. In particular, a recent study by Alfano et al. measures performance as the logarithm of sales over total assets, a commonly employed index. See Alfano, M.R., Cantabene, C., De Iudicibus, A. (2024), "The effectiveness of a certification of legality. Evidence from Italian firms", *MPRA*, Paper No. 12306, <https://mpra.ub.uni-muenchen.de/120306/>. Rice, J., Liao, T.-S., Galvin, P., & Martin, N. (2015), "A configuration-based approach to integrating dynamic capabilities and market transformation in small and medium-sized enterprises to achieve firm performance", *Int. Small Bus. J.*, 33(3), 231-253. Giannarakis, G. (2014), "Corporate governance and financial characteristic effects on the extent of corporate social responsibility disclosure", *Soc. Resp. J.*, 10(4), 569-590.

This metric is particularly informative in contexts where value creation depends primarily on human capital, allowing for more size-neutral comparisons across firms<sup>2</sup>. A secondary indicator, the *EBITDA-to-assets ratio*, is introduced solely as a robustness check for capital efficiency (Section 4.5).

Thus, the research offers a novel contribution to the existing literature by evaluating the economic effects of white list certification for firms and offering significant insights into how legality instruments can counter organised crime within the legitimate economy.

The analysis reveals that registration is positively associated with improved business performance, as measured by higher EBITDA per employee among Tuscan firms compared with similar companies non-registered on the White Lists. These findings underline that white list certification is not only a tool for safeguarding legality but also an effective mechanism for strengthening firms' competitive position within their business environment.

The rest of the thesis is structured in four main chapters. Chapter 1 establishes the conceptual framework by analysing the role of legality in economic systems and defining the research scope. It also introduces the Tuscan context, examining how regional characteristics influence the interactions between legality and economic practices, and formulates the main research objectives.

Chapter 2 introduces the White Lists as an anti-mafia policy tool, clarifying their legal foundations, operational procedures, and importance for firms. Furthermore, it reviews the existing literature on legality certifications and their relationship with firm performance, with particular emphasis on the White Lists.

Chapter 3 presents the dataset and describes the characteristics of Tuscan firms included in the analysis, highlighting key differences between registered and non-registered companies.

The methodological choices and statistical results are presented in Chapter 4, which explains the econometric models employed, discusses the results obtained from the analysis, and presents some robustness checks.

The thesis concludes with a summary of the main findings, a discussion of their implications for policy and future research, and reflections on the broader significance of legality as a driver of economic development.

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<sup>2</sup> Camuffo, A. (2017, June 20), "The impact of lean on the financial performance of an SME", *Planet Lean*, <https://www.planet-lean.com/articles/financial-performance-sme-research>. Bryan, L. L. (2007), "The new metrics of corporate performance: Profit per employee", *McKinsey Quarterly*, <https://www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/the-new-metrics-of-corporate-performance-profit-per-employee>.

In summary, the study enriches both academic debate and policy reflection by offering original empirical evidence on the relationship between legality and firm performance, focusing on the Tuscan case study. This approach enables a detailed comparison between certified and non-certified enterprises, overcoming the limitations of fragmented official sources.

In evaluating this regulatory instrument, the thesis not only advances methodological approaches to the study of legality but also informs policymakers seeking to refine anti-mafia and compliance frameworks.

In this way, the research demonstrates that mechanisms designed to prevent criminal infiltration can, when effectively implemented, reinforce the competitiveness and resilience of legitimate businesses.

## **Chapter 1:**

### **Legality and business: framework and scope of the analysis**

Over the years, the relationship between legality and business activity has garnered substantial attention from both academics and policymakers, and today it occupies an important place in the study of contemporary economies. Understanding this relationship is essential for analysing how legal frameworks influence business behaviour, economic development, and regional context.

The prevalence of unobserved or illicit economic activities typically distorts market functioning, erodes public revenue, and undermines societal trust in institutions. Italy, with its well-documented organised crime infiltration – as estimated by the Italian Parliament’s Antimafia Commission, according to which the total turnover linked to organised crime reached €150 billion in 2012<sup>3</sup> – offers a particularly relevant context for examining how formal mechanisms of legal certification can shape firm behaviour and performance. More recent data show that suspicious financial transactions connected to criminal organisations increased by 85% between 2022 and 2023, with over 53,000 operations recorded in Rome, Milan, and Naples<sup>4</sup>.

Chapter 1 provides both the conceptual basis and the contextual focus for an examination of legality as it relates to businesses. Section 1.1 clarifies what is meant by legality within economic systems, analysing its definitions and its effects on development and enterprise behaviour. Section 1.2 presents legality certifications as innovative tools to promote compliance. Section 1.3 focuses on the specific local context of Tuscany, examining how regional characteristics influence the interactions between legality and business practices. Finally, the chapter states the research aims and offers new perspectives for original academic contributions.

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<sup>3</sup> United Nations Interregional Crime and Justice Research Institute (UNICRI) (2016), *Organised crime and the legal economy: The Italian case*, Report No. 2016-06, UNICRI, <https://unicri.org/organised-crime-and-legal-economy-italian-case>. De Simoni, M. (2022, March), “The financial profile of firms infiltrated by organised crime in Italy”, *Quaderni dell’antiriciclaggio. Analisi e studi*, No. 17, Banca d’Italia.

<sup>4</sup> Ufficio Stampa Unimpresa (2024, 5 October), *Mafie: Unimpresa, a Roma, Milano e Napoli boom di riciclaggio in banca +85%*, Unimpresa, <https://www.unimpresa.it/mafie-unimpresa-a-roma-milano-e-napoli-boom-di-riciclaggio-in-banca-85/61599>. Additional data indicate that illicit turnover in the tourism sector alone is estimated at €3.3 billion annually, with the ’Ndrangheta accounting for approximately half of this amount. Furthermore, organised crime is estimated to control or influence around 150,000 firms nationwide, generating a criminal economy valued at roughly €40 billion and positioning mafia-related activities as the fourth-largest industry in Italy. See Demoskopika (2024, 10 December), *Turismo. Welfare criminale vale 3,3 miliardi di euro* [Press release], <https://demoskopika.it/wp-content/uploads/2024/12/CS-Welfare-criminale-2024.pdf>. Servicematica (2024, 14 December), *Le mafie sono la quarta industria del paese*, <https://servicematica.com/le-mafie-sono-la-quarta-industria-del-paese/>.

### 1.1. The role of legality in the economic field: definitions and impact

*Legality*, in its most general sense, can be defined as the principle according to which the actions of individuals and institutions must conform to the laws and rules established by a legal system<sup>5</sup>. It represents adherence to the rules that govern social coexistence, ensuring order, justice, and security within a community. This principle implies the obligation to adhere to laws created to protect the rights and duties of all citizens.

Within the economic context, legality refers to firms' and individuals' adherence to the prevailing set of laws, regulations, and institutional norms governing economic transactions and business practices<sup>6</sup>. These activities encompass not only the production, exchange, and consumption of goods and services but also the functioning of markets themselves, which are shaped by both economic principles, such as supply and demand, and legal frameworks designed to safeguard competition and efficiency.

This includes formal compliance, such as timely tax filings, labour-law observance, and anti-corruption measures, as well as the broader social license to operate, reflected in transparency, ethical conduct, and reputational capital. When firms engage in illicit activities (e.g., tax evasion, undeclared labour, money laundering), they distort market competition, harm legitimate operators, reduce government revenues, and undermine the rule of law. Such deviations not only generate immediate distortions but also shape broader patterns of market dynamics and regional development.

The legal framework plays a significant role in economic activities because it influences how businesses interact with institutions, markets, and society. In recent years, several studies<sup>7</sup> have emphasised the link between legality and economic growth, a crucial issue globally since legality-focused policies have proven effective in enhancing business efficiency and reducing regional economic disparities (Chapter 2).

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<sup>5</sup> Barbera, A., Fusaro, C., & Caruso, C. (2024), *Corso di diritto pubblico* (13<sup>a</sup> ed.), Il Mulino. Ronco, M. (2010), "Il principio di legalità (The principle of legality)", *La legge penale. Fonti, tempo, spazio, persone*, <https://hdl.handle.net/11577/2491040>.

<sup>6</sup> Niero, E. (2023), *La legalità economica*, Panodysey, <https://panodysey.com/en/article/culture/la-legalit-economica-f98kv4erg3ab>.

Istituto G. Tagliacarne (2015), *Il valore economico della legalità per la piccola e media imprenditoria italiana*, Focus PMI, [https://www.lslex.com/all/Ricerca\\_Istituto\\_Guglielmo\\_Tagliacarne\\_Focus\\_PMI\\_2015.pdf](https://www.lslex.com/all/Ricerca_Istituto_Guglielmo_Tagliacarne_Focus_PMI_2015.pdf).

<sup>7</sup> Acemoglu, D., Johnson, S., & Robinson, J. A. (2001), "The Colonial Origins of Comparative Development: An Empirical Investigation", *The Am. Econ. Rev.*, 91(5), 1369–1401, <http://www.jstor.org/stable/2677930>. Edelman, L. B., & Stryker, R. (2005), "23. A sociological approach to law and the economy", *The Handbook of Economic Sociology*, Princeton University Press, 527. Astarta, C., Capuano C., & Purificato F. (2018), "The macroeconomic impact of organised crime: A post-keynesian analysis", *Econ. Model.*, 68, pp. 514–528.

Governments promote economic improvement by providing official information about businesses from legal, fiscal, and ethical perspectives.

Such disclosure, in turn, helps uncover illegal activities, reduces the impact of criminal infiltration, and assists consumers, investors, and public institutions by addressing adverse selection, free-riding, and moral hazard problems. Consequently, this contributes to greater economic stability and local development<sup>8</sup>. The costs of crime, corruption, and informality in business activities exceed lost tax revenue, as they slow down productive investment, discourage external financing, and generate uncertainty in contractual relationships, ultimately hindering long-term growth. Therefore, a solid legal framework represents not just a formal requirement but a fundamental condition for sustainable and inclusive growth.

From an institutional perspective, legality is not simply the absence of illicit behaviour but a complex system of formal and informal rules and norms that govern economic exchanges. This multifaceted framework – comprising laws, regulations, property rights, social conventions, and expectations – shapes economic actors’ behaviour and overall economic performance. The predictability and effective enforcement of these institutional arrangements foster trust, reduce uncertainty, and support sustainable economic development<sup>9</sup>.

Companies operating transparently and legally tend to enjoy more stable conditions, greater access to credit, and improved reputational capital. Compliance and transparency are increasingly strategic resources that enhance a firm’s legitimacy and stakeholder confidence.

Empirical evidence<sup>10</sup> consistently shows a strong positive correlation between robust legal institutions and economic performance, although the nature of this relationship is complex and not necessarily causal. Countries with effective legal systems tend to display higher levels of financial development, productivity, and GDP growth. At the firm level, companies in transparent legal environments often benefit from lower capital costs, better credit access, and higher innovation rates.

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<sup>8</sup> Steurer, R. (2011), “Soft instruments, few networks: How ‘new governance’ materializes in public policies on corporate social responsibility across Europe”, *Environ. Policy Gov.*, Volume 21, Issue 4, pp 270–290.

<sup>9</sup> For example, studies on Italian SMEs have shown that clarity and stability in tax and labour regulations positively influence firm growth, investment decisions, and managerial confidence. Moreover, regions characterized by a stronger rule of law and regulatory predictability tend to display better economic performance, lower firm exit rates, and higher innovation capacity. Li, Q., & Zou, H.-F. (2024), “Institutional quality and economic growth”, *J. Gov. Regul.*, 13(2), 399-418. Chang, C.-C., & Johnson, S. (2023), “The impact of quality of institutions on firm performance”, *J. Bus. Res.*, 140, 123-134. Glaeser, E., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2004), “Do institutions cause growth?”, *J. Econ. Growth*, 9, 271–303.

<sup>10</sup> Beck, T., & Levine, R. (2003), “Legal institutions and financial development”, *NBER*, Working Paper 10126, <http://www.nber.org/papers/w10126>. La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R. W. (1997), “Legal determinants of external Finance”, *J. Finance*, VOL LII, NO. 3. La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R.W. (1998), “Law and finance”, *J. Polit. Econ.*, 106, 1113–1155. No. 6.

Conversely, illegality imposes significant costs<sup>11</sup>. It distorts competition by granting unfair advantages to illicit operators, discourages investment and innovation, diminishes government revenues by evading taxes, and weakens public services. Criminal infiltration compromises the economy's integrity, redirects resources from productive use, and sometimes weakens state authority. Moreover, illegality fosters exploitative labour conditions and erodes social trust, perpetuating informality, and disengagement that harm economic development.

In summary, legality functions both as a regulatory framework and as a strategic asset within economic systems. Its efficacy depends on enforcement, institutional coherence and cultural acceptance that together foster sustainable growth and equitable competition.

Effective promotion of legality, therefore, requires not only robust rules but credible application and institutional alignment, which are essential for ensuring trust, stability, and fair economic relations.

### *1.2. Legality certifications as tools to promote compliance*

Within this context, a growing number of institutional mechanisms have been introduced to formally certify firms' compliance with legal and ethical standards. The introduction of legality certifications as tools to promote compliance serves as an institutional signal. These instruments reduce information asymmetries between companies and stakeholders, protect public procurement processes from corruption, and foster ethical behaviour. As a result, they help companies reduce risks, build credibility, facilitate access to finance, and strengthen their business reputation, supporting relationships with key stakeholders. Thus, they transform legality from a mere regulatory requirement into a strategic resource that can enhance competitiveness, especially in sectors exposed to criminal infiltration or strongly linked to public-sector contracts<sup>12</sup>.

One notable example is the Italian *Legality Rating* (Rating di Legalità), issued by the Competition Authority (AGCM)<sup>13</sup>. This rating evaluates firms on criteria such as tax transparency,

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<sup>11</sup> Pinotti, P. (2011), "The economic consequences of organized crime: Evidence from Southern Italy", *Bank of Italy*. Pinotti, P. (2015), "The economic costs of organised crime: Evidence from southern Italy", *Econ. J.*, 125(586), pp. 203-232. Daniele, V., & Marani, U. (2011), "Organized crime and foreign direct investment: the Italian case", *MPRA*, [http://mpra.ub.uni-muenchen.de/7127/1/MPRA\\_paper\\_7127.pdf](http://mpra.ub.uni-muenchen.de/7127/1/MPRA_paper_7127.pdf). Miranda, L., Mocetti, S., & Rizzica, L. (2022), "The Economic Effects of Mafia: Firm Level Evidence", *Am. Econ. Rev.*, 112(8), pp. 2748-73. Astarita, Capuano, & Purificato, 2018.

<sup>12</sup> La Rosa, F., Paternostro, S., & Bernini, F. (2023), "Corporate and regional governance antecedents of the Legality Rating of private Italian companies", *J Manag Gov*, 27, 297-329, <https://doi.org/10.1007/s10997-021-09612-7>.

<sup>13</sup> The *Rating di Legalità* is an innovative certification system introduced in Italy in 2012 and managed by the Italian Competition Authority (Autorità Garante della Concorrenza e del Mercato, AGCM). To be eligible for the rating, companies must satisfy a number of requirements, including but not limited to: absence of criminal convictions or administrative sanctions for the company and its management; adoption of organisational models

anti-corruption measures, corporate responsibility, and sustainability. At the European level there is no single, uniform certification scheme that comprehensively certifies corporate legality across legal, fiscal, and anti-infiltration dimensions. The Italian Legality Rating therefore represents one of the more formalised and institutionally integrated approaches in Europe<sup>14</sup>. Empirical evidence<sup>15</sup> shows that Legality Rating can generate tangible benefits for firms, particularly small and medium-sized enterprises (SMEs). For instance, holding the certification has been found to double the probability of winning a public procurement contract for SMEs, offering them a clear competitive advantage in sectors where informational frictions are strong. Moreover, certified firms tend to execute contracts more efficiently, with fewer cost overruns, delays, and renegotiations, which ultimately benefits both the companies and public institutions.

These findings suggest that legality certifications act not only as compliance tools but also as mechanisms that reinforce institutional trust, improve allocative efficiency, and enhance firms' reputational capital. Another distinct mechanism of this kind is the White Lists, a certification system introduced by Italian legislation<sup>16</sup> to attest companies' transparency, reliability, and freedom from criminal infiltration. This thesis focuses on this tool. Given their relevance for the Italian context and their increasing role in shaping firm behaviour, the White Lists constitute the legality certification examined here, with particular attention to their implementation and effects in the Tuscan regional context (Chapter 2).

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compliant with Legislative Decree no. 231/2001 concerning corporate liability; implementation of anti-corruption measures; adherence to regulations on traceability of financial transactions; a minimum turnover of €2 million in the previous financial year; and at least two years of registration in the Business Register. Recent regulatory updates by AGCM have extended the duration of the rating validity from two to three years and enhanced some access and maintenance criteria. See Legislative Decree No. 1 of 24 January 2012, *Urgent provisions for competition, development of infrastructures, and competitiveness*, art. 5-ter, Gazzetta Ufficiale No. 19, <https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legge:2012-01-24;1~art5ter>.

<sup>14</sup> De Benedetto, M.A., Giuranno, M.G., Mastromarco, C. (2023), "Legality rating and corporate efficiency: evidence from a conditional nonparametric frontier analysis", *Empir. Econ.*, <https://doi.org/10.1007/s00181-023-02511-w>.

<sup>15</sup> Fazio, A., Florio, E., & Piga, G. (2024, December 17), "SMEs Performance in Public Procurement and the Italian Legality Rating", *CEIS Working Paper*, No. 587, <https://ssrn.com/abstract=5062763>. Pizzo, C. (2024, September 19), "Government Certification in Public Procurement: Evidence from the Italian Legality Rating", *SSRN*, <https://ssrn.com/abstract=4961758>.

<sup>16</sup> Law No. 190 of 6 November 2012, *Provisions for the prevention and repression of corruption and illegality in public administration. (12G0213)*, in G.U. general series no. 265 of 13-11-2012.

### 1.3. The Tuscany business environment

Tuscany stands out in the Italian and European economic landscape for its unique combination of rich cultural heritage and a productive structure strongly rooted in an ecosystem of interconnected companies and traditional industrial clusters. Its economy is characterised by the predominance of small and medium-sized enterprises (SMEs), deeply embedded in the regional socio-economic fabric. Such firms are not isolated entities but are organised into dense networks of family-owned and artisanal firms, often clustered within traditional industrial districts (e.g. textiles and clothing, leather, jewellery, paper, etc.), alongside a vibrant tourism sector centred on art, historic towns, and distinctive landscapes.

This combination of industrial competence and cultural appeal makes Tuscany an export-oriented region with strong sectoral specialisation<sup>17</sup>. In practice, the development of SMEs in the region resulted not from top-down planning but from a locally embedded process supported by an institutional environment composed of dense networks of firms, public administrations, and social actors. The growth of industrial districts has relied on locally available resources, socio-political conditions, and shared norms, forming a model of regionalized capitalism based on decentralized and non-coordinated market networks<sup>18</sup>.

Given the predominance of SMEs in Tuscany's industrial districts, the region is particularly vulnerable to the adverse effects of organised crime. Empirical research shows that smaller firms suffer disproportionately from mafia-style infiltration, exposed to higher operational costs, diminished competitiveness, and more fragile long-term growth prospects<sup>19</sup>. This structural fragility underscores the importance of institutional tools that promote legality and protect firms from criminal pressures.

However, preserving a legal and transparent environment has become more challenging in recent decades. Tuscany's SMEs now operate in increasingly globalised markets, with extended supply chains and complex financial relationships. This openness brings growth opportunities but also vulnerabilities, where illicit practices can infiltrate – from subcontracting and procurement to cross-border financial operations. The more interconnected the economy, the greater the number of “entry points” for actors engaged in illegal or semi-legal activities.

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<sup>17</sup> Ferrari, G., Zhao, Y., Mondéjar Jiménez, J., & Secondi L. (2024), “The economy of Tuscany in the post Covid-19 era: Struggling with energy crisis and inflation. What to do to resume the journey?”, *New Adv. Res.*, 6(1), 1–26, <https://doi.org/10.3934/NAR.2024001>.

<sup>18</sup> Trigilia, C., & Burroni, L. (2001), “Italy: Economic Development through Local Economies”, in Crouch C., Le Galès P., Trigilia C., & Voelzkow H., *Local Production Systems in Europe: Rise or Demise?*, Great Britain, Oxford University Press. Trigilia, C., & Burroni, L. (2009), “Italy: rise, decline and restructuring of a regionalized capitalism”, *Econ. Soc.*, Anno 2009, n. 38: 4, 630-653, <http://dx.doi.org/10.1080/03085140903190367>.

<sup>19</sup> Ganau, R., & Rodríguez-Pose, A. (2017), *Smaller firms suffer far more from organised, mafia-style crime*, VoxEU Column (Centre for Economic Policy Research).

Despite the widespread perception of Tuscany as a safe haven, free from organised crime groups, the region is not immune to criminal influence and activities. Domestic and transnational criminal networks recognise the strategic value of infiltrating its economy.

Unlike the overt territorial control exercised by mafia groups in the South, infiltration here is subtle, targeting sectors where economic and financial crimes are less visible.

Preferred activities include money laundering, fraudulent bankruptcy, bid rigging in public procurement, and manipulation of tourism-related cash flows<sup>20</sup>.

Official estimates provide a measure of the problem: the illegal economy in Tuscany is valued at around €1.2 billion annually, within a wider underground economy worth approximately €11.3 billion – about 11.7% of the region's GDP<sup>21</sup>. This paradox shows Tuscany's economic wealth increases its attractiveness for illicit operations. Organised crime exploits highly profitable and cash-intensive sectors (construction, tourism, agriculture, manufacturing supply chains), via financial schemes hard to detect and prosecute.

For SMEs, this context poses specific risks. Firms can become unwittingly involved in fraudulent invoicing, opaque investment partnerships, or supply agreements with front companies linked to criminal organisations. Even indirect involvement carries reputational and economic consequences – from loss of market access to disqualification from public contracts. In trust-dependent systems, even rumours of illegal connections damage long-standing business relationships.

Taken together, these factors explain why Tuscany is a particularly revealing case study. The region combines a dense network of SMEs with a socio-economic model highly dependent on mutual trust yet exposed to criminal infiltration. In such a setting, joining the White Lists is more than a formality: it is a deliberate choice with potential economic implications. Some see it as an investment in credibility and market access; others may avoid it due to costs, perceived bureaucracy, or reluctance to be scrutinised. Comparing firms that join with those that do not makes it possible to assess whether obtaining legality certifications translates into tangible business advantages. This analysis of Tuscany offers valuable insights into the complex relationship between law, territory, and businesses in Italy.

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<sup>20</sup> Report DIA of 2nd semester 2020, p. 306.

<sup>21</sup> IRPET (a cura di), (2024), *Illegalità e criminalità organizzata nell'economia della Toscana. Rapporto 2023*, I libri della giunta regionale – società [Illegality and organised crime in the Tuscan economy. Report 2023, The books of the regional government - society].

#### *1.4. Objective of the study*

Building on the complex relationship between legality, business activities, and territory outlined above, this research aims to examine how legal frameworks and public policies shape firms' economic performance.

The main objective is to analyse the impact of legality on firms, focusing on Tuscany and public policies against organised crime. The key question is:

*“Do Tuscan firms registered on the White Lists exhibit better economic performance than comparable eligible firms not registered?”*

By addressing this question, the thesis aims at contributing to the literature on the microeconomic impact of anti-mafia policies and legality certifications within the economic environment. The relevance of this study can be considered from two complementary perspectives. First, it provides robust and statistically rigorous evidence on the relationship between legality and firm performance, drawing on a unique and detailed dataset of Tuscan companies.

Second, it offers an original contribution by applying econometric techniques – including linear regression and propensity score matching – and using a new dataset never analysed at this level of granularity, to isolate the effects of white list registration while controlling for contextual factors. Through the analysis of Tuscan firms, this approach demonstrates how legal compliance can serve both as a competitive advantage and as a protective factor against criminal infiltration.

Building on these insights, the thesis formulates the following hypothesis for testing.

**Hypothesis:** Inclusion in the White Lists is associated with improved firm performance for certified enterprises compared to non-certified but eligible firms.

This hypothesis sets the foundation for the empirical analysis that follows. Its aim is to understand how legality and formal recognition foster economic development and improve business outcomes, especially in contexts affected by organised crime and institutional weaknesses. While prior studies have found positive impacts of the White Lists and legality certifications, significant gaps remain concerning the precise benefits conferred. To begin with, there is a scarcity of studies that systematically analyse the impact of the White Lists on business productivity, particularly at a regional level. Furthermore, the lack of comprehensive and reliable datasets has hindered precise measurement of the effects of legality certifications on firm performance.

In Italy, for instance, no unified national database exists listing all companies registered on the White Lists; rather, each prefecture publishes updated lists on its own websites in varying formats. This research aims at addressing these gaps by exploiting a detailed dataset of Tuscan firms, thereby providing more accurate and regionally specific evidence on the economic impact of white list certification.

In conclusion, the study offers an innovative contribution to academic knowledge by overcoming previous empirical limitations and providing new evidence on the role of legality. At the same time, it offers new perspectives for policymakers, highlighting the conditions under which legality certifications can strengthen competitiveness and resilience in economies.

## **Chapter 2:**

### **White list enrolment and economic performance: a literature review on legality certification**

As highlighted in the previous chapter, the concept of legality plays a significant role in the economic environment. In recent years, Italian authorities have introduced several policies aimed at preventing and fighting criminal infiltration in business. Among the measures introduced are legality certifications, formal tools attesting a company's adherence to ethical and transparent practices. An important innovation within this background is the creation of the *White Lists*: official registries established at each prefecture that contain businesses deemed free from mafia-related interference although operating in sectors considered at elevated risk of infiltration. This chapter first presents the White Lists (Section 2.1), then a critical review of the literature linking legality to firm performance (Section 2.2). The chapter also pays special attention to studies on legality certifications, with a particular emphasis on the White Lists, examining the empirical evidence (Section 2.3).

#### *2.1. White Lists: definition, legislation, and objectives*

In the last fifteen years, the Italian government has adopted significant actions to counter organised crime and foster transparency in business operations, particularly in sectors vulnerable to criminal infiltration. A major advancement was the enactment of the new Antimafia Code in 2011<sup>22</sup>, followed by the 2012 anti-corruption law<sup>23</sup>. These laws introduced proactive measures to disrupt crime infiltration, including initiatives to promote legality. In this regard, several initiatives were implemented to promote legality, especially in public procurement. Examples include the initiatives for reconstruction efforts after the 2009 Abruzzo earthquake<sup>24</sup>, the 2012 Emilia earthquake<sup>25</sup>, and works related to Expo 2015<sup>26</sup>.

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<sup>22</sup> Legislative Decree No. 159 of 6 September 2011, *Code of Anti-Mafia Laws and Preventive Measures, as well as new provisions on anti-mafia documentation*, pursuant to Articles 1 and 2 of Law No. 136 of August 13, 2010. (11G0201), <https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2011-09-06;159>.

<sup>23</sup> Law No. 190/2012.

<sup>24</sup> Decree-Law No. 135 of 6 April 2009, *Urgent interventions in favour of the populations hit by the earthquakes in the Abruzzo region in April 2009 and other urgent civil protection interventions*, G.U. No. 97 of 24-04-2009.

<sup>25</sup> Decree-Law No. 74 of 6 June 2012, *Urgent measures in favour of the populations affected by the earthquakes that hit the territory of the provinces of Bologna, Modena, Ferrara, Mantua, Reggio Emilia and Rovigo on 20 and 29 May 2012*, G.U. No. 131 of 07-06-2012.

<sup>26</sup> Decree-Law No. 135 of 25 September 2009, *Urgent provisions for the implementation of Community obligations and for the execution of judgments of the Court of Justice of the European Communities.*, G.U. No. 223 of 25-09-2009.

In these cases, supervising activities were based on lists of suppliers, service providers, and contractors operating in sectors at elevated risk of criminal infiltration which were verified as free from such influence.

Following the relative success of these initiatives, the government made these lists permanent by enacting Law No. 190 of November 6, 2012 (Art. 1, paragraphs 52 to 57, with subsequent modifications)<sup>27</sup>, which entered into force in 2013. Hence, in response to the persistent influence of organised crime in Italy's economy, the *White Lists* (WL)<sup>28</sup> were formally established on a permanent basis. Their purpose is to enable the acquisition of anti-mafia information on firms operating in vulnerable sectors.

Each prefecture compiles a list of companies in exposed sectors, presented below, certifying their non-involvement in criminal activities. By establishing these registers, the Italian Government created a formal mechanism that would allow businesses to publicly demonstrate their independence from criminal influence.

The legislation identifies the following sectors as at risk:

1. extraction, supply, and transport of soil and inert materials;
2. packaging, supply, and transport of concrete and bitumen;
3. cold rentals of machinery;
4. supply of wrought iron;
5. hot freight;
6. road transport for third parties;
7. security services for construction sites;
8. funeral and cemetery services;
9. catering, canteen management, and food services;
10. environmental services, including national and cross-border waste collection, transportation, treatment, and disposal, as well as reclamation and remediation activities and other services related to waste management<sup>29</sup>.

These sectors can be updated annually through a specific interministerial decree. Only companies belonging to these identified sectors can obtain white list certification.

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<sup>27</sup> Decree of the President of the Council of Ministers of April 18, 2013, *Procedures for the establishment and updating of lists of suppliers, service providers and contractors not subject to mafia infiltration attempts*, pursuant to Article 1, paragraph 52, of Law No. 190 of November 6, 2012. Decree of the President of the Council of Ministers of January 24, 2017, amending the Decree of the President of the Council of Ministers of April 18, 2013, *On procedures for the establishment and updating of lists of suppliers, service providers and contractors not subject to mafia infiltration attempts*, pursuant to Article 1, paragraphs 52 to 57, of Law No. 190 of November 6, 2012.

<sup>28</sup> A concise overview of the main features of the white list procedure is provided in *Table 1* in the Appendix.

<sup>29</sup> Sector expanded with the "Liquidity Decree" (Decree-Law 23/2020), which extended the scope of the list to cover a broader range of environmental activities.

Firms must apply for admission at the prefecture where they are headquartered. The application must be submitted by the owner of the sole proprietorship or, in the case of a company, by its legal representative. For companies established abroad, the application must be submitted at the prefecture of the province where the company has a stable presence according to Article 2508 of the Civil Code, or at any prefecture if no such presence exists within Italy. The application must include the enterprise's basic information, such as company name, registered office<sup>30</sup>, tax code, VAT number, and the business sectors for which registration is requested. Additionally, applicants must submit a self-certification of registration with the Chamber of Commerce and a self-declaration from all individuals subject to background checks, including information on cohabiting family members<sup>31</sup>.

Registration is generally voluntary and replaces the requirement for anti-mafia clearance notifications for contracts or subcontracts unrelated to registered activities, provided involved parties and share capital composition remain unchanged<sup>32</sup>. However, registration becomes mandatory for certain businesses entering direct or indirect contracts, including subcontracts, with public administrations<sup>33</sup>.

The competent prefecture verifies the absence of impediments under Article 67 of the Antimafia Code<sup>34</sup>. It also checks for attempts at mafia infiltration aimed at influencing the company's decisions and directions<sup>35</sup>. Once the company passes these checks, the prefecture authorises its registration and publishes the updated list on its official website<sup>36</sup>.

Although enrolment is voluntary, it may serve several strategic purposes beyond participation in public procurement.

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<sup>30</sup> The registered office is the official address of a company, used in legal and administrative documents. It is the address recorded with government authorities to receive official correspondence, legal notices, and regulatory communications. Cambridge Dictionary, <https://dictionary.cambridge.org/>.

<sup>31</sup> Legislative Decree No. 159/2011, art. 85.

<sup>32</sup> Ministry of the Interior, Prefectures, <https://prefettura.interno.gov.it/it>.

<sup>33</sup> ANAC, (2023), *Rischio infiltrazioni mafiose: l'imprenditore è tenuto a richiedere l'iscrizione alle white list* [Risk of mafia infiltration: the contractor is required to apply for white list registration], <https://www.anticorruzione.it/-/rischio-infiltrazioni-economiche-l-imprenditore-%C3%A8-tenuto-a-richiedere-l-iscrizione-alla-white-list>.

<sup>34</sup> Article 67 of the Antimafia Code regulates the effects of preventive measures applied to individuals deemed socially dangerous. In essence, it provides that anyone who has been subjected to a preventive measure by a final decision may not obtain certain licences, authorisations, concessions, registrations, certificates, professional qualifications, or public disbursements. Furthermore, it prohibits the conclusion of public contracts for works, services, and supplies, fiduciary contracts for works by direct award (*cottimo fiduciario*), and the related subcontracts and sub-subcontracts. See Legislative Decree No. 159/2011.

<sup>35</sup> Absence of any attempts at mafia infiltration aimed at influencing the choices and directions of the company referred to in Article 84, paragraph 3, of the Antimafia Code. See Legislative Decree No. 159/2011.

<sup>36</sup> For more information, please refer to the registration procedure for the lists on the Prefectures' website: <https://prefettura.interno.gov.it/it/prefetture/firenze/white-list-iscrizione-rinnovo-e-modulistica>.

Firms enrol not only to simplify “*antimafia*” documentation and secure facilitated access to public procurement, but also to enhance their reputation and expand their network of business relationships within the local economy<sup>37</sup>.

Conversely, non-enrolment does not render a firm inherently suspicious of illicit behaviour. Legitimate alternative motivations include high administrative costs and bureaucratic difficulties (documentation, audits, etc.), limited awareness of potential benefits, the absence of strategic incentives when operating primarily in private markets, or strategic choices to enrol discontinuously according to their needs.

The registration lasts 12 months. Firms must request renewal at least 30 days before the expiry date. Since registration is renewable annually, firms can enter and exit the White Lists over time. While this flexibility could enable opportunistic behaviour (strategically timed enrolment for specific public tenders), prefectures mitigate such risks through continuous monitoring and antimafia checks<sup>38</sup>, which limit strategic manipulation. Beyond initial and renewal checks, prefectures may conduct random inspections at any time to verify ongoing compliance. These checks assess the transparency of organisational and functional structures, compliance with tax, social security, environmental, and occupational safety regulations, as well as adherence to financial flow traceability requirements. If conditions are not met, the prefecture may cancel the registration. Cancellation from the White Lists does not constitute a permanent or automatic reputational sanction. It bars firms from public contracts, undermines trust with clients and partners, but it does not represent a definitive exclusion from the market. The company can rehabilitate its standing over time by correcting identified irregularities and reapplying successfully<sup>39</sup>.

White Lists serve as a preventive measure fostering public confidence and ethical business practices. They facilitate access to government contracts and reduce bureaucratic hurdles, while allowing companies to demonstrate their commitment to lawful operation. Inclusion in the White Lists acts as a mark of trust towards clients, suppliers, and public administrations, enhancing market reputation and improving access to public procurement opportunities.

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<sup>37</sup> ANAC (2023), *Rischio infiltrazioni mafiose: l'imprenditore è tenuto a richiedere l'iscrizione alle white list*. <https://www.anticorruzione.it/-/rischio-infiltrazioni-economiche-l-imprenditore-%C3%A8-tenuto-a-richiedere-l-iscrizione-alla-white-list>. Biblus (2025), *White list antimafia: cosa sono e cosa servono*, <https://biblus.acca.it/appalti-ecco-i-vantaggi-delle-white-list-antimafia/>. LAPAM (2022), *White List: cos'è e come funziona l'iscrizione*, <https://www.lapam.eu/notizie/normative/white-list/>.

<sup>38</sup> Legislative Decree No. 159/2011, art. 83.

<sup>39</sup> As highlighted in the literature on institutional reputation mechanisms, exclusion from certification schemes typically entails temporary, context-specific effects rather than permanent market exclusion. See Klein, B., & Leffler, K. B. (1981), “The role of market forces in assuring contractual performance”, *J. Pol. Econ.*, 89(4), 615-641, <https://doi.org/10.1086/260996>.

In recent years, there has been a significant increase in the utilisation of the White Lists, as demonstrated by the “Liquidity Decree” of June 5th, 2020<sup>40</sup>. This legislation, inspired by recommendations from the Ecomafie Commission, notably amended the “White List-Green” system, introducing modifications to Article 4-bis and expanding the list to cover more environmental sectors<sup>41</sup>. Under the revised framework, companies in environmental services must register on a dedicated “ad-hoc list”. This represents a broadening of the White Lists’ previous scope, which had been largely confined to activities involving the management of plants, landfills, remediation efforts, and the transportation and disposal of waste on behalf of third parties.

The extension of the lists to include additional business sectors, such as environmental services, reflects growing recognition of the importance of promoting a healthier, more sustainable economic environment across various industries by systematically reducing criminal influence.

## 2.2. *Legality, economic performance, and competitiveness*

In a global marketplace increasingly characterised by significant information asymmetry, companies struggle to signal their reliability to consumers, institutions, and competitors<sup>42</sup>.

In contexts like Italy, where institutions are comparatively weak and marked by a pronounced socio-institutional divide between North and South, coupled with significant disparities in human and social capital, the challenge becomes particularly acute. This is consistent with the literature<sup>43</sup> highlighting how weak institutional environments exacerbate information asymmetries and reduce the effectiveness of regulatory controls.

The acknowledgement that economic activity is deeply intertwined with social systems has given rise to extensive research on how the social context affects business outcomes<sup>44</sup>.

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<sup>40</sup> Decree-Law No. 23 of 8 April 2020, *Urgent measures regarding access to credit and tax compliance for businesses, special powers in strategic sectors, as well as measures regarding health and work, and the extension of administrative and procedural deadlines*, G.U. No. 143 of 06-06-2020.

<sup>41</sup> Parliamentary Antimafia Commission on Environmental Crimes (2021), *VIII report on the remediation of illegal landfill sites subject to the European Court of Justice ruling of 2 December 2014 (Case C196/13)*, Italian Government Report, pp. 16-46.

[https://www.commissariobonificadiscariche.governo.it/media/3095/viii\\_relazionecc\\_vo\\_11\\_pag-1\\_103.pdf](https://www.commissariobonificadiscariche.governo.it/media/3095/viii_relazionecc_vo_11_pag-1_103.pdf).

<sup>42</sup> Akerlof, G. A. (1970), “The market for ‘lemons’: quality uncertainty and the market mechanism”, *Q. J. Econ.*, 84(3), 488-500. Landon, S., & Smith, C. E. (1998), “Quality expectations, reputation, and price”, *South. Econ. J.*, d4(3), 628-647.

<sup>43</sup> Bonaccorsi di Patti, E. (2009), “Weak institutions and credit availability: the impact of crime on bank loans”, *Questioni di Economia e Finanza (Occasional Papers)*, 52, Bank of Italy, Economic Research and International Relations Area. Onour, I. (2020), “Crime surge and institutional weakness: Are they associated? Evidence from a conflict country”, *MPRA Paper*, No. 115995, <https://mpra.ub.uni-muenchen.de/115995/>.

<sup>44</sup> Polanyi, K. (2001), *The great transformation: The political and economic origins of our time*, Beacon press. See also Trigilia, & Burroni, 2001.

The quality of the institutional environment is often used as a criterion for businesses that wish to invest in a particular area. Specifically, it has been shown that government efficiency, security of property rights, contract enforcement, political stability, and the absence of corruption and violence generate higher investment flows and function as a catalyst for growth and development<sup>45</sup>.

The existing literature on the relationship between legality and economic growth is extensive and presents various perspectives. From the late 1990s to the early 2000s, foundational legal and financial studies consistently underscored the pivotal role of a robust legal framework.

Influential institutions such as the World Bank<sup>46</sup> and the International Monetary Fund<sup>47</sup> emphasised the connection between legality and economic growth in different seminal works. These highlighted how legal systems underpin economic activity and market development<sup>48</sup>. Hall and Jones<sup>49</sup> (1999) document that differences in capital accumulation, productivity, and therefore output per worker are driven by differences in institutions and government policies, which they call “social infrastructure”.

Research on this relationship thus begins to highlight the impact of regulatory compliance, transparency, and anti-crime policies on economic growth and business performance.

Scholars argue that legality is not merely an obligation but can serve as a competitive advantage, as businesses operating within lawful frameworks tend to perform better in sustainable markets<sup>50</sup>.

Between 2000 and 2010, the literature that goes under the label of “economics of justice”, originated in the late 20th century with the work of Richard A. Posner<sup>51</sup>, became well established. This strand of research emphasises that the proper functioning of the justice system is a decisive factor for economic performance.

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<sup>45</sup> Globerman, S., Shapiro, D. (2002), “Global foreign direct investment flows: the role of governance infrastructures”, *World Dev*, 30 (11), 1899–1919. Bénassy-Quéré, A., Coupet, M., Mayer, T. (2007), “Institutional determinants of foreign direct investments”, *World Econ.*, 30 (5), 764–782. Daude, C., Stein, E. (2007), “The quality of institutions and foreign direct investments”, *Econ. Polit.*, 19 (3), 317–344.

<sup>46</sup> World Bank (2006), *Global economic prospects 2006: Economic implications of remittances and migration*, <https://documents1.worldbank.org/curated/en/507301468142196936/pdf/Global-economic-prospects-2006-economic-implications-of-remittances-and-migration.pdf>.

<sup>47</sup> Flanagan, R. J. (1995), “Institutional Structure and Labor Market Outcomes: Western Lessons for European Countries in Transition”, *IMF Working Papers*, 1995(063), A001. Retrieved August 27<sup>th</sup>, 2025, <https://doi.org/10.5089/9781451848366.001.A001>.

<sup>48</sup> La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R.W., 1998. Djankov, S., La Porta, R., Lopez-de-Silanes, F., Shleifer, A. (2008), “The law and economics of self-dealing”, *J. Financ. Econ.*, 88 (issue 3), pp. 430–465.

<sup>49</sup> Hall, R. E., Jones, C. I. (1999), “Why do Some Countries Produce So Much More Output Per Worker than Others?”, *Q. J. Econ.*, Volume 114, Issue 1, Pages 83–116, <https://doi.org/10.1162/003355399555954>.

<sup>50</sup> Levine, R. (1999), “Law, finance, and economic growth”, *J. Financ. Inter*, 8(1-2), 8-35. Kaufmann, D., Kraay, A., & Zoido, P. (1999), *Governance Matters*, <https://ssrn.com/abstract=188568>.

<sup>51</sup> Posner, R. A. (1981), *The economics of justice*, Harvard University Press.

Empirical studies confirm that judicial effectiveness secures property rights, enforces contracts, and supports fair competition, thereby enhancing economic results. Notable contributions from scholars have provided empirical evidence supporting the idea that judicial effectiveness directly correlates with enhanced economic activity and competitiveness<sup>52</sup>.

In the 2010-2020 decade, research further substantiated the importance of judicial efficiency, demonstrating that well-functioning legal institutions not only attract foreign direct investments but also foster superior production efficiency among compliant firms<sup>53</sup>.

Comi, Grasseni, and Resmini<sup>54</sup> show how regions with effective judicial systems offer a more secure business environment, reinforcing the positive link between legal performance and economic development. Regulatory compliance provides firms with tangible benefits, including improved operational efficiency and competitiveness. Additionally, the authors demonstrated that variations in judicial efficiency across Italian municipalities help explain differences in foreign direct investment, even after accounting for other local characteristics. In fact, judicial inefficiency discourages foreign financing and creates a competitive disadvantage that weakens the attractiveness of certain areas under otherwise similar conditions.

Building on this foundation, an important strand of research since 2010 focuses on the significant economic costs imposed by organised crime, corruption, and illegal market infiltration. These factors distort fair competition, undermine investor confidence, and increase operational costs for businesses.

In the Italian context, a substantial body of literature documents how mafia-related activities impose additional burdens on regional economies through extortion, coercion, and unfair market practices. For example, Pinotti provides empirical evidence from Southern Italy illustrating how organised crime suppresses firm profitability and economic growth<sup>55</sup>.

Daniele and Marani further demonstrate how illicit activities undermine institutional quality and deter foreign direct investment<sup>56</sup>.

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<sup>52</sup> Bae, K., Goyal, V.K. (2009), "Creditor rights, enforcement, and bank loans", *J. Finance*, 64 (2), pp. 823–860. Qian, J., Strahan, P. (2007), "How law and institutions shape financial contracts: the case of bank loans", *J. Finance*, 62 (6), pp. 2803–2834. Djankov, S., Hart, O., McLiesh, C., & Shleifer, A. (2008), "Debt Enforcement around the World", *J. Polit. Econ.*, 116, No. 6: 1105–49, <https://doi.org/10.1086/595015>. Djankov, La Porta, Lopez-de-Silanes, Shleifer, 2008.

<sup>53</sup> Steurer, 2011.

<sup>54</sup> Comi, S., Grasseni, M., Resmini, L. (2021), "Can judicial efficiency improve territorial attractiveness to FDI? The Italian experience", *Eur. J. Polit. Econ.*, 70, 102043, <https://doi.org/10.1016/j.ejpoleco.2021.102043>.

<sup>55</sup> Pinotti, 2011. Pinotti, 2015.

<sup>56</sup> Daniele, V. (2009), "Organized crime and regional development. a review of the Italian case", *Trends in Organized Crime*, 12, pp. 211–234. Daniele, V., & Marani, U. (2011), "Organized crime, the quality of local institutions and FDI in Italy: A panel data analysis", *Eur. J. Polit. Econ.*, 27(1), pp. 132–142. Daniele, & Marani, 2011.

Similarly, Mirenda, Mocetti, and Rizzica described the contextual factors that may have contributed to the emergence of mafias and examined their impact on economic growth. They also developed an indicator of infiltration for firms located in areas traditionally free of Mafia influence<sup>57</sup>. Moreover, institutional reports estimate that costs related to criminality (including extortion, usury, and public expenditure on law enforcement and defence) reach billions of euros annually, particularly affecting Southern Italy's economy. These costs represent a significant economic disadvantage for lawful firms operating in an environment distorted by illicit actors<sup>58</sup>. Amidst such challenges, adherence to regulatory compliance and corporate social responsibility emerges not just as a legal necessity but as a competitive advantage. Ethically responsible firms tend to strengthen their reputation and build reliable relationships with investors, customers, and suppliers<sup>59</sup>. This facilitates access to resources such as qualified labour and capital.

To sum up, the literature recognises that legality constitutes a fundamental driver of economic productivity and business competitiveness. A well-functioning legal framework not only supports market stability and growth but also fosters an environment in which businesses are incentivised to comply with rules, enhancing their reputation, and strengthening economic outcomes across regions and sectors.

The examined literature consistently shows that legality and institutional quality are fundamental drivers of productivity, competitiveness, and long-term economic growth. Within this framework, recent studies have also emphasised the role of compliance mechanisms and anti-crime measures in shaping business outcomes. The next section explores this line of research, focusing on legality certifications, and particularly the White Lists.

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<sup>57</sup> Mirenda, Mocetti, & Rizzica, 2022. Mocetti, S., & Rizzica L. (2021), "La criminalità organizzata in Italia: un'analisi economica" [Organized Crime in Italy: An Economic Analysis], *Questioni di Economia e Finanza*, Banca d'Italia, No. 661.

<sup>58</sup> Confcommercio (2010, February 23), *7.8% è il costo della criminalità sul valore aggiunto del terziario nel Sud Italia, per un totale di 3.5 miliardi di euro*, [Report]. IRPET, 2024.

<sup>59</sup> Branco, M. C., Rodrigues, L. L. (2006), "Corporate social responsibility and resource-based perspectives", *J. Bus. Ethics*, 69(2), pp. 111-132. Alwi, S. F. S., Ali, S. M., Nguyen, B. (2017), "The Importance of Ethics in Branding: Mediating Effects of Ethical Branding on Company Reputation and Brand Loyalty.", *J. Bus. Ethics*, Q 27(3), pp. 393-422. Wanner, J., Janiesch, C. (2019), "Big data analytics in sustainability reports: an analysis based on the perceived credibility of corporate published information", *J. Bus. Res.*, 12(1), pp. 143-173.

### 2.3. Legality certifications: White Lists and their impact on enterprises

In recent years, the use of certifications to signal legality and compliance has attracted significant scholarly attention. Contemporary research explores how adherence to legal and ethical standards translates into tangible economic benefits for companies. These works move along a trajectory established by earlier studies on how the social context influences business outcomes (see Section 2.2), with a specific focus on firm signalling strategies and their effects<sup>60</sup>.

Legality certifications function as third-party signals that reduce information asymmetry between firms and external stakeholders – such as financial institutions, customers, and suppliers. This fosters trust and facilitates access to critical resources like credit and markets.

Existing literature on legality certifications emphasises their importance in improving market transparency, promoting fair business practices, and deterring criminal infiltration and corruption<sup>61</sup>. Bellucci, Borisov, Giombini, and Zaccardo (2023)<sup>62</sup> show that such external certification – illustrated in this study by competitive public subsidies awarded to medium-sized enterprises (SMEs) – can serve as an observable positive signal that lower the cost of bank debt, particularly when private information available to lenders is limited or local credit markets are less competitive. This certification effect is driven by the reduction of uncertainty about borrower quality and an increase in market contestability, which enhances the competitive pressure on lenders to offer more favourable credit terms.

A 2023 study<sup>63</sup> by De Benedetto, Giuranno, and Mastromarco investigates the “Legality Rating” (Rating di Legalità) system implemented by the Italian government. Their analysis, based on a nonparametric frontier, identifies a positive relationship between legality certification and firms’ production efficiency. Firms awarded with the rating exhibit higher productive efficiency and better credit access. As a result, they can invest more and reduce financial, legal, and tax risks. Notably, the legality rating also contributes to inter-regional convergence by helping less productive firms improve their efficiency, particularly in Southern Italy, which traditionally suffers from higher levels of criminal infiltration and lower institutional quality.

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<sup>60</sup> Colombo, O. (2021), “The use of signals in new-venture financing: A review and research agenda”, *J. Manag.*, 47(1), 237-259.

<sup>61</sup> Acconcia, A., Alfano, M. R., Baraldi, A. L., Cantabene, C. (2021), “Public certification to fight against illegality: Evidence on private investment. Technical report”, *Centre for Studies in Economics and Finance (CSEF)*, University of Naples, Working paper No. 633.

<sup>62</sup> Bellucci, A., Borisov, A., Giombini, G., & Zazzaro, A. (2023), “Information asymmetry, external certification, and the cost of bank debt”, *J. Corp. Fin.*, 78, 102336, <https://doi.org/10.1016/j.jcorpfin.2022.102336>.

<sup>63</sup> De Benedetto, Giuranno, Mastromarco, 2023.

Within this framework, the Italian context presents an ideal case study for examining such measures due to the historical challenges posed by organised crime and regional socio-economic disparities. Over the past decade, Italy has introduced various policies, such as the White Lists, to certify firms' freedom from criminal infiltration in high-risk sectors. They act not only as administrative tools but as official government-issued certifications that streamline anti-mafia controls, particularly for businesses involved in public procurement. They replace traditional anti-mafia documentation and enhance firms' credibility in private markets. Empirical studies focusing explicitly on the White Lists provide compelling evidence on their positive impact on firm performance. A recent study by Barletta, Capuano, and De Iudicibus (2022)<sup>64</sup> contributes new evidence on the White Lists, noting that firms registered in these lists tend to perform better economically. Through a descriptive survey between firms belonging to the lists with companies not belonging to them but which are similar in terms of size and economic sector, they find that white list firms show higher profitability and a lower reliance on third-party capital compared to similar non-registered firms. Their analysis reveals two geographical clusters of white list firms: one linked to post-earthquake reconstruction phases along the Apennine ridge, and another concentrated in areas with historically higher mafia infiltration, particularly Southern Italy. Although registration is voluntary, the data suggest that registered firms leverage the certification to overcome barriers in public procurement and demonstrate enhanced financial stability.

Another study by Alfano, Cantabene, and De Iudicibus<sup>65</sup>, using extensive firm-level data and a difference-in-differences approach, demonstrates that inclusion in the White Lists significantly improves firms' access to bank credit and profitability. Their analysis reveals that the positive effect on credit access is particularly strong in Southern Italy, where organised crime is more prevalent. Conversely, the impact on profitability is more marked in the North, reflecting regional institutional and economic differences.

Their study further shows that the duration of certification matters. Firms that maintain white list registration for multiple years experience increased benefits, underlining the importance of sustained commitment to legality.

In summary, legality certifications, and the White Lists in particular, are institutional tools that contribute positively to firm productivity and enhance firms' presence in Italy's high-risk business environments.

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<sup>64</sup> Capuano, C., Barletta, A., De Iudicibus, A. (2022), "White List: An Administrative Tool to Contrast Crime", *Games*, 13, 8, <https://doi.org/10.3390/g13010008>.

<sup>65</sup> Alfano, Cantabene, De Iudicibus, 2024.

Empirical evidence discussed highlights that firms registered benefit from improved financial performance and credit access, especially when the certification is maintained over time. The analysis also reveals geographical variations, reflecting differences in institutional quality and criminal infiltration. Overall, these findings support the role of the White Lists as both preventive legal instruments and strategic assets for firms operating in contexts marked by legal and institutional challenges.

### **Chapter 3:** **Businesses and White Lists in Tuscany:** **Sample Definition and Exploratory Data Analysis**

This chapter describes the data used in the analysis. The aim is to detail the composition of the sample: which sources were used, how data were collected, how the dataset was constructed. Subsequently, the exploratory data analysis compares companies registered in the White Lists (WL) with those not registered (non-WL). We also illustrate *EBITDA per employee* as the indicator of economic performance used in the econometric analysis.

#### *3.1. Dataset construction*

As outlined in Chapters 1 and 2, the Italian authorities, at both national and regional levels, have historically implemented various measures to fight business-related crime. These include anti-corruption initiatives<sup>66</sup>, anti-money-laundering laws<sup>67</sup>, regulations on transparency in public procurement<sup>68</sup>, and strengthened checks to assess the lawfulness and reliability of companies, particularly concerning the risk of organised crime involvement in the economy<sup>69</sup>. Among these initiatives, the creation of the White Lists stands out. It is an administrative measure designed to simplify anti-mafia certification for compliant companies, helping to prevent criminal infiltration in public procurement and local economic activities (Section 2.1). Currently, there is no single, centralised national database listing companies registered in the White Lists.

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<sup>66</sup> For an overview of anti-corruption measures, see ANAC <https://www.anticorruzione.it/missione-competenze>, accessed April 18<sup>th</sup>, 2025.

<sup>67</sup> Legislative Decree No. 231/2007 (*Implementation of Directive 2005/60/EC on the prevention of the use of the financial system for the purpose of money laundering and terrorist financing, and of Directive 2006/70/EC laying down implementing measures*, <https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2007-11-21;231>, accessed April 18<sup>th</sup>, 2025) and its subsequent modifications, which establish obligations for customer due diligence and impose criminal penalties for those who falsify data or use false information.

<sup>68</sup> Regarding regulations on transparency in public procurement: as of 2024, new rules have come into force that strengthen digitalization and transparency in public procurement procedures. These rules require contracting authorities to promptly transmit data to the National Database of Public Contracts (BDNCP), managed by ANAC, <https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2023;036>, (accessed April 18<sup>th</sup>, 2025). Italy addresses the phenomenon of criminal organisations infiltrating legitimate businesses through a combination of regulatory measures, preventive controls, financial flow monitoring, and inter-institutional cooperation. See Arellano-Bover, J., De Simoni, M., Guiso, L., Macchiavello, R., Marchetti, D. J., Prem, M. (2024, November), “Mafia and firms”, *Quaderni dell’antiriciclaggio. Analisi e studi*, No. 24, Banca d’Italia.

<sup>69</sup> In recent years, Italian authorities have introduced institutional tools like the White Lists and the Legality Rating as proxies to assess companies’ compliance in terms of legal, financial, and ethical reliability. These tools have been promoted as part of broader efforts to prevent and counter organised crime (Chapters 1 and 2). See: Alfano, Cantabene, De Iudicibus, 2024. De Benedetto, Giuranno, Mastromarco, 2023; Acconcia, Alfano, Baraldi, Cantabene, 2021.

Instead, each prefecture<sup>70</sup> maintains its own register, which is periodically (typically once a year) published online; therefore, data must be downloaded individually from the official website of each prefecture. The lists used in this work, referred to the ten Tuscan Prefectures, were collected between November 2023 and February 2024<sup>71</sup>. Since the prefectures annually update and replace the previous lists with the latest versions, the data used corresponds to the most recent available at that time. The lists were subsequently cleaned to resolve duplicates, formatting inconsistencies, and overlapping records. The white list data were then merged into a single, standardised dataset. The resulting register reports company name, tax code and/or VAT number, registration date, registration expiry date, industry, the ATECO 2007 code<sup>72</sup>, and geographical location<sup>73</sup>.

A limitation encountered during the data collection process is related to the lack of uniformity in the publication practices adopted by the various prefectures: in many cases, in fact, the prefectures overwrite previously published data, failing to maintain historical records of registration dates<sup>74</sup>. As a result, for a subset of certified firms, it was not possible to reconstruct a complete timeline of their white list status. This restriction affects the ability to account for firms' pre-treatment characteristics, particularly economic variables from prior years. To maintain consistency in the data employed for the econometric analysis, only a set of basic structural characteristics referring to 2023 was considered when constructing the sample, namely firm size, industry, geographical location, and firm age.

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<sup>70</sup> In Italy, a *prefecture* (*prefettura*) is the office of the central government in a province (*provincia*). The main roles of the prefecture include public security, civil protection, and the implementation of national policies within the province. Each province usually hosts a prefecture, but there are only 103 prefectures in Italy for 107 provinces: in the Aosta Valley, prefectural duties are handled by the Regional President, and for South Sardinia, by the Cagliari prefecture. In Tuscany, there are ten prefectures, one for each province. See Ministry of the Interior (n.d.), *Governo sul territorio: Prefetture*, retrieved June 20<sup>th</sup>, 2025, <https://www.interno.gov.it/it/temi/territorio/governo-sul-territorio-prefettura>.

<sup>71</sup> Table 2 in the Appendix.

<sup>72</sup> The ATECO code is the classification of economic activities adopted by ISTAT (the Italian National Institute of Statistics). As of January 1<sup>st</sup>, 2025, the new classification system, ATECO 2025, has officially come into force and will be operationally applied starting from April 1<sup>st</sup>, 2025. This research, however, uses the previous version of the classification ATECO 2007. The ATECO code is composed by 6 digits; for analytical purposes and sample construction, firms were grouped according to the first three digits of the code. For more information about data extraction, see Table 2 and Table 3 in the Appendix. Additional explanations is available at ISTAT: <https://www.istat.it/classificazione/classificazione-delle-attivita-economiche-ateco/>, accessed April 20<sup>th</sup>, 2025.

<sup>73</sup> Province where the company has its registered office or operational headquarters.

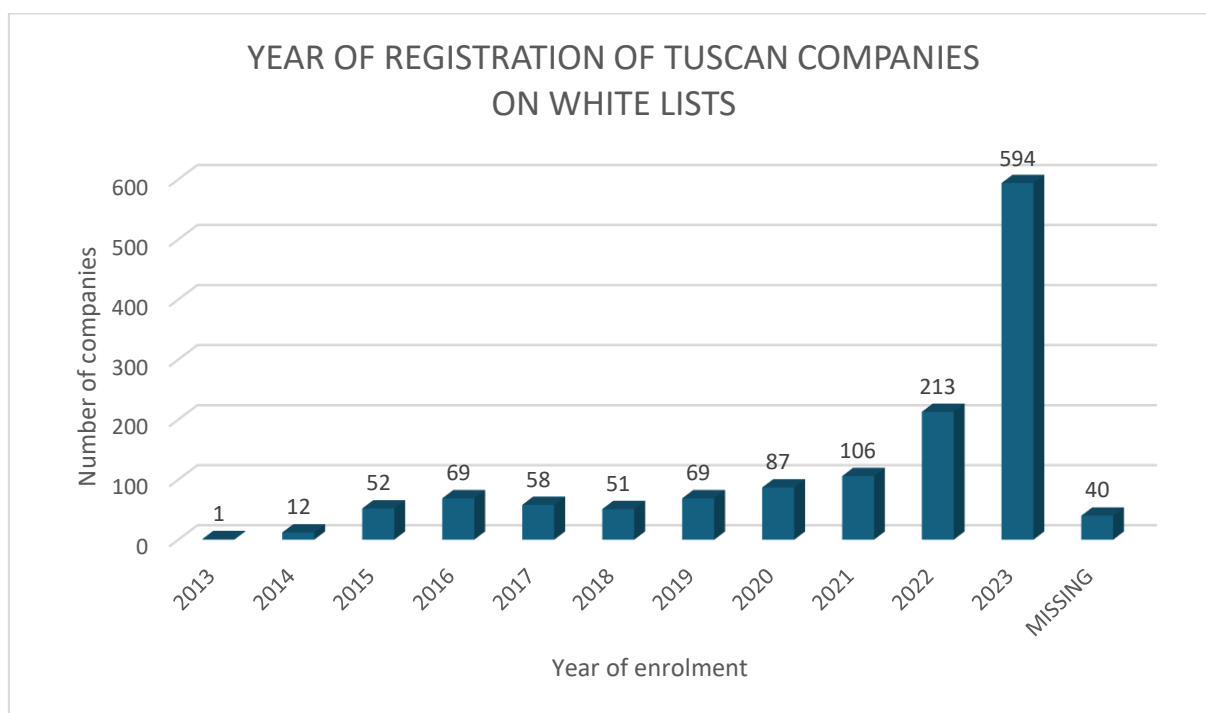
<sup>74</sup> To gather more information on how the date of registration in the White Lists had been assigned to companies, an e-mail was sent to each Tuscan Prefecture. It was asked whether this date, which was shown in the data downloaded from the prefectures' websites, corresponded to the company's actual "first-time" registration or whether it was overwritten. Some prefectures confirmed that the date entered did indeed correspond to the first registration (and was not overwritten), others unfortunately overwrote it (despite having a history in the database). Therefore, given the lack of consistency of the information for some of the certified companies and to avoid "criticalities" in the analysis, it was not possible to include control variables concerning years prior to 2023.

Despite this constraint, we used the available information on the sampled firms, which was considered sufficient to identify their status with respect to the White Lists.

According to the purpose of this analysis, only companies registered in the White Lists between 2013 – one year after the entry into force of Law 190/2012 – and 2023 were included.

Figure 1 shows the distribution of firms by registration year across Tuscan Prefectures over this period, based on dates from lists downloaded in November 2023. Since some prefectures replace earlier lists when updating them, the year associated with each firm may indicate either the first historical enrolment or the latest recorded registration, depending on the prefectural source. Thus, the figure provides a descriptive overview of observable registration years rather than annual new enrolments or continuous presence.

Figure 1: Distribution of Tuscan WL firms by year of registration reported in prefectural records



Source: Own elaboration based on Tuscan Prefecture data. The figure excludes 3 firms registered in 2024 (included in Table 2 and in the empirical analysis) for comparability across years, as data for 2024 cover only the first months of the year. Some missing values in the chart are because, for certain companies, the date of registration is not reported by some prefectures (Grosseto, Massa-Carrara, Pisa) as the enrolment is being renewed, updated, or currently under review<sup>75</sup>.

<sup>75</sup> The procedures for renewal, update, and review of white list registration are not the same. Firms that are already registered must proceed with periodic renewal (typically annual) to maintain a valid registration; they may also communicate relevant changes through the update phase (e.g., changes in the corporate structure, management, or registered office); finally, the prefecture may order an extraordinary review should new elements emerge that require verification. For an example of how some prefectures handle registration data, see Figure 1 caption.

Overall, based on the available data, the distribution suggests an increasing concentration of firms in more recent years, with a first marked increase in 2015. Between 2015 and 2019, the distribution remains relatively stable (ranging from 50 to 70 companies per year), followed by a sharp concentration in 2022 and a peak in 2023.

Only companies operating in certain sectors considered at high risk of criminal infiltration are eligible to apply for inclusion in the White Lists<sup>76</sup>.

The companies listed in the White Lists are classified into these sectors by the prefectures, based on both their registration application and their ATECO 2007 code<sup>77</sup>. Accordingly, the sample of registered companies reflects this sectoral structure. *Table 1* presents the nine high-risk sectors considered in this study<sup>78</sup>.

*Table 1: High-risk sectors eligible for white list enrolment: activity descriptions*

<b>SECTOR</b>	<b>DESCRIPTION</b>
<i>sez1</i>	Extraction, supply, and transport of soil and inert materials
<i>sez2</i>	Packaging, supply and transport of concrete and bitumen
<i>sez35</i>	Cold rental of machinery and Hot freight
<i>sez4</i>	Supply of wrought iron
<i>sez6</i>	Road transport on behalf of third parties
<i>sez7</i>	Construction site guardian
<i>sez8</i>	Funeral and cemetery services
<i>sez9</i>	Catering, canteen management, food services
<i>sez10</i>	Environmental services

*Own elaboration based on information from the website of the Italian Ministry of Interior.*

<sup>76</sup> According to Article 53 of the Anti-Corruption Law and the amended version of Law 40/2020 (Article 4-bis, Section 2), the activities most exposed to the risk of organised crime infiltration are as follows: Extraction, supply, and transport of soil and inert materials; Packaging, supply, and transport of concrete and bitumen; Cold rental of machinery; Supply of wrought iron; Hot freight; Road transport on behalf of third parties; Construction site guardian; Funeral and cemetery services; Catering, canteen management, and food services; Environmental services, including waste collection, domestic and cross-border transport (including on behalf of third parties), waste treatment and disposal, as well as remediation and reclamation activities and other services related to waste management. See *Table 3* in the Appendix.

<sup>77</sup> As noted in Chapter 2, white list enrolment is voluntary, and companies can be listed within 90 days after submitting their application to the prefectures. During the application process, companies are required only to specify the sector of activity for which they are applying and to provide supporting documentation for verification.

<sup>78</sup> The current legislation identifies ten risk sectors, but to avoid overlaps or redundancies, this study merges the “Cold rental of machinery” sector (*sez3*) with the “Hot freight” sector (*sez5*), considering the significant number of companies registered in both sectors.

Starting from white list data, we obtained an initial sample of Tuscan registered firms, grouped by industry and province.

To collect financial data for the econometric analysis and to conduct a comparative assessment, we matched the group of white list firms with a control population of similar non-registered firms in the lists. First, we retrieved the population of active companies in Tuscany from the AIDA database<sup>79</sup>, which provides financial and administrative data for Italian limited companies. To ensure comparability, we selected only firms with ATECO 2007 codes included in white list sectors (*Table 3* of the Appendix).

From AIDA, we extracted the financial and other company variables used in the econometric analysis. This information was derived from the 2023 annual financial statements. It is important to note a limitation stemming from the AIDA database itself, which provides economic and financial information exclusively for corporations and not for partnerships or sole proprietorships<sup>80</sup>. Consequently, 482 out of the firms registered in the White Lists could not be used for the analysis due to the unavailability of their financial data<sup>81</sup>.

We then matched this universe with the official registry of white list members collected from the Tuscan Prefectures, using the company's tax code as a unique identifier.

Once the merged sample of certified and non-certified firms had been established, we applied inclusion criteria to consider only active and economically relevant companies.

First, we retained only firms reporting annual revenues in excess of €50,000. Next, to focus on firms with operational personnel, we kept only those with at least one employee and positive personnel costs<sup>82</sup>.

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<sup>79</sup> AIDA, which is owned by Moody's Analytics (formerly Bureau Van Dijk S.p.A.), includes financial information of 1 million Italian companies, excluding banks, insurance companies, and public administrations. It is not limited to Italian businesses but also provides information on foreign companies operating within Italian territory. The database includes basic company information, product and service details, and annual financial statements, allowing comparisons by industry, location, or key economic indicators, <https://login.bvdinfo.com/R1/AidaNeo?SetLanguage=it>, accessed August 9<sup>th</sup>, 2025.

<sup>80</sup> AIDA covers corporations (e.g., S.p.A., S.r.l.) because these entities are legally required to file their financial statements with the Italian Business Register. In contrast, sole proprietorships and partnerships (e.g., S.n.c., S.a.s., simple partnerships) are generally not subject to the same disclosure requirements, except in specific cases (e.g., when exceeding size thresholds or under special accounting regimes). As a result, although such entities may appear in the White Lists, they were excluded from the analysis due to the lack of comparable financial information. With the transposition of EU Directive 2025/25 – which mandates financial reporting for S.n.c. and S.a.s. starting in 2028 – it is likely that AIDA will progressively include these types of companies. See Directive (EU) 2025/25 of the European Parliament and of the Council of December 19<sup>th</sup>, 2024, amending Directives 2009/102/EC and (EU) 2017/1132 as regards further expanding and improving the use of digital tools and processes in company law.

<sup>81</sup> The resulting dataset, referred to as the *initial sample*, therefore includes only companies with complete financial statements for 2023. Therefore, in addition to WL-registered partnerships not included in AIDA, firms being wound up and those without available 2023 financial statements were excluded at this preliminary stage.

<sup>82</sup> The number of employees is not reported in the financial statements (balance sheet and income statement), instead, it is typically found in the notes, and AIDA generally provides the employee count: for firms with missing or zero employees but positive personnel costs, we estimated the number of employees as

This condition ensures that our analysis targets firms engaged in actual business activity<sup>83</sup>. Finally, firms with incomplete financial statements or that have ceased trading<sup>84</sup> were omitted from the sample, as their financial data would not accurately reflect ongoing performance. After applying these filters, the dataset includes a set of active firms with reliable financial data, divided into certified and non-certified groups, suitable for comparative analysis. *Table 2* illustrates the percentage distribution of Tuscan companies included in the sample, across the nine sectors, grouped into registered and non-registered companies.

*Table 2: Percentage distribution by high-risk industry of registered and non-registered firms*

Industry	Firms with financial data	
	Non-registered	WL Registered
sez1	4.44%	4.43%
sez2	0.75%	1.92%
sez35	37.37%	40.15%
sez4	16.26%	16.97%
sez6	8.16%	3.54%
sez7	0.17%	0.81%
sez8	2.10%	0.96%
sez9	25.19%	17.79%
sez10	5.57%	13.43%
<b>Subtotal</b>	N = 34,344	N = 1,355 <sup>85</sup>
<b>TOTAL</b>	<b>N = 35,699</b>	

*Own elaboration based on Tuscan Prefectures and AIDA data. Percentages are calculated relative to the total number of firms in each group. Firms registered in the White Lists but not included in the AIDA database (482 enterprises organised as partnerships or sole proprietorships) were excluded from the certified group for percentage calculations, due to the lack of economic and financial data.*

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$round\left(\frac{personnel\ costs_i}{average\ personnel\ costs}\right)$ , where the denominator is calculated only on the companies with a positive number of employees.

<sup>83</sup> International Monetary Fund, (2018), *Considerations in Setting the VAT Threshold*, IMF eLibrary. Stice, D., Stice, E. K., & Stice-Lawrence, L. (2022), “The Power of Numbers: Base-Ten Threshold Effects in Reported Revenue”, *J. Account. Econ.*, <https://doi.org/10.1111/1911-3846.12799>. Chen, J, Das, J, Gong, H. (2014), “Selection of optimal threshold using cost and revenue matrix”, *Model Assisted Stat. Appl.*, 9(2):97-107, doi:10.3233/MAS-130282.

<sup>84</sup> Specifically, AIDA indicates when a firm has ceased operations and highlights incomplete financial statements, as the absence of certain balance sheet items reveals missing data even where other financial records are present.

<sup>85</sup> The slight difference between the total number of White List firms reported in *Figure 1* and in *Table 2* is due to the exclusion of three firms registered in 2024 from the figure to ensure comparability across years.

In both groups, the most represented sectors are Cold rental of machinery and hot freight (*sez35*) and Catering, canteen management, and food services (*sez9*). Interestingly, a recent national-level study<sup>86</sup> has found that other industries, such as Road transport for third parties (*sez6*), Packaging, supply, and transport of concrete and bitumen (*sez2*), and Environmental services (*sez10*), are the most common sectors among white list firms across Italy. These industries have historically been among the most exposed to organised crime infiltration.

*Table 2* indicates that the situation in Tuscany is different. This reflects both the specific structure of the Tuscan economy, where tourism and related services play a key role, and the fact that sectors such as hospitality and construction have historically been prime targets for organised crime, also in this regional context<sup>87</sup>. The only similarity with the national context is the relatively higher proportion of white list firms in Environmental services (*sez10*) compared with non-registered firms, which may reflect a stronger incentive for companies in this sector to distinguish themselves from potentially criminal counterparts, highlighting their commitment to compliance and lawful operations<sup>88</sup>.

To refine the sample and ensure consistency with the research plan presented in Chapter 1, a further step was taken: companies with a SOA certificate<sup>89</sup> were excluded from the final dataset; in fact, this certificate, which is a formal qualification required to participate in public tenders, may influence firm behaviour and performance independently of white list membership. Excluding SOA-certified companies ensures that the analysis focuses specifically on the impact of white list registration<sup>90</sup>.

As a result, the full merged dataset comprised 1,355 white list companies and 34,344 non-white list companies. This selection includes all registered firms for which financial data were available, as well as those eligible for white list registration (*Table 2*). After removing 1,492 companies with SOA certification, the sample is reduced to 815 WL and 33,392 non-WL companies.

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<sup>86</sup> Alfano, Cantabene, De Iudicibus, 2024.

<sup>87</sup> IRPET, 2024.

<sup>88</sup> Aureliani, T., Carni, A., & Villani, D. (2024), "Environmental crimes, mafias, and waste: A multidisciplinary perspective", *Rivista di Studi e Ricerche sulla criminalità organizzata*, 10(1), <https://doi.org/10.54103/cross-26938>.

<sup>89</sup> The SOA certificate is necessary for companies that intend to participate in public procurement contracts of at least €150,000 (Article 91 of Legislative Decree 159/2011). The certificate is valid for 5 years, with a mid-term review in the third year to confirm performance of requirements. For more information, see: ANAC, <https://www.anticorruzione.it/-/servizi-alle-societ-c3-a0-organismo-di-attestazione-soa->, accessed April 28<sup>th</sup>, 2025.

<sup>90</sup> Data on firms holding SOA certification were obtained from the National Anti-Corruption Authority (ANAC) portal, <https://www.anticorruzione.it/-/casellario-delle-imprese-1>, accessed April 20<sup>th</sup>, 2025.

A further 15,043 firms (15,014 non-WL and 29 WL firms) were then excluded due to missing data on EBITDA per employee, which serves as the economic performance indicator in the subsequent regression models. The higher incidence of missing EBITDA per employee among unregistered companies is mainly attributable to limitations in data availability within the AIDA database, which does not systematically report 2023 financial statements for all active firms. In contrast, companies registered in the White Lists are subject to stricter administrative and reporting requirements, which may be associated with greater data availability. Therefore, the observed difference reflects heterogeneity in data coverage rather than firm performance itself. The exclusion criteria applied allow all subsequent analyses on a sample of companies that are active, comparable, and meet the same financial reporting requirements. The final sample therefore consists of 19,164 companies: 786 White Lists registered and 18,378 not registered. From this point onward, all subsequent analyses refer to this final composition. *Table 3* summarises the exclusion process and presents the final sample used in the econometric analysis.

*Table 3: Final sample composition: exclusion for SOA certification and missing EBITDA per employee information*

<b>Group</b>	<b>Initial sample</b>	<b>Firms excluded for SOA</b>	<b>Sample after SOA exclusion</b>	<b>Firms excluded for missing EBITDA data</b>	<b>Final sample</b>
<b>Non-registered firms</b>	34,344	952	33,392	15,014	<b>18,378</b>
<b>WL registered firms</b>	1,355	540	815	29	<b>786</b>
<b>Total</b>	35,699	1,492	34,207	15,043	<b>19,164</b>

*Own elaboration based on Tuscan Prefectures, AIDA, and ANAC data. The table shows the initial sample size and the exclusion for SOA certification and missing data. A total of 15,043 companies were excluded from the main dataset due to the lack of available information on EBITDA per employee, which is the economic performance indicator used in the further analysis.*

The table indicates that the vast majority of Tuscan companies (96.2%) are not registered in the White Lists. Such a low registration rate may reflect limited awareness of the benefits of inclusion in the White Lists or perceived bureaucratic burdens.

The data also suggest a positive association between white list membership and SOA certification in the initial sample: companies registered in the White Lists hold SOA certification far more frequently (39.85%) than those not registered (2.77%).

Overall, the dataset construction process guarantees comparability between WL and non-WL companies by selecting firms that share the same characteristics and are in good standing.

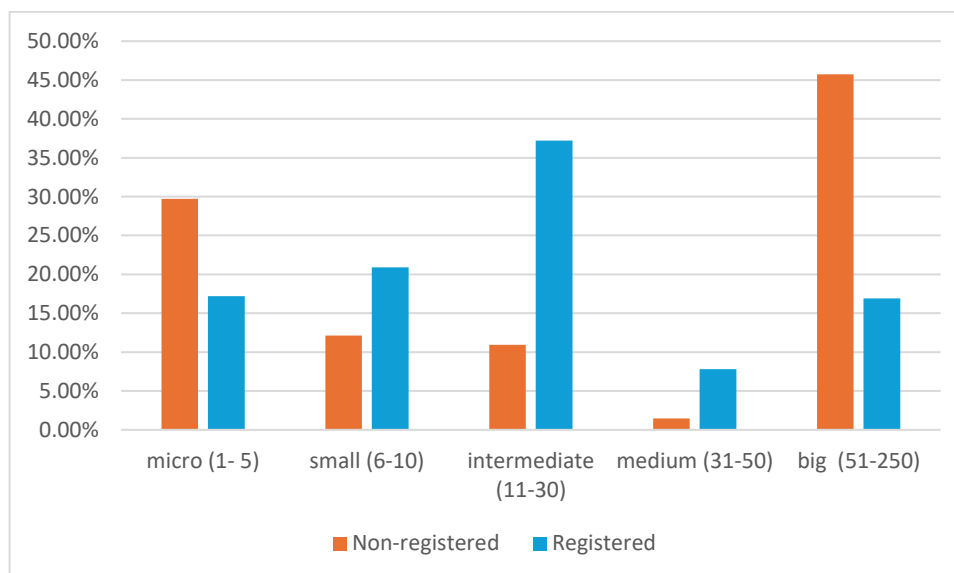
With the final dataset constructed and cleaned, we proceed to examine its composition, focusing on how sampled firms differ across key structural dimensions.

### 3.2. Characteristics of companies listed and not listed in the White Lists

As discussed in Section 3.1, the sample includes certified and comparison firms, distinguished by their white list registration status. This setup allows for a comparative analysis of firms that meet eligibility criteria but differ in their registration status, focusing on dimensions such as firm size, industry, and geographical location.

To explore structural differences between sampled firms, *Figure 2* shows the distribution of companies by size category (measured by number of employees)<sup>91</sup>.

*Figure 2: Distribution of firms by size and white list registration status*



*Source: Own elaboration based on Tuscan Prefectures and AIDA data.*

While large and micro firms dominate among non-registered businesses, white list companies show a comparatively higher presence in intermediate and small size classes. This can reflect the fact that intermediate-sized companies – being more structured and organised than micro firms, yet not large enough to have established internal procedures or alternative mechanisms that reduce the need for formal white list registration – are facilitated in the bureaucratic processes to obtain registration.

<sup>91</sup> Firm size is classified according to the number of employees as follows: micro-sized (1–5 employees), small-sized (6–10 employees), intermediate (11–30 employees), medium-sized (31–50 employees), and large-sized (51–250 employees). For further details, refer to *Table 4* in the Appendix.

Figure 3 reports the distribution by industry.

Figure 3: Distribution of firms by industry and white list registration status



Source: Own elaboration based on Tuscan Prefectures and AIDA data.

White-listed firms are more frequently found in the construction sector (*Cold rental machinery and hot freight, sez35*), in line with the sector's greater exposure to public procurement and anti-mafia compliance requirements. Non-registered companies also remain prevalent in the same construction industry (*sez35*), while also showing a significant presence in the hospitality industry (*Catering, canteen management, and food services, sez9*), as well as in the transport sector (*Road transport for third parties, sez6*). Also standing out is the percentage of white-listed companies in the environmental services sector (*Environmental services, sez10*).

Figure 4 compares the share of white list registrants versus non-registrants by Tuscan provinces.

Figure 4: Percentage distribution of firms by province



Source: Own elaboration based on Tuscan Prefectures and AIDA data.

White-listed firms tend to be concentrated in the Florence, Pisa, Arezzo, and Lucca Provinces. Florence has the highest number of firms overall, but comparatively a low share of WL-registered firms relative to its strong presence of non-registered firms. Arezzo, Grosseto, and Pisa exhibit a higher proportion of white-listed enterprises relative to their weight in the non-registered group.

Formal testing of these structural differences was conducted using Pearson chi-squared tests, which confirmed statistical significance<sup>92</sup>. The results confirm significant distributional differences between registered and non-registered firms along all examined dimensions: firm size ( $\chi^2(8) = 1,500$ ;  $p\text{-value} < 0.001$ ), industry sector ( $\chi^2(8) = 261.81$ ;  $p\text{-value} < 0.001$ ), and province ( $\chi^2(9) = 165.72$ ;  $p\text{-value} < 0.001$ )<sup>93</sup>.

<sup>92</sup> The Pearson chi-squared tests are conducted on the initial sample, as they serve a descriptive role, aimed at identifying pre-existing structural differences between WL and non-WL firms before sample restrictions. The impact analysis is instead performed on the final sample, which excludes SOA-certified firms and observations with missing financial data to isolate the effect of WL registration. Lee, W-S. (2013), "Propensity score matching and variations on the balancing test", *Empir. Econ.*, Springer, vol. 44(1), pp. 47-80. Shipman J. E., Swanquist, Q., T., Whited, R., L. (2017), "Propensity Score Matching in Accounting Research", *Account. Rev.*, 92 (1): 213-244., <https://doi.org/10.2308/accr-51449>. Austin, P. C. (2011), "An Introduction to Propensity Score Methods for Reducing the Effects of Confounding in Observational Studies", *Multivar. Behav. Res.*, 46(3), 399-424, <https://doi.org/10.1080/00273171.2011.568786>.

<sup>93</sup> Full output of the chi-squared tests is reported in the Appendix: *Tables 5, 6 and 7*.

These results statistically support the descriptive patterns observed in *Figures 2, 3, and 4*.

To summarize, a preliminary comparison between the WL and the non-WL firms reveals structural differences across firm size, industry sector, and geographical location. This observed heterogeneity may also influence business performance.

To investigate this further, the following section introduces the selected performance indicator EBITDA per employee and presents its descriptive statistics.

### 3.3. EBITDA per employee as an economic performance indicator

To evaluate the economic performance of firms, we rely on *Earnings Before Interest, Taxes, Depreciation, Amortization (EBITDA)*<sup>94</sup> as the main indicator. This metric captures the firm's ability to generate operating profits relative to its workforce size, offering a size-neutral measure of productivity.

EBITDA per employee was calculated using 2023 balance sheets<sup>95</sup> data by subtracting personnel expenses from value added<sup>96</sup>.

$$EBITDA \text{ per employee} = \frac{\text{Value Added} - \text{Personnel Cost}}{\text{Number of employees}}$$

Standardising<sup>97</sup> by workforce size increases its ability to measure labour productivity and enables fair comparisons across firms of varying sizes and structures. This is particularly relevant in the Tuscan context, where firm characteristics are highly heterogeneous<sup>98</sup>.

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<sup>94</sup> Ghini, A. (2012), "Margine operativo, lordo e netto. L'importanza per il controllo dell'andamento gestionale" [EBITDA gross and net. The importance for controlling management performance], *Economia Aziendale Online*-3: 1-14. Bouwens, J., De Kok, T., & Verriest, A. (2019), "The Prevalence and Validity of EBITDA as a Performance Measure", *Account. Audit. Control*, 25(1), 55-105, <https://shs.cairn.info/journal-accounting-auditing-control-2019-1-page-55?lang=en>. Nissim, D. (2024, June 01.), EBITDA, EBITA or EBIT?, *Columbia Business School Research Paper*, No. 17-71, Available at SSRN: <https://ssrn.com/abstract=2999675> or <http://dx.doi.org/10.2139/ssrn.2999675>.

<sup>95</sup> Financial data were sourced from AIDA by Bureau Van Dijk, covering both listed and non-listed firms operating in Tuscany's risk sectors in 2023. Data extracted from income statements were matched with annual full-time equivalent employee counts from the same database. Only firms with complete data for variables needed to compute EBITDA and employee headcount were included.

<sup>96</sup> Value-added is the difference between the value of production and the costs of external inputs directly used in the production process, such as raw materials, outsourced services, and third-party goods. It represents the primary economic outcome, indicating the residual amount available to the company for remunerating production factors not directly purchased from the market, such as labour and capital. See: Salaga J., Bartosova, V., & Kicova, E. (2015), "Economic Value Added as a measurement tool of financial performance", *Proc. Econ. Fin.*, 26, 484-489, [https://doi.org/10.1016/S2212-5671\(15\)00877-1](https://doi.org/10.1016/S2212-5671(15)00877-1). Airoldi, G., Brunetti, G., & Coda, V. (2020), *Corso di economia aziendale* [Business economics course], Il Mulino.

<sup>97</sup> See OECD & European Commission (2008), *Handbook on constructing composite indicators: Methodology and user guide*, OECD Publishing, <https://doi.org/10.1787/9789264043466-en>.

<sup>98</sup> Pasqual, S. (2023, February), *The snapshot of the regional production system from 2022 Business Register data*, Digital Services and Data Integration Sector, Regional Statistics Office.

Table 4 presents the descriptive statistics of EBITDA per employee (in thousands of euros per employee)<sup>99</sup>. On average, companies registered in the White Lists tend to exhibit stronger economic performance than their non-WL counterparts; the median also follows a similar ranking (18.7 vs 11.3 thousand of euros per employee). The distribution in both categories is strongly skewed and influenced by extreme values.

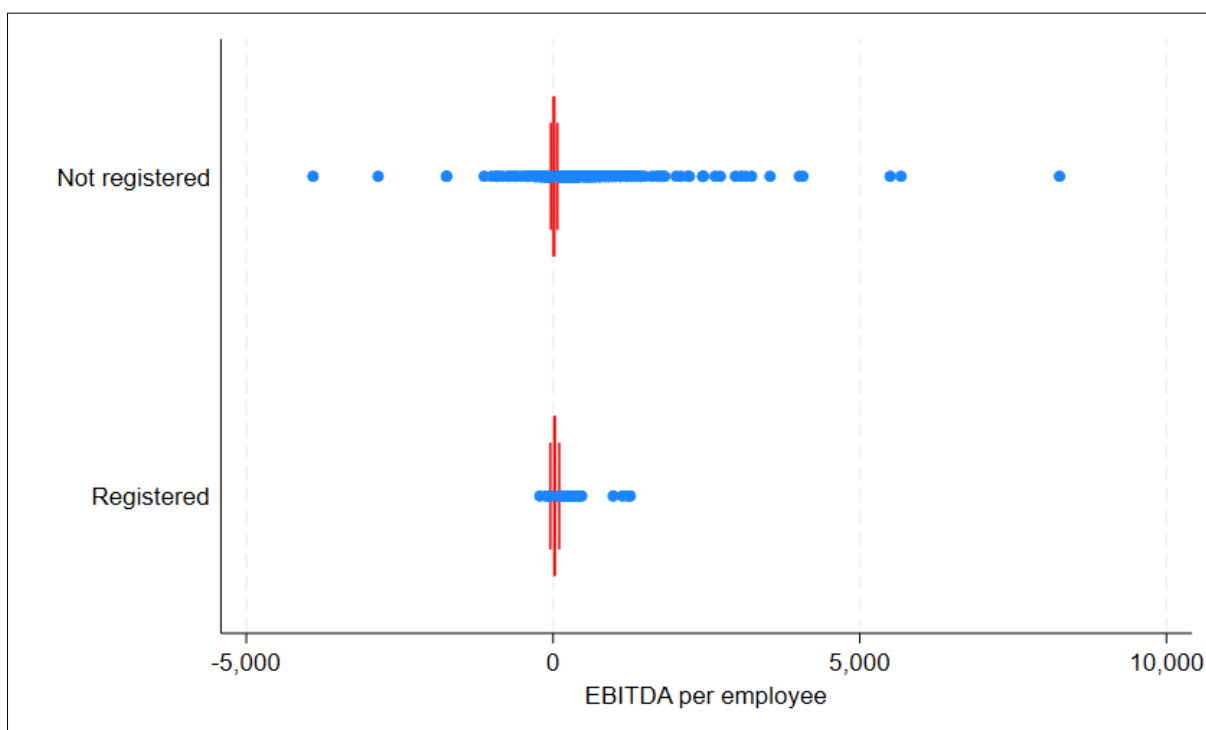
Table 4: Descriptive statistics of EBITDA per employee (thousands of euros per employee)

	N	Mean	Standard Deviation	Minimum	1 <sup>st</sup> Quartile	Median	3 <sup>rd</sup> Quartile	Maximum
WL								
Non-registered	18,378	35.22	159.09	-3912.88	3.57	11.27	30.30	8257.14
Registered	786	42.69	98.97	-214.61	6.47	18.71	44.58	1258.86

Own elaboration based on Tuscan Prefectures and AIDA data.

The box plots in Figure 5 visually confirm the right-skewed shape of the EBITDA per employee distribution in both sets.

Figure 5: Box plot EBITDA per employee (data not winsorized)



Source: Own elaboration based on Tuscan Prefectures and AIDA data.

<sup>99</sup> Table 4 reports descriptive statistics of EBITDA per employee based on non-winsorized data.

To formally test whether the differences in economic performance are statistically significant, we conducted both a two-sample t-test and a non-parametric Wilcoxon rank-sum test<sup>100</sup>.

The t-test confirms that the average EBITDA per employee is significantly higher for white list firms than for non-registered firms, with a *p-value* < 0.001.

The Wilcoxon test further supports these findings by showing that the median EBITDA per employee is also significantly different across the two groups (*p-value* < 0.001). These results suggest that white list membership can be associated with stronger economic performance.

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<sup>100</sup> The two-sample t-test and Wilcoxon rank-sum test are conducted on winsorized values of EBITDA per employee to mitigate the influence of extreme observations, which can inflate the variance and make the mean a noisy measure of central tendency. See the Appendix, *Figures 1* and *2* for complete test output.

## **Chapter 4:**

### **Methods and results: evaluating the impact of White Lists on firm performance**

The previous chapter presented descriptive differences between firms registered in the White Lists (treated group) and those not registered (control group). It revealed that the treated group, on average, reports higher values of EBITDA per employee. This chapter describes the empirical approach used to assess whether this association reflects a positive impact of white list registration on firm performance. We estimate this relationship by combining linear regression analysis with propensity score matching (PSM).

The chapter is structured as follows. The first section introduces the empirical strategy: detailing the variables, measurement choices, and the rationale for their selection. The second section presents the model used to estimate the relationship between registration in the White Lists and firm performance, controlling for relevant covariates. The third section describes the implementation of Propensity Score Matching (PSM) to adjust for possible selection bias. The last two sections of the chapter present the main results (Section 4.4) and evaluate the robustness and sensitivity of the findings (Section 4.5).

#### *4.1. Empirical strategy*

To test the main hypothesis of the study (Chapter 1), we compare the performance of firms registered in the White Lists with those that are not. The underlying idea is that the white list membership serves as a signal of legality and integrity, potentially improving firms' reputation and internal efficiency, which can positively affect its economic and financial profile<sup>101</sup>. Since registration in the White Lists is not randomly assigned, our analysis distinguishes between two groups: the "treated" firms, which are included in the White Lists, and the "control" group, composed of firms eligible for registration but not listed. This classification helps ensure that observed differences in performance reflect certification status rather than underlying firm characteristics.

Firms are classified as treated if they are registered in the White Lists as of 2023, based on the most recent data available from the Tuscan prefectures. The treated group therefore includes all firms listed in the White Lists from their introduction in 2013 up to 2023, regardless of when initial registration occurred. As registration dates are incomplete and inconsistently reported across prefectures, the treatment definition relies only on firms recorded as of 2023, rather than a longitudinal reconstruction of registration timelines (see Chapter 3).

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<sup>101</sup> Acconcia, Alfano, Baraldi, Cantabene, 2021. Comi, Grasseni, Resmini, 2021. Alfano, Cantabene, De Iudibus, 2024.

In an experimental sample, average differences in outcomes can be attributed to the treatment because allocation is randomized. However, in our observational setting, firms in the two groups may differ not only in treatment status but also in other features that could influence both participation and the outcomes<sup>102</sup>. Matching techniques help in mitigating this bias by comparing treated units with untreated ones that have similar observable characteristics<sup>103</sup>.

For these reasons, the empirical strategy combines linear regression analysis with Propensity Score Matching (PSM) to control for possible confounding variables and isolate the association between white list enrolment and firm performance. This dual approach enhances the credibility of the estimated association by addressing selection biases arising from observable characteristics and by reducing the risk of unobserved bias.

A crucial element of this strategy is the construction of balanced comparison groups through a careful selection of covariates. Hence, the variable definition process of this study draws on empirical evidence and well-established theoretical literature<sup>104</sup>. The key variables involved in the analysis, include the dependent variable measuring firm performance, the main independent variable capturing white list registration, and a set of control variables to account for other relevant firm characteristics.

Firm performance is measured using EBITDA per employee, an indicator of operational productivity widely used in the literature<sup>105</sup> that normalises value added over personnel costs relative to firm size. As noted in Section 3.3 (*Figure 5*), EBITDA per employee tends to exhibit high variability and is affected by outliers. In order to reduce their influence and improve the robustness of the analysis, we applied a *winsorization* procedure<sup>106</sup>.

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<sup>102</sup> Alfano, Cantabene, De Iudicibus, 2024.

<sup>103</sup> Heinrich, C., Maffioli, A., & Vazquez, G. (2010), “A primer for applying propensity-score matching”, *Impact-Evaluation Guidelines*, Technical Notes, No. IDB-TN-161, Inter-American Development Bank.

<sup>104</sup> The selection of variables draws on a combination of empirical evidence and economic theory, as discussed in detail in Chapter 2, where the relevant literature on firm performance determinants and legitimacy signals is reviewed. This theoretical foundation guides the identification of key covariates to ensure comparability and robustness in the analysis. For more details on the variables used in the analyses, see *Table 4* in the Appendix.

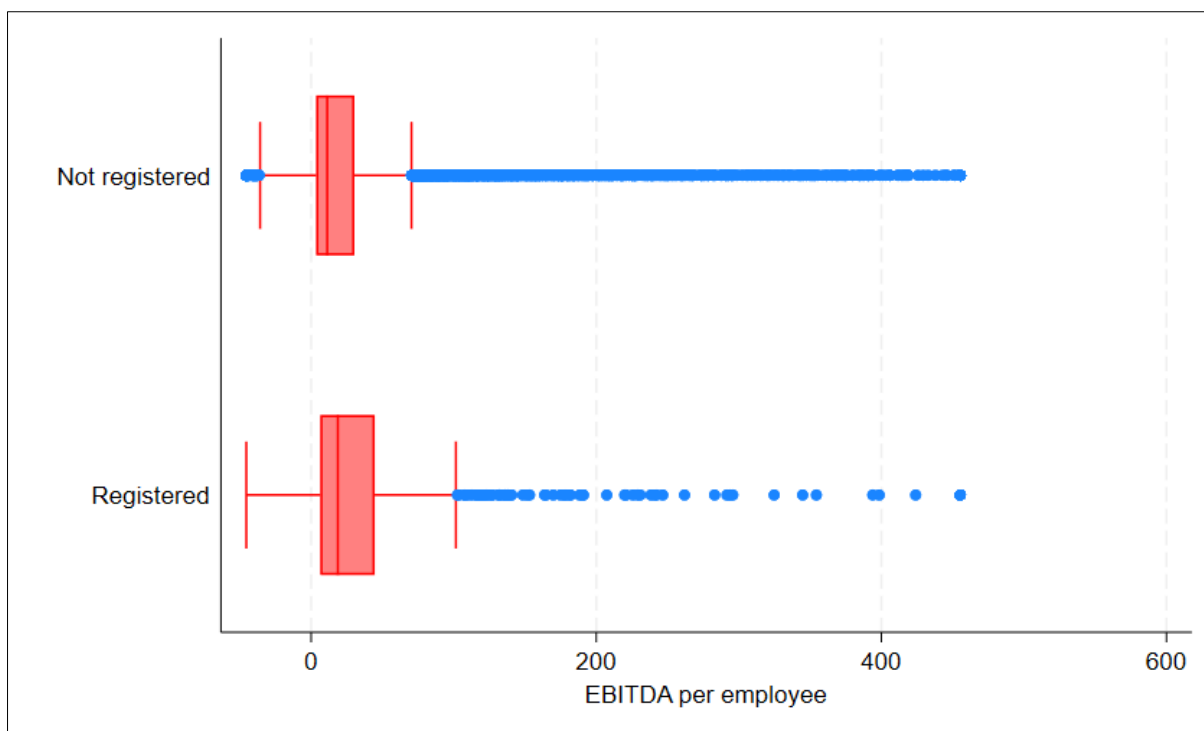
<sup>105</sup> Damodaran, A. (2002), *Investment Valuation: Tools and Techniques for Determining the Value of Any Asset*, Wiley, Hoboken, NJ. Palepu, K.G., Healy, P.M., Bernard, V.L. (2000), *Business analysis and valuation using financial statements*, 2nd edition, South-Western, Cincinnati, OH. Gagliardi, G., & Marsilii, S. (2017), “La funzione dell’EBITDA nelle compravendite societarie” [The role of EBITDA in corporate transactions], *Amministrazione & Finanza*, n. 5. Pinto Jerald, E. (2015), *Equity Asset Valuation*. Rogers, J. (2013), “The Analysis of Performance. In: Strategy, Value and Risk”, *Palgrave Macmillan Finance and Capital Markets Series*, Palgrave Macmillan, London, [https://doi.org/10.1057/9780230392687\\_5](https://doi.org/10.1057/9780230392687_5).

<sup>106</sup> The winsorization procedure consists of removing outliers by replacing them with predefined values, thereby mitigating their impact on regression parameters. For more details, see: Sullivan, J. H., Warkentin, M., & Wallace, L. (2021), “So many ways for assessing outliers: What really works and does it matter?”, *J. Bus. Res.*, 132, 530–543, <https://doi.org/10.1016/j.jbusres.2021.04.052>;

Wilcox, R. (2005), “Trimming and Winsorization”, *Encyclopedia of Biostatistics*, Wiley, <https://doi.org/10.1002/0470011815.b2a15165>. Ludwig-Mayerhofer, W. (2020, September 28), *Stata Guide* – *Winsorization*, retrieved 24th April 2025, from

This technique replaces extreme values below the 1<sup>st</sup> and above the 99<sup>th</sup> percentiles with the closest values within these limits (*Figure 6*).

*Figure 6: Box plot EBITDA per employee (winsorized data)*



*Source: Own elaboration based on Tuscan Prefecture and AIDA data.*

*Figure 6* illustrates the distribution of EBITDA per employee after winsorization, separately for the two sampled groups. As evident from the box plot, extreme values in both tails have been capped.

The key independent variable is white list registration (*WL*), coded as a binary variable to indicate whether a company is registered or not (1 if registered, 0 otherwise).

Control variables include several firm characteristics: size (*size*), a variable classifying the company's economic activity (*sez*), a geographical variable (*area*), and the age of the company (linear and square terms – *age* and *age*<sup>2</sup>), all of which are recognised possible confounders in empirical analyses of firm performance<sup>107</sup>.

Firm size is measured by the number of employees, grouped into nine classes defined as follows: micro-sized (1–5 employees), small-sized (6–10 employees), intermediate (11–30 employees), medium-sized (31–50 employees), and large-sized (51–250 employees)<sup>108</sup>.

<https://wlm.userweb.mwn.de/Stata/wstatwin.htm>. Dixon, W.J., & Yuen, K.K. (1974), "Trimming and winsorization: A review", *Stat. Hefte*, 15, 157-170.

<sup>107</sup> For more details, see *Table 4* in the Appendix.

<sup>108</sup> For further details, refer to Chapter 3 and *Table 4* in the Appendix.

The micro-enterprise group (1 to 5 employees), which is highly represented in the dataset, was further subdivided into five categories to better capture internal variability.

Sectors are classified according to the list of industries identified by the Council of Ministers as more exposed to mafia infiltration, following the logic underlying the white list inclusion (see Section 2.1).

Geographical location corresponds to Tuscan provinces where companies are based or operate, to account for local economic conditions. This variable also reflects the administrative structure of the White Lists, which are managed at the prefectural level, where companies register according to their location.

Firm age represents the number of years in business, capturing company's experience and stability. Its squared value controls for potential non-linear effects.

The analysis proceeds in two steps. First, a linear regression estimates the association between white list enrolment and EBITDA per employee, controlling for all covariates discussed. Second, we implement Propensity Score Matching (PSM) to compare white-listed firms with a matched sample of unlisted firms sharing similar observable features.

The choice to adopt the PSM approach was motivated by the need to mitigate potential identification challenges arising from the non-random nature of white list enrolment. Voluntarily registering firms may differ systematically from non-registered ones in unobservable traits. As a result, white list registration may not be the only relevant difference: higher-performing or more compliant firms may be more likely to seek certification. This mechanism may generate endogeneity in the estimation of the effect of white list enrolment on economic performance. Propensity Score Matching mitigates this issue by balancing observable covariates between treated and control firms (Section 4.3).

Overall, PSM<sup>109</sup> provides a credible quasi-experimental framework for isolating the association between white list registration and firm performance in the current dataset.

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<sup>109</sup> This approach is consistent with established applications in non-experimental policy evaluation and aligns with best practice recommendations for handling selection bias in observational. See Rosenbaum, P. R., & Rubin, D. B. (1983), "The central role of the propensity score in observational studies for causal effects", *Biometrika* 70(1), 41-55. Imbens, G.W. (2004), "Nonparametric estimation of average treatment effects under exogeneity: A review", *Rev. Econ. Stat.*, 86(1), 4-29. Angrist, J.D., & Pischke, J.S. (2009)., *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.

#### 4.2. Modelling the effect of white list enrolment on businesses

In order to quantify the impact of each independent variable on the outcome, we estimated a cross-sectional linear regression model<sup>110</sup> on the 2023 data. Specifically, we estimated the equation

$$Y_i = \beta_0 + \beta_1 WL_i + X_i' \beta_2 + \varepsilon_i \quad (1)$$

where  $\beta_0$  is a constant term,  $\beta_1$  is the coefficient of interest associated with white list registration,  $\beta_2$  is a vector of coefficients associated with the control variables included in the analysis, and  $\varepsilon_i$  is an error term.

$Y_i$  represents the outcome variable EBITDA per employee.

$WL_i$  is a binary variable coded as 1 if the company is registered in the White Lists, and 0 otherwise. Its coefficient  $\beta_1$  captures the conditional average difference in performance between registered and unregistered firms, conditional on the controls included in  $X_i'$ . We expect a positive and statistically significant  $\beta_1$  to validate our hypothesis that white list registration improves firm performance.

Following the literature<sup>111</sup>, we select a vector  $X_i'$  of covariates<sup>112</sup> (see Section 4.1) that may influence the dependent variable. In particular, we include some characteristics in terms of:

- firm structure: categorical variable for size, the industry sector, and the age of the firm (linear and squared);
- the geographical location: Tuscan province in which each firm operates.

Dummy variables for firm size, industry, and province were included, with large firms (*big*), construction sector (*sez35*), and Pisa (*PI*) serving as the reference categories.

Due to the lack of complete historical data on registrations (see Chapter 3), the analysis adopts a cross-sectional design, comparing firms at a single point in time.

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<sup>110</sup> The linear regression model applied to cross-sectional data is a foundational econometric tool to examine the relationship between a dependent variable and one or more explanatory variables at a single point in time. The model assumes a linear functional form and includes a stochastic error term capturing unobserved influences. The estimation is typically performed using Ordinary Least Squares (OLS) methods. See: Sanford, W. (2014), *Applied Linear Regression*, John Wiley & Sons. Olsen, C., & St George, D. M (2004), “Cross-sectional study design and data analysis”, *Coll. Entrance Exam. Board*, 26(03), 2006. Wang, X., & Cheng, Z. (2020), “Cross-sectional studies: strengths, weaknesses, and recommendations”, *Chest*, 158(1), S65-S71. Pasquazzi, L. (2022, February 28), *Modelli di regressione*, Dipartimento di Statistica e Metodi Quantitativi, Università degli Studi di Milano-Bicocca, <https://orcid.org/0000-0002-2467-2667>.

<sup>111</sup> Alfano, Cantabene, De Iudicibus, 2024. De Benedetto, Giuranno, Mastromarco, 2023. Acconcia, Alfano, Baraldi, Cantabene, 2021.

<sup>112</sup> For detailed definitions and the sources, see *Table 4* in the Appendix.

This choice improves data reliability and avoids inconsistencies from incomplete longitudinal information, even if it limits causal inference and the ability to detect temporal effects.

Although the regression model allows us to estimate the average association between white list registration and firm performance, it may not fully account for differences in firm characteristics between registered and non-registered firms. Therefore, the next section presents a propensity score matching technique to mitigate selection bias and improve the robustness of the estimated association.

### 4.3. Propensity score matching

As introduced in the previous section, propensity score matching constructs a balanced comparison sample by pairing each WL registered firm with one or more comparable non-registered firms that share similar observable characteristics<sup>113</sup>.

In this context, the voluntary nature of enrolment raises concerns about self-selection. Firms choosing to register may differ systematically from non-registered firms along observable and unobservable dimensions, potentially biasing simple comparisons. This issue is addressed through PSM, a method particularly suited to cross-sectional data with selection bias and widely used in policy evaluation. In the literature on anti-mafia policies and legality certifications, alternative empirical strategies are often employed, but in this case data limitations prevent their application. Recent studies rely on comparable quasi-experimental designs: difference-in-differences (DiD) to capture pre/post effects of mafia arrests on firm revenues<sup>114</sup>; instrumental variables to address unobserved confounders in criminal firm detection<sup>115</sup>; and synthetic control methods to evaluate aggregate regional impacts<sup>116</sup>. Instrumental variable approaches, however, would require a source of exogenous variation affecting white list enrolment but not firm performance directly, which is difficult to identify in the present institutional context. Similarly, difference-in-differences designs would require detailed longitudinal data on registration timing, which are not available (see Chapter 3).

The PSM approach aligns with established applications in studies on certification impacts<sup>117</sup> and mafia-related firm performance<sup>118</sup>.

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<sup>113</sup> Heinrich, Maffioli, & Vazquez, 2010.

<sup>114</sup> Chircop, J., Fabrizi, M., Malaspina, P. & Parbonetti, A. (2023), “Anti-Mafia Police Actions, Criminal Firms, and Peer Firm Tax Avoidance”, *J. Account. Res.*, Vol. 61 No. 1, doi: 10.1111/1475-679X.12455.

<sup>115</sup> Mocetti, S., Rizzica, L., Mirenda, L. (2019), *The boss on board: Mafia infiltrations, firm performance, and local economic growth*, CEPR, <https://cepr.org/voxeu/columns/boss-board-mafia-infiltrations-firm-performance-and-local-economic-growth>.

<sup>116</sup> Fontana, S., D’Agostino, G. (2022), *Anti-mafia policies and public goods in Italy*, Dipartimento di Economia Università degli studi Roma Tre, Working Paper n. 272, ISSN 2279-6916.

<sup>117</sup> Alfano, Cantabene, De Iudicibus, 2024.

Building on this framework, the propensity score is defined as the conditional probability of being registered in the White Lists given a set of observed covariates. In practice, identifying a suitable metric that balances firms across many covariates of several types can be challenging, especially when the dimensionality of the data is high. For this reason, the propensity score acts as a *balancing score* and a *minimal sufficient statistic* for covariate information, summarising all relevant characteristics into a single scalar measure. Conditioning on the propensity score therefore effectively controls for observed confounders and ensures conditional independence between treatment assignment and potential outcomes<sup>119</sup>. Formally, for each firm  $i$ , the propensity score is estimated as:

$$p(X_i) = P(WL_i = 1 \mid X_i') \quad (2)$$

where  $WL_i$  is the binary indicator of white list registration which represents the treatment variable in this study, and  $X_i'$  is the vector of covariates describing firm characteristics.

Following a consolidated procedure<sup>120</sup>, this conditional probability was estimated through a probit regression model, where the binary dependent variable  $WL_i$  equals 1 if the firm is registered and 0 otherwise. The probit specification is given by:

$$Pr(WL_i = 1) = \Phi(\gamma_0 + X_i'\gamma) \quad (3)$$

where  $\Phi(\cdot)$  denotes the cumulative distribution function of the standard normal distribution, and  $\gamma$  is the vector of estimated coefficients. The covariates included in the model are the same as those presented previously in the linear regression model (*Equation 1* in Section 4.2): firm size, geographical location, industry sector, and firm age (linear and squared terms).

Due to lack of historical data on registration dates (see Chapter 3), only baseline structural characteristics were included in estimation. Economic indicators that could be affected by the treatment itself were excluded to avoid post-treatment bias<sup>121</sup>.

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<sup>118</sup> Mirenda, L., Mocetti, S., & Rizzica, L. (2019), “The real effects of ‘ndrangheta: firm-level evidence”, *Temì di discussione (Working Papers)*, Banca d’Italia, No. 1235.

<sup>119</sup> Rosenbaum, Rubin, 1983.

<sup>120</sup> Leuven, E., & Sianesi, B. (2003), *Psmatch2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing*. Austin, (2011). Stuart, E. A. (2010), “Matching Methods for Causal Inference: A Review and a Look Forward,” *Stat. Sci.*, 25(1), 1–21. Rosenbaum, Rubin, 1983.

After estimating the propensity score, each treated firm was matched to its four nearest neighbours among untreated firms, using the *nearest neighbour matching*<sup>122</sup> (NNM) algorithm without replacement<sup>123</sup>.

This method pairs each treated unit with the closest control units based on the estimated propensity scores, ensuring that each control firm can be matched only once and that the matched groups are balanced. It iterates through the list of treated firms, selecting the closest eligible controls for each, and is well-documented as the most common approach in the literature<sup>124</sup>.

Two key assumptions underpin the validity of the PSM approach to produce accurate estimates of the treatment effect in an observational study: the Conditional Independence Assumption (CIA); and the Common support condition<sup>125</sup>. The CIA requires that, conditional on the observed covariates, the treatment assignment is independent of the potential outcomes. This assumes that all relevant differences between treated and untreated firms are captured by the included variables. The Common support condition ensures that for each treated firm there exists a comparable untreated firm with a similar propensity score. These conditions are necessary to interpret the results of PSM as indicative of a treatment association between certification and performance.

Once the matching was performed, we verified the balance of covariates using the *standardised percentage bias*, comparing the mean values of each variable across treated and control groups before and after matching<sup>126</sup>. This statistic measures the percentage difference in sample means relative to the average standard deviation.

<sup>121</sup> Austin, P. C. (2010), “Statistical criteria for selecting the optimal number of untreated subjects matched to each treated subject when using many-to-one matching on the propensity score”, *Am. J. Epidemiol.* 172(9), 1092-1097.

<sup>122</sup> The analysis employed the “psmatch2” module developed by Leuven and Sianesi, compatible with Stata. Propensity Score Matching was implemented using nearest-neighbour matching without replacement, based on the estimated propensity scores. Each treated firm was matched to its four nearest untreated firms, without applying a calliper restriction. Leuven, & Sianesi, 2003.

<sup>123</sup> By default, the *psmatch2* command in Stata performs nearest neighbour matching without replacement, meaning that once a control unit is matched to a treated unit, it cannot be used again for another match. In this analysis, each treated firm was therefore matched to its four nearest control firms based on estimated propensity scores, ensuring unique matches for all treated observations.

<sup>124</sup> Thoemmes, F. J., & Kim, E. S. (2011), “A systematic review of propensity score methods in the social sciences”, *Multivar. Behav. Res.*, 46(1), 90-118. Zakrisson, T., Austin, P., & McCredie, V. (2018), “A systematic review of propensity score methods in the acute care surgery literature: avoiding the pitfalls and proposing a set of reporting guidelines”, *Eur. J. Trauma Emerg. Surg.*, 44, 385-395.

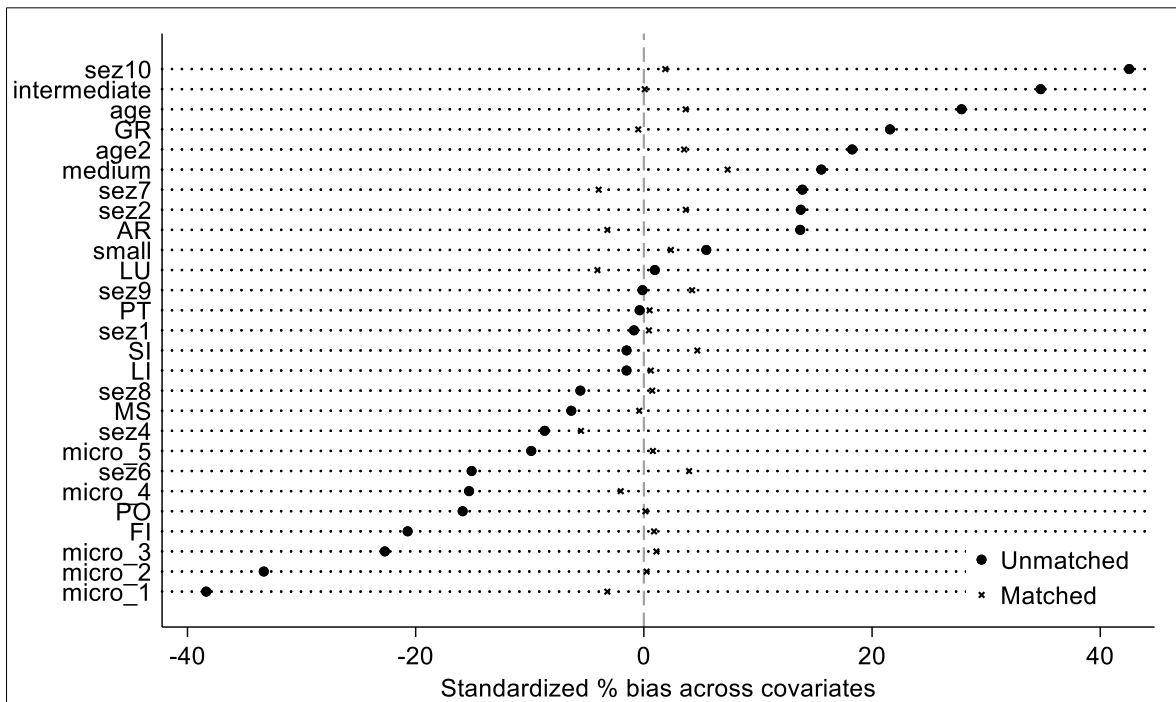
<sup>125</sup> Caliendo, M., & Kopeinig, S. (2008), “Some practical guidance for the implementation of propensity score matching”, *J. Econ. Surv.*, 22(1), 31-72.

<sup>126</sup> The standardised percentage bias for a covariate is calculated as:  $B = \frac{\bar{X}_T - \bar{X}_C}{\sqrt{\frac{s_T^2 + s_C^2}{2}}} \times 100$  where:  $\bar{X}_T$  and  $\bar{X}_C$  are the

sample means of the covariate in the treated and matched control groups, respectively;  $s_T^2$  and  $s_C^2$  are the corresponding sample variances. This statistic expresses the difference in means between the two groups as a percentage of the pooled standard deviation. A value closer to zero indicates better covariate balance after matching.

Figure 7 illustrates these biases for selected covariates. The reduction in bias toward zero post-matching (to below 5%) for the vast majority of variables demonstrates that the procedure successfully balanced the two groups. The figure confirms the effectiveness of the matching method in ensuring comparability between the two groups with respect to the considered control variables, reducing the risk of adverse selection bias, and improving the reliability of the results.

Figure 7: Covariate Balance Assessment: Pre- and Post-Matching Standardised Bias



Standardised percentage bias for each covariate before (●) and after (×) matching. The vertical line at zero indicates perfect balance between treated and control groups. Points closer to zero post-matching demonstrate that the procedure effectively reduced imbalance and improved comparability across the observed covariates. Covariates are listed on the vertical axis.

After matching, we re-estimated a weighted ordinary least squares (OLS) regression on the matched sample, using the matching weights produced by the PSM algorithm. The weights correspond to the inverse probability of treatment derived from the matching procedure.

This weighting scheme refines the estimation of the association between white list registration and firm performance (EBITDA per employee), assigning greater weight to observations that are more similar in terms of propensity score. The use of robust standard errors further improves inference reliability<sup>127</sup>.

<sup>127</sup> Austin, 2010.

Once a balanced comparison sample was obtained and the matching quality verified, the analysis proceeded to estimate the effect of white list registration on firm performance.

The next section presents the results obtained from the OLS regression and from the weighted regression following propensity score matching, discussing how certification is associated with differences in operational outcome between registered and non-registered firms.

#### 4.4. Effects of white list registration on businesses

Building on the methodology described in Sections 4.2 and 4.3, this section presents the estimated effects of white list registration on firm performance, testing the research hypothesis (Chapter 1). The analysis proceeds in two steps: first, by estimating an OLS regression on the unmatched sample, and second, by re-estimating the model using post-matching weights obtained through the propensity score procedure to reduce selection bias.

Table 5 reports both sets of estimates: *column (1)* presents the baseline OLS regression results, while *column (2)* shows the weighted estimates obtained after propensity score matching. The model controls for a comprehensive set of structural, sectoral, and geographical covariates.

In the baseline model, the coefficient for white list registration (*WL*) is positive and highly significant ( $\beta_1 = 8.36$  thousand of euros per employee,  $p\text{-value} < 0.01$ ), indicating that certified firms display, on average, higher EBITDA per employee than non-certified firms. This result is consistent with the hypothesis that legality certification can enhance firms' operational efficiency and labour productivity by signalling reliability to clients and partners, reducing information asymmetry, and strengthening business mechanisms, as also discussed in previous studies<sup>128</sup>.

Regarding firm size, the coefficients for micro and small enterprises are positive and significant relative to "big" firms (the reference category – Section 4.2). Since the dependent variable normalises operating income per number of employees, this outcome is coherent with the accounting structure: at equal total earnings, firms with fewer employees display a higher EBITDA per employee. This pattern is also consistent with the economic literature on firm size and productivity, which highlights structural difference in per-capita profitability across size classes<sup>129</sup>.

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<sup>128</sup> Capuano, Barletta, De Iudicibus, 2022. Alfano, Cantabene, De Iudicibus, 2024.

<sup>129</sup> Syverson, C. (2011), "What determine productivity?", *J. Econ. Lit.*, 49(2), 326-365, doi: 10.1257/jel.49.2.326. Haltiwanger, J., Jarmin, R., & Miranda, J. (2013), "Who creates jobs? Small versus large versus young", *Rev. Econ. Stat.*, 95(2), 347–361. Coad, A. (2009), *The Growth of Firms: A Survey of Theories and Empirical Evidence*, Edward Elgar.

The model's coefficients adjust for this aspect of the dependent variable, ensuring that the estimated effect of white list registration reflects true performance differences rather than firm size. Such adjustments align with the economic rationale that firm size influences productivity through scale effects<sup>130</sup>.

Additionally, the age variables reveal a non-linear pattern: the positive coefficient of age and the negative coefficient of its squared term indicate that operational performance increases with experience but begins to decline after a certain threshold.

Based on the estimated parameters, the turning point occurs at approximately 92 years, meaning that performance continues to improve for almost all firms in the sample<sup>131</sup>.

As for the control dummies, several sectoral and geographical effects emerge in the OLS unmatched model. Firms operating in sectors characterised by high labour intensity and lower value added<sup>132</sup> – such as Road transport (*sez6*), Security services for construction sites (*sez7*), Funeral and cemetery services (*sez8*), and Catering and food services (*sez9*) – exhibit significantly lower EBITDA per employee compared with the reference sector *sez35* (combining Cold machinery rental and Hot freight – Section 4.2). These negative coefficients are consistent with the literature on industry-specific productivity differentials, which highlights that firms in traditional services and logistics industries often operate under lower margins and stronger cost constraints<sup>133</sup>. Conversely, firms engaged in Environmental services (*sez10*) exhibit a positive and highly significant coefficient, which may reflect higher profitability or labour productivity within the sector.

At the geographical level, significant coefficients are found for Florence, Massa-Carrara, and Grosseto. The positive signs for Florence and Massa-Carrara indicate that firms located in these provinces tend to display higher productivity per employee relative to *Pisa* (the reference category – Section 4.2).

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<sup>130</sup> Syverson, 2011.

<sup>131</sup> Firms beyond this age threshold are rare in the sample. In such cases, the observed flattening or potential decline in performance could reflect structural rigidity or diminished innovation capacity, as suggested by the literature on organisational ageing. See Evans, D. S. (1987), "The relationship between firm growth, size, and age: Estimates for 100 manufacturing industries", *J. Ind. Econ.*, 35(4), 567–581, <https://doi.org/10.2307/2098588>. Coad, A., Segarra, A., & Teruel, M. (2013), "Like milk or wine: Does firm performance improve with age?", *Struct. Change Econ. Dyn.*, 24, 173–189, <https://doi.org/10.1016/j.strueco.2012.07.002>.

<sup>132</sup> Holding other factors constant, firms operating in labour-intensive sectors typically exhibit lower EBITDA per employee, as these industries are characterised by lower labour productivity and a higher proportion of fixed labour costs relative to the value added generated. Syverson, 2011. O'Mahony, M., & Timmer, M. P. (2009), "Output, Input and Productivity Measures at the Industry Level: The EU KLEMS Database", *Econ. J.*, 119(538), F374–F403, <https://www.jstor.org/stable/40271370>.

<sup>133</sup> Syverson, 2011.

In contrast, the negative coefficient for Grosseto could be associated with a less diversified industrial structure and smaller market size. These interpretations are consistent with observed regional economic patterns<sup>134</sup>.

Overall, the results from the baseline OLS regression provide an initial indication of the positive correlation between white list enrolment and firm-level operating performance, controlling for structural and location factors.

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<sup>134</sup> Banca d'Italia (2025), *L'economia della Toscana*, (Rapporto annuale), <https://www.bancaditalia.it/pubblicazioni/economie-regionali/2025/2025-0009/index.html>. Regione Toscana, Consiglio Regionale (2025), *Documento di economia e finanza regionale 2025: Nota di aggiornamento* (Allegato 1), [https://www.consiglio.regione.toscana.it/upload/crt/resoconti-aula/2476\\_5893.pdf](https://www.consiglio.regione.toscana.it/upload/crt/resoconti-aula/2476_5893.pdf).

Table 5: Impact of white list certification on firm performance (OLS and weighted OLS after PSM)

EBITDA per employee	(1)	(2)
	OLS - Pre matching	Weighted OLS Post matching
WL	8.359*** (2.346)	17.427*** (4.158)
micro_1	47.695*** (2.786)	52.629** (22.661)
micro_2	14.210*** (2.353)	1.913 (12.773)
micro_3	9.378*** (2.374)	42.255** (19.782)
micro_4	3.875* (2.242)	15.072 (16.276)
micro_5	2.384 (2.246)	33.459 (21.784)
small	3.791* (2.001)	-1.224 (9.621)
intermediate	3.225 (1.968)	3.102 (8.774)
medium	4.328* (2.614)	-4.055 (8.232)
sez1	-3.353 (2.181)	-9.312 (12.842)
sez2	.617 (5.044)	-6.434 (16.170)
sez4	-6.005*** (1.336)	-7.049 (17.864)
sez6	-15.979*** (1.605)	-32.437* (19.350)
sez7	-26.864*** (3.825)	-39.258*** (14.963)
sez8	-22.607*** (2.322)	-40.203*** (14.028)
sez9	-20.002*** (1.059)	-32.480** (12.973)
sez10	34.007*** (4.102)	6.666 (20.130)
Age	.861*** (.088)	1.268** (.576)
Quadratic age	-.005*** (.001)	-.009** (.004)
AR	-.266 (1.880)	-34.395** (15.636)
FI	3.443** (1.579)	-14.536 (11.589)
GR	-4.297* (2.245)	-4.618 (13.217)
LI	.686 (2.040)	-27.301** (11.522)
LU	-.806 (1.815)	-8.448 (23.314)
MS	5.177** (2.468)	-41.129* (22.714)
PT	-1.416 (2.082)	-24.412 (16.928)
PO	2.951 (2.137)	-21.854 (16.540)
SI	-2.181 (1.959)	18.915 (25.692)
Constant	12.819*** (2.680)	24.7836 (15.706)
N	19,164	1,399
R-squared	.130	.149

Robust standard errors in parentheses

\* p<0.1, \*\* p<0.05, \*\*\* p<0.01

Note: Robust standard errors in parentheses. Statistical significance is indicated as follows: \* p-value < 0.1, \*\* p-value < 0.05, \*\*\* p-value < 0.01. Data are at the firm level and refer to the year 2023. The White list dummy equals 1 if the firm is registered and 0 otherwise. Estimates contain controls for firm size, location, industry, age, and age squared. Reference categories: big firms (size), sez35 (industry), and Pisa (province).

As detailed in Section 4.3, to account for non-random registration, we applied propensity score matching to enhance the comparability between treated and control groups and to address potential selection bias.

After propensity score matching, we re-estimated the model using post-matching weights, retaining the baseline covariates that were previously used to estimate the cross-sectional regression model (Equation 1 in Section 4.2). Matching weights derive from the PSM procedure and represent the relative contribution of each unit to the matched sample<sup>135</sup>. As shown in *Table 5 (column 2)*, the coefficient for WL remains positive and statistically significant ( $\beta_l = 17.43$  thousand of euros per employee,  $p\text{-value} < 0.001$ ), confirming the robustness of the association between white list registration and firm performance even after adjusting for observable differences between treated and control firms. The comparison between the pre-matching and post-matching results reveals a significant increase in the WL coefficient (from 8.36 to 17.43 thousand of euros per employee). This variation reflects differences in sample composition between the unmatched and matched samples, capturing an average treatment effect on a more homogeneous subsample of firms with comparable observable characteristics. Although the matched sample is smaller, the findings confirm a reduction in covariate imbalance, suggesting that the post-matching estimate is less affected by selection bias and more representative of the effect of certification within the common support.

These findings support the view that the certification of legality has an impact on companies' activity. On average, the EBITDA per employee of firms on the White Lists is greater than that of non-certified firms.

Consequently, the results are consistent with the research hypothesis, indicating that inclusion in the White Lists is associated with improved firm performance for certified enterprises compared to non-certified but eligible firms.

The reliability of these estimates depends on the underlying assumptions of the linear regression model. Both models were estimated under the standard OLS assumptions of linearity in parameters, homoscedasticity (relaxed through robust standard errors), and absence of perfect multicollinearity among regressors. We also assume that the error term is uncorrelated with the explanatory variables, ensuring unbiased and consistent estimates ( $E[\varepsilon_i | WL_i, X_i'] = 0$ ).

To verify that these assumptions hold in practice, we conducted a series of diagnostic checks. The Variance Inflation Factor (VIF) test indicates the absence of problematic multicollinearity (mean VIF = 2.45, reported in the Appendix)<sup>136</sup>.

The distribution of residuals from the weighted post-matching regression model approximates normality, although with some right skewness, as shown in the residual plots<sup>137</sup>.

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<sup>135</sup> In our 1:4 nearest-neighbour matching without replacement, each treated unit is assigned a weight of one, while the weight of each control unit corresponds to the number of times it is matched to a treated unit. These weights are incorporated into the post-matching regression to accurately reflect the matched sample structure and obtain unbiased estimates.

<sup>136</sup> See *Figure 3* in the Appendix.

However, given the large sample size and the use of robust standard errors, this deviation does not materially affect the validity of inference.

In summary, the econometric analysis reveals a positive and robust association between white list certification and firm-level performance in terms of EBITDA per employee, suggesting potential competitive benefits of legality certification. Certification therefore represents a crucial tool for businesses, as it acts as a signal of transparency and credibility in relationships with suppliers, customers, and financial institutions, which perceive certified firms as more reliable. White list enrolment attests to legality and integrity by reducing information asymmetries, thereby facilitating transactions and more favourable contractual conditions. Certified firms may benefit from easier access to credit, improved positioning within supply chains, and lower compliance costs due to verified legal status. Demonstrating pre-certified legality also reduces the risk of penalties or contractual delays. These mechanisms help explain how a tool originally designed to prevent criminal infiltration can generate indirect advantages for firms' competitiveness, supporting the empirical evidence of higher EBITDA per employee among certified enterprises observed in this study.

#### 4.5. Robustness checks and sensitivity analysis

To assess the robustness of the results, we conducted two additional analyses. The aim is to verify whether the observed association between white list registration and firm performance is influenced by model specification choices or sample selection procedures.

Given the well-known limitations of the *Conditional Independence Assumption* (CIA – see Section 4.3) in propensity score matching<sup>138</sup>, it is important to test whether the estimated effect of certification remains stable under alternative specifications. Although the matching approach balances observable characteristics, it cannot account for unobserved confounders that may simultaneously influence certification and firm performance.

Therefore, robustness checks were performed: an alternative treatment definition, distinguishing firms registered in the White Lists before 31 December 2022 from those not yet registered at that time<sup>139</sup>; and an alternative performance indicator to examine the consistency of the findings across different measures of firm efficiency<sup>140</sup>.

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<sup>137</sup> See the distribution of residuals reported in *Figure 4* and *5* in the Appendix.

<sup>138</sup> Also referred to as the *unconfoundedness* or *ignorability assumption* in the propensity score matching literature. Rosenbaum, & Rubin, 1983. Imbens, Guido W. (2003), "Sensitivity to Exogeneity Assumptions in Program Evaluation", *Am. Econ. Rev.*, 93 (2): 126–132, doi: [10.1257/000282803321946921](https://doi.org/10.1257/000282803321946921). Caliendo, & Kopeinig, 2008.

<sup>139</sup> Modifying the definition of the treatment is a well-established practice for testing the sensitivity of results to different specifications. For example, Lin and Haepf use an alternative measure of treatment to analyse the effect of minimum wage regulations on firm decisions, demonstrating that the results remain robust even when dif-

First, the baseline model was re-estimated considering only firms registered by 2022, to verify whether the positive association holds when considering a different treatment group. The results remained consistent even with this specification: the coefficient for white list registration in the post-matching weighted regression was positive and statistically significant, even when recently registered companies were excluded from the treated group ( $\beta_1 = 14.83$ ,  $p\text{-value} = 0.013$ )<sup>141</sup>.

Second, a different performance metric was adopted – *the EBITDA-to-assets ratio* – as a proxy for capital efficiency and operational effectiveness. By normalising EBITDA with respect to total assets, this indicator captures how efficiently firms use their capital base to generate value, complementing the labour productivity perspective of EBITDA per employee.

The relevance of this ratio as a measure of resource efficiency and operational performance is supported by several studies<sup>142</sup>.

As with the main specification, linear regression models were estimated before and after matching. In the pre-matching regression, certified firms displayed a positive and highly significant coefficient ( $\beta_1 = 0.020$ ,  $p\text{-value} < 0.001$ ), indicating that the certification was associated with greater operating performance relative to the firm's assets base<sup>143</sup>.

The post-matching regression<sup>144</sup> also confirmed this result, with the WL coefficient remaining positive and statistically significant ( $\beta_1 = 0.015$ ,  $p\text{-value} = 0.046$ ), even after adjusting for covariate balance and applying matching weights. These findings indicate that the positive link between white list registration and firm performance is not limited to a single financial indicator but extends across different dimensions of operational efficiency, reinforcing the robustness of the results.

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ferent definitions of the treatment are applied. Haepf, T., & Lin, C. (2017), "How Does the Minimum Wage Affect Firm Investments in Fixed and Human Capital? Evidence from China", *Rev Dev Econ*, 21: 1057-1080, <https://doi.org/10.1111/rode.12296>. Similarly, Alfano et al. reapply the baseline equation to different control samples with to verify the stability of the main results (better access to bank credit and higher sales for WL certified firms). Alfano M.R., Cantabene C., De Iudicibus A., 2024.

<sup>140</sup> Applying alternative measures of firm performance to test the consistency of main results is widely recognised as best practice in applied econometric analysis, enabling researchers to validate findings and demonstrate robustness to varying definitions of economic outcomes. Lu, X., & White, H. (2014), "Robustness checks and robustness tests in applied economics", *J. Econ.*, 178, 1, 194-206, <https://doi.org/10.1016/j.jeconom.2013.08.016>.

<sup>141</sup> See Table 8 in the Appendix.

<sup>142</sup> The use of EBITDA/assets as a robustness check alternative performance measure is widely recognised in economic and financial research. This ratio captures a firm's ability to generate operating profit relative to its total assets, reflecting capital efficiency and operational effectiveness. See, Nhleko, R., & Schutte, D. (2024), "A Panel Analysis of the Impact of EBITDA, Equity Book Values, Growth, Risk and Negative Earnings on Share Price Variations", *Sage Open*, 14(3), <https://doi.org/10.1177/21582440241271172>. Bouwens, De Kok, & Verriest, (2019). Sultana, N., Zeya, F., Islam, K. M. Z., & Rodriguez, A. J. (2025), "The Role of Total Assets in Financial Performance: Evaluating Econometrics and Machine Learning Approaches", *J. Corp. Account. Financ.*, <https://doi.org/10.1002/jcaf.70010>.

<sup>143</sup> For further details about cross-sectional linear regression model, see Table 9 (column 1) in the Appendix.

<sup>144</sup> See Table 9 (column 2) in the Appendix for additional information about post-matching weighted regression.

Taken together, the robustness checks confirm the stability of the main empirical evidence: the association between white list certification and firm-level performance remains consistent under alternative specifications and outcome measures, indicating that the findings are not sensitive to modelling choices or the specific performance metric adopted.

In conclusion, this consistency supports the study's hypothesis that white list certification is systematically associated with superior operational efficiency among Tuscan firms. The following chapter discusses these results, highlighting their implications, limitations, and their policy relevance.

## Concluding remarks

This study has examined the relationship between white list registration and firm-level economic performance in Tuscany, focusing on the role of legality certifications in contributing to operational efficiency and competitiveness.

The purpose of the White Lists is to enhance the effectiveness of pre-emptive anti-mafia checks for economic entities operating in sectors particularly susceptible to criminal infiltration. At the same time, the initiative aims to strengthen the prevention of illegal activities targeting the legitimate economy across Italy. The presence of criminal organisations within Italian territory increases uncertainty, diminishes trust, and disrupts mutual cooperation, not only between businesses and institutions but also among individuals. These processes generate negative effects on local market dynamics between businesses: elevated transaction costs, a weakening of the socio-economic structure, and reduced operational efficiency among local firms. Measures to counter illegality are therefore a central part of the government agenda, especially in Italy, where a long-standing history of organised crime infiltration, systemic corruption, and territorial control by criminal organisations continues to affect several economic sectors. The white list system is intended to improve anti-mafia monitoring, focusing on those sectors most vulnerable to criminal involvement. Firms in these sectors can voluntarily register on the White Lists, demonstrating their commitment to lawful practices and their determination to resist organised crime.

Our study offers novel insights into the functioning of white list certification that are relevant for both managers and government authorities. Using a new firm-level database created *ad hoc* to map the Tuscan context, we estimate a significant and positive impact of the legality certification on the activity of Tuscan businesses. Registration on the White Lists is associated with greater economic performance among businesses, in line with the initial research hypothesis (Chapter 1). The econometric analysis further confirms this relationship: certified companies display, on average, higher EBITDA per employee compared to their non-certified counterparts. This result is confirmed across both baseline OLS regressions and propensity score-weighted estimates.

The findings also align closely with the theoretical literature on the economic role of legality. In contexts characterised by high information asymmetry and comparatively weak institutions, compliance with formal legal frameworks can function as a crucial signal of credibility and reliability to firms. Legality certifications, including the White Lists, reduce uncertainty and lower transaction costs, facilitating access to markets and resources while simultaneously deterring criminal infiltration.

Empirical and theoretical studies discussed consistently indicate that well-functioning regulatory systems underpin higher productivity, competitiveness, and economic development, and the evidence from our research confirms these mechanisms at the firm level (Sections 2.2 and 2.3).

To clarify the importance of white list certifications and the contribution of this study to the literature, it is also useful to compare them with other legality certifications. Unlike voluntary reputational signals, such as the Italian Legality Rating (issued by the AGCM<sup>145</sup> to reward transparency and ethical standards) or ISO 37001<sup>146</sup> (an international standard for anti-bribery management), White Lists function as a preventive anti-mafia filter embedded in public security frameworks. Rather than attesting to internal processes *ex post*, they screen operator's *ex ante* in infiltration-prone sectors through prefectural scrutiny and law enforcement databases, certifying impermeability to criminal influence rather than mere procedural compliance.

This institutional specificity also explains why assessing the economic effects of White Lists is methodologically more challenging than evaluating other certifications. Prefectural control is often based on non-public evidence, making it difficult for researchers to reconstruct the dynamics leading to the exclusion of a firm. Moreover, it is inherently complex to measure what does not occur. If the White Lists operate as a deterrent, their effectiveness lies precisely in the absence of infiltration, which is by definition less observable than economic success or firm growth certified by other standards. By addressing an object of analysis that is both institutionally complex and comparatively underexplored in the management and economics literature, this thesis provides novel empirical evidence on how anti-crime policies shape economic behaviour within vulnerable production systems.

The selection of Tuscany as a case study was not arbitrary. The region provides particularly relevant research setting for interpreting the empirical results of the analysis. More than a generic territory, Tuscany can be regarded as a natural laboratory for observing the effects of white list enrolment on firms, due to the structure of its production system.

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<sup>145</sup> The Italian Legality Rating (Rating di Legalità) is a voluntary reputational instrument introduced by Law No. 27/2012 and administered by the Italian Competition Authority (AGCM). It assigns a score ranging from one to three “stars” to firms that comply with specific requirements related to transparency, legality, and ethical conduct. The Rating is primarily intended to facilitate access to credit and public financing by signalling reliability to financial institutions and public administrations, but it does not entail continuous investigative monitoring or preventive anti-mafia screening. Autorità Garante della Concorrenza e del mercato, <https://www.agcm.it/competenze/rating-di-legalita/>.

<sup>146</sup> ISO 37001 is an international voluntary standard specifying requirements for the implementation of an anti-bribery management system. It focuses on internal governance mechanisms aimed at preventing, detecting, and addressing bribery risks within organisations. Certification under ISO 37001 assesses the adequacy of internal procedures and controls but does not involve public authority oversight or investigative scrutiny, nor does it certify immunity from external criminal influence. ISO 37001: Anti-bribery management systems – Requirements with guidance for use, [https://www.iso.org/standard/37001?utm\\_source=chatgpt.com](https://www.iso.org/standard/37001?utm_source=chatgpt.com).

Many of its industrial districts are characterised by small and medium-sized enterprises embedded in highly integrated supply chains, where trust, reputation, and regulatory compliance are crucial for securing contracts and maintaining stable commercial relationships. Although less conspicuous than in other regions, Tuscan districts also face risks of criminal infiltration and malpractice. In this context, white list certification plays a pivotal role by sending a credible signal of legality and integrity. It enables firms to mitigate operational risks, secure more favourable contractual terms, and strengthen their position within supply chains. The certification attests to firms' compliance and reliability, underscoring its importance in contexts where trust and reputational capital represent key productive assets.

Despite the consistency of the results, several methodological limitations prevent us from drawing causal conclusions. First, white list registration is voluntary and potentially subject to self-selection based on unobservable factors influencing both the probability of registration and the economic outcomes. Although propensity score matching addresses observable heterogeneity, it is not possible to completely exclude residual endogeneity<sup>147</sup>. Second, the analysis relies on cross-sectional data: the lack of information on pre/post registration performance prevents the use of panel data or longitudinal causal identification strategies. Furthermore, since some prefectures periodically overwrite white list records, a pre/post analysis is infeasible, severely limiting the assessment of temporal performance trends and the application of more rigorous causal identification strategies. Data coverage is also limited to companies for which financial statement information is available, excluding partnerships and sole proprietorships registered on the White Lists, which may lead to an underrepresentation of smaller or less structured businesses in the overall sample.

These limitations highlight several opportunities for future research. The creation of a national database that consolidates the white list registries and ensures consistency of historical data would enable longitudinal analyses, allowing researchers to track the causal effects of certification over time. Comparative studies across regions or sectors could further clarify the contextual factors that influence the effectiveness of legality certifications. Such efforts would not only refine empirical understanding but also provide policymakers with more precise evidence to design targeted and effective interventions. In addition to informing future research, the findings provide concrete evidence supporting the contribution of Italy's policy framework against organised crime.

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<sup>147</sup> Austin, 2011. Yang, J. Y., Webster-Clark, M., Lund, J. L., Sandler, R. S., Dellon, E. S., Stürmer, T. (2019), "Propensity score methods to control for confounding in observational cohort studies: a statistical primer and application to endoscopy research", *Gastrointest. Endosc.*, 90(3):360-369, doi: 10.1016/j.gie.2019.04.236.

The results nonetheless offer evidence of the effectiveness of the public policy enacted by the Italian authorities via Law 190/2012, which introduced proactive measures bolstering law-abiding businesses and improving transparency in sectors vulnerable to mafia influence.

In particular, our research has shown that even when a company does not participate in public procurement procedures for which white list certification is recommended (if not mandatory) or does not receive contract assignments from general government entities, inclusion in the White Lists serves as a safeguard in dealings between private entities.

By officially certifying certain companies as “legal,” the White Lists attest to the reliability of businesses in the eyes of customers, partners, and institutions. Consequently, the ultimate outcomes include advantages for businesses that go beyond those associated with interactions with public entities. Policymaking, accordingly, can harness this certification to encourage legal compliance within businesses.

Overall, this study underscores the broader significance of legality as a driver of economic performance. White list certifications do not merely ensure compliance with formal rules; they act as strategic assets that enhance operational efficiency, facilitate access to resources, and strengthen the competitive positioning of firms operating in challenging institutional environments. By fostering a culture of legality and supporting the widespread adoption of compliance mechanisms, policymakers and stakeholders can help sustain both firm-level success and the long-term development of resilient and transparent markets.

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## Appendix: legislation and case law

- Directive (EU) 2025/25 of the European Parliament and of the Council of 19 December 2024 amending Directives 2009/102/EC and (EU) 2017/1132 as regards further expanding and improving the use of digital tools and processes in company law.
- Decree-Law No. 58 of 24 February 1998, *Consolidated Law on Financial Intermediation, pursuant to Articles 8 and 21 of Law No. 52 of February 6, 1996, Article 120*, <https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:1998-02-24;58~art120-com2>.
- Decree-Law No. 135 of 6 April 2009, *Urgent interventions in favour of the populations hit by the earthquakes in the Abruzzo region in April 2009 and other urgent civil protection interventions*, G.U. No. 97 of 24-04-2009.
- Decree-Law No. 135 of 25 September 2009, *Urgent provisions for the implementation of Community obligations and for the execution of judgments of the Court of Justice of the European Communities.*, G.U. No. 223 of 25-09-2009.
- Decree Law No. 74 of 6 June 2012, *Urgent measures in favour of the populations affected by the earthquakes that hit the territory of the provinces of Bologna, Modena, Ferrara, Mantua, Reggio Emilia and Rovigo on 20 and 29 May 2012*, G.U. No. 131 of 07-06-2012.
- Decree Law No. 90 of 24 June 2014, converted with amendments by Law No. 144 of 11 August 2014, and by the D.P.C.M. of 18 April 2013 published in the G.U. on 15 July 2013, as amended by the D.P.C.M. of 24 November 2016 published in the G.U. on 31 January 2017.
- Decree-Law No. 23 of April 8, 2020, known as the “Liquidity Decree”, containing urgent measures on access to credit and fiscal obligations for businesses, special powers in strategic sectors, and extension of the scope of lists of suppliers, service providers, and contractors not subject to mafia infiltration attempts, including a broader range of environmental activities.
- Directive (EU) 2025/25 of the European Parliament and of the Council of 19th December 2024 amending Directives 2009/102/EC and (EU) 2017/1132 as regards further expanding and improving the use of digital tools and processes in company law.
- Law No. 190 of 6 November 2012, *Provisions for the prevention and repression of corruption and illegality in public administration. (12G0213)*, in G.U. general series No. 265 of 13-11-2012.

- Decree of the President of the Council of Ministers of April 18, 2013, *Procedures for the establishment and updating of lists of suppliers, service providers and contractors not subject to mafia infiltration attempts*, pursuant to Article 1, paragraph 52, of Law No. 190 of November 6, 2012.
  
- Decree of the President of the Council of Ministers of January 24, 2017, amending the Decree of the President of the Council of Ministers of April 18, 2013, *On procedures for the establishment and updating of lists of suppliers, service providers and contractors not subject to mafia infiltration attempts*, pursuant to Article 1, paragraphs 52 to 57, of Law No. 190 of November 6, 2012.
  
- Law No. 40 of 5 June 2020, *Conversion into law, with amendments, of Decree-Law No. 23 of April 8, 2020, containing urgent measures regarding access to credit and tax compliance for businesses, special powers in strategic sectors, as well as interventions concerning health and labour, extension of administrative and procedural deadlines.* (20G00060), in G.U. general series no. 143 of 06-06-2020, <https://www.gazzettaufficiale.it/eli/id/2020/06/06/20G00060/sg>.
  
- Legislative Decree No. 231 of 21 November 2007, *Implementation of Directive 2005/60/EC on the prevention of the use of the financial system for the purpose of money laundering and terrorist financing, as well as Directive 2006/70/EC laying down implementing measures thereof*, <https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2007-11-21;231>.
  
- Legislative Decree No. 159 of 6 September 2011, *Code of Anti-Mafia Laws and Preventive Measures, as well as new provisions on anti-mafia documentation*, pursuant to Articles 1 and 2 of Law No. 136 of August 13, 2010. (11G0201), <https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2011-09-06;159>.
  
- Legislative Decree No. 1 of 24 January 2012, *Urgent provisions for competition, development of infrastructures, and competitiveness*, art. 5-ter, Gazzetta Ufficiale No. 19, <https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legge:2012-01-24;1~art5ter>.
  
- Legislative Decree No. 36 of 31 March 2023, *Public Procurement Code implementing Article 1 of Law No. 78 of 21 June 2022*, delegating the Government in the matter of public contracts. (23G00044), <https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2023;036>.

## Appendix: web sources

- AIDA, <https://login.bvdinfo.com/R1/AidaNeo?SetLanguage=it>
- ANAC, <https://www.anticorruzione.it/>
- Autorità Garante della Concorrenza e del Mercato, <https://www.agcm.it/>
- Bureau van Dijk, AIDA, <https://login.bvdinfo.com/R1/AidaNeo>
- Cambridge Dictionary, <https://dictionary.cambridge.org/>
- CEPR, Centre for Economic Policy Research, <https://cepr.org/>
- Istituto Regionale per la Programmazione Economica della Toscana, <https://www.irpet.it/>
- ISTAT, [www.istat.it](http://www.istat.it)
- FINTEK LAB WIKI – BOCCONI, [https://wiki.fintechlab.unirondi.eu/wiki/Main\\_Page](https://wiki.fintechlab.unirondi.eu/wiki/Main_Page)
- European Council, Council of the European Union, The EU's fight against organised crime, <https://consilium.europa.eu/it/policies/eu-fight-against-crime/#how>
- Ministry of the Interior, Prefectures, <https://prefettura.interno.gov.it/it>
- Ministry of the Interior, (n.d.), *Governo sul territorio: Prefetture*, <https://www.interno.gov.it/it/temi/territorio/governo-sul-territorio-prefetture>

## Appendix

Table 1: White Lists - Summary Sheet

<b>What?</b>	White Lists are lists of companies set up at each prefecture, with the aim of making anti-mafia controls more effective with respect to business activities considered most at risk of infiltration by organised crime.
<b>Who can obtain it?</b>	Companies belonging to sectors most at risk of mafia infiltration.
<b>How to request it?</b>	The application must be submitted by the owner of the sole proprietorship or, in the case of a company, by its legal representative. It must include the basic identifying information of the enterprise (such as the company name, registered office – including for foreign companies – permanent branch in Italy, tax code, and VAT number), as well as the business sectors for which registration is requested. The application must be accompanied by a self-certification of registration with the Chamber of Commerce and self-declarations from all individuals subject to background checks under Article 85 of the Antimafia Code, including information on their cohabiting family members.
<b>How long does it take?</b>	The deadline for finalising the procedure is 90 days from the date of application.
<b>Does it have a deadline?</b>	The company's registration on the list remains effective for a period of 12 months from the date on which registration is granted by the prefecture and may be renewed by applying to the prefecture at least 30 days before the expiry of the validity of registration.
<b>Which requirements?</b>	<ul style="list-style-type: none"> <li>• Absence of any causes for exclusion, suspension, or prohibition as set out in Article 67 of Legislative Decree No. 159 of 6 September 2011 (Antimafia Code).</li> <li>• Absence of any attempts at mafia infiltration aimed at influencing the choices and direction of the company, as referred to in Article 84, paragraph 3, of the Anti-Mafia Code.</li> </ul>
<b>What advantages for registered firms?</b>	<ul style="list-style-type: none"> <li>• An element of guarantee for companies vis-à-vis third parties.</li> <li>• It replaces the communication and the anti-mafia clearance information, including the purposes of entering into, approving or authorizing contracts or sub-contracts relating to activities other than those for which it was required. Therefore, once registered on the White Lists, companies are not required to submit any further documents to public administrations for the purposes of the so-called “anti-mafia clearance”.</li> <li>• White Lists make anti-mafia controls more effective with respect to business activities considered most at risk of infiltration by organised crime.</li> </ul>

Table 2: Date of white list information downloaded from the Prefectures' official websites

PREFECTURE	DATE
AREZZO	30/11/2023
FIRENZE	30/11/2023
GROSSETO	30/11/2023
LIVORNO	30/11/2023
LUCCA	30/11/2023
MASSA-CARRARA	30/11/2023
PISA	30/11/2023
PISTOIA	30/11/2023
PRATO	28/11/2023
SIENA	30/11/2023

Table 3. Sectors eligible for white list enrolment: description and corresponding ATECO 2007 codes

SECTOR	NAME	DESCRIPTION	ATECO 2007 CODE
sez1	Extraction, supply, and transport of soil and inert materials	Activity of extracting materials such as sand, gravel, and other inert materials, and their transport to construction sites or other places of use.	016, 021, 022, 024, 081, 089, 210, 220, 222, 233, 239, 469, 477, 749
sez2	Packaging, supply and transport of concrete and bitumen	Production, supply, and transport of concrete and bitumen, essential materials for construction and building.	192, 236, 237
sez35	Cold rental of machinery and Hot freight	The rental of machinery and equipment (cold) and the provision of services requiring the use of heated equipment (hot), such as asphaltting and earth-moving operations.	011, 014, 266, 281, 332, 411, 412, 420, 421, 422, 429, 431, 433 439, 464, 466, 681, 702, 711, 712, 770, 771, 773, 811, 900, 620
sez4	Supply of wrought iron	Activity of processing and supplying iron for construction and other applications.	161, 162, 221, 241, 243, 251, 252, 256, 259, 263, 271, 273, 279, 282, 284, 289, 310, 331, 432, 467, 475, 701
sez6	Road transport on behalf of third parties	The transport of goods on behalf of other entities.	451, 461, 473, 479, 493, 522, 532, 631
sez7	Construction site guardian	The surveillance and protection of construction sites and other works.	610, 801, 802, 803
sez8	Funeral and cemetery services	Providers of funeral arrangements and burial services.	821, 829, 879, 960
sez9	Catering, canteen management, food services	Businesses providing on-site catering, hospitality, and food services.	107, 108, 463, 472, 494, 551, 561, 562, 563, 791, 799, 812, 855, 871, 873, 880, 881, 889
sez10	Environmental services	All activities related to waste management, including collection, transport, treatment, and disposal.	201, 244, 265, 370, 380, 381, 382, 383, 390, 682, 732, 813, 951

Table 3 reports the “high-risk” sectors defined by the Council of Ministers’ anti-mafia regulations, together with the three-digit ATECO 2007 codes we ultimately used to identify eligible firms. In this study, sector 3 and sector 5 are merged to avoid overlaps. In order to replicate the real-world enrolment process, we first examined the actual lists of companies that had applied to the White Lists in Tuscany. From those lists, we extracted every three-digit ATECO code and then grouped them under the ten sectors officially deemed at highest risk of mafia infiltration. A company was included in our sample if its primary activity code matched any of the ATECO 2007 codes shown in the table.

Table 4: Variables

Variables	Description	Source
<b>WL</b>	Dummy variable equal to 1 if a company is registered in the WL and 0 otherwise.	Tuscan prefectures
<b>EBITDA_employee</b>	Earning Before Interests Taxes Depreciations Amortizations (EBITDA) per employee. It is calculated by subtracting staff costs from value added (total revenues minus operating costs).	AIDA Bureau Van Dijk
<b>SOA</b>	Dummy variable equal to 1 if a company has SOA certification and 0 otherwise.	ANAC
<b>Sez</b>	Company's economic sector ( <i>sez1, sez2, sez35, sez4, sez6, sez7, sez8, sez9, sez10</i> ).	AIDA Bureau Van Dijk
<b>Size</b>	Categorical variable indicating company size based on the number of employees. It includes binary indicators for the following size classes: <i>micro_1</i> (1 employee), <i>micro_2</i> (2 employees), <i>micro_3</i> (3 employees), <i>micro_4</i> (4 employees), <i>micro_5</i> (5 employees), <i>small</i> (6–10), <i>medium-small</i> (11–30), <i>medium</i> (31–50), and <i>big</i> (51–250).	AIDA Bureau Van Dijk
<b>Area</b>	Tuscan province where the companies have their registered office or operational headquarters. (AR, FI, GR, LI, LU, MS, PI, PO, PT, SI)	Tuscan prefectures and AIDA Bureau Van Dijk
<b>Age</b>	Age of the company. It is calculated as the difference between the current year and the year of establishment.	AIDA Bureau Van Dijk

Table 5: Chi-squared test: Firm size and WL registration status

Firm size	WL		Total
	Not registered	Registered	
Micro (1 employee)	2,777	40	2,817
Micro (2 employee)	2,359	39	2,398
Micro (3 employee)	1,992	48	2,040
Micro (4 employee)	1,641	47	1,688
Micro (5 employee)	1,431	59	1,490
Small (6-10)	4,169	283	4,452
Intermediate (11-30)	3,761	504	4,265
Medium (31-50)	508	106	614
Big (51-250)	15,706	229	15,935
<b>Total</b>	<b>34,344</b>	<b>1,355</b>	<b>35,699</b>

Note: distribution of firms by detailed size class and WL status. The test confirms significant differences in registration patterns across firm sizes ( $\chi^2(8) = 1,500$ ;  $p$ -value  $< 0.001$ ).

Table 6: Chi-squared test: Industry and WL registration status

Industry	WL		Total
	Not registered	Registered	
Sez1	1,525	60	1,585
Sez2	257	26	283
Sez35	12,834	544	13,378
Sez4	5,584	230	5,814
Sez6	2,802	48	2,850
Sez7	59	11	70
Sez8	720	13	733
Sez9	8,650	241	8,891
Sez10	1,913	182	2,095
<b>Total</b>	<b>34,344</b>	<b>1,355</b>	<b>35,699</b>

Note: industry distribution by WL registration. The chi-squared test reveals that certain sectors (e.g., sez9 and sez10) have higher WL representation ( $\chi^2(8) = 261.81$ ;  $p$ -value  $< 0.001$ ).

Table 7: Chi-squared test: Province and WL registration status

Province	WL		Total
	Not registered	Registered	
AREZZO	2,946	167	3,113
FLORENCE	9,058	268	9,326
GROSSETO	1,755	134	1,889
LIVORNO	2,717	85	2,802
LUCCA	3,643	167	3,810
MASSA-CARRARA	2,575	78	2,653
PISA	3,700	208	3,908
PISTOIA	2,565	93	2,658
PRATO	2,918	58	2,976
SIENA	2,467	97	2,564
<b>Total</b>	<b>34,344</b>	<b>1,355</b>	<b>35,699</b>

Note: regional distribution by Tuscan province. The significant result suggests geographical clustering of WL firms ( $\chi^2(9) = 165.72$ ;  $p$ -value  $< 0.001$ ).

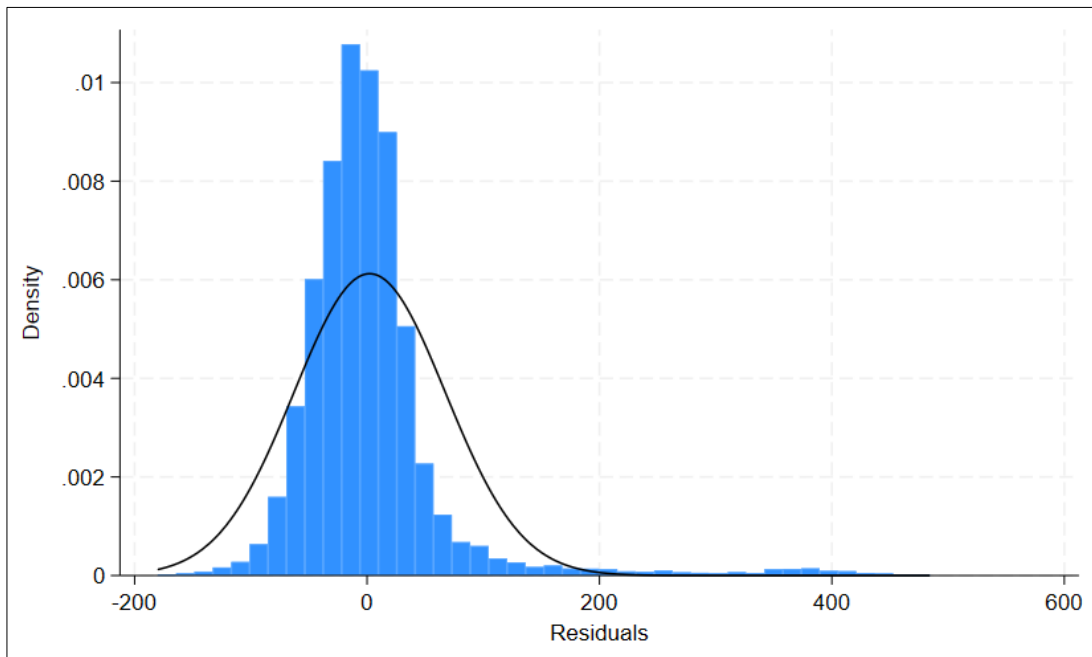


Figure 3: Variance Inflation Factor (VIF) for the weighted OLS regression after PSM

Variable	VIF	1/VIF
small	5.66	0.176632
age2	5.09	0.196525
intermediate	5.04	0.198512
age	4.80	0.208475
micro_1	4.33	0.230753
micro_2	3.87	0.258540
FI	3.41	0.293568
micro_5	3.28	0.304666
micro_4	3.04	0.328973
micro_3	2.88	0.347763
LU	2.32	0.430972
AR	1.99	0.503197
MS	1.86	0.538974
SI	1.83	0.546294
PT	1.77	0.565267
PO	1.68	0.596800
medium	1.63	0.614932
LI	1.58	0.631613
sez9	1.57	0.637055
GR	1.46	0.682744
sez4	1.45	0.689009
sez10	1.35	0.739363
sez6	1.29	0.772349
sez1	1.22	0.818279
sez8	1.09	0.917628
WL	1.07	0.936180
sez2	1.04	0.957026
sez7	1.02	0.983665
Mean VIF	2.45	

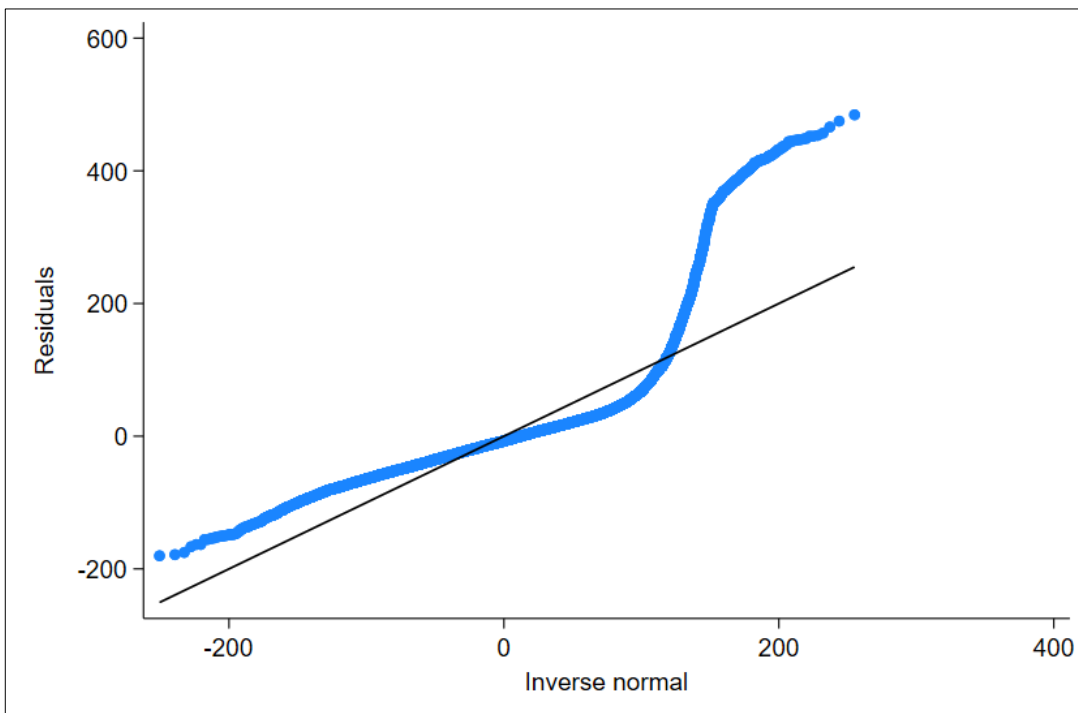
Variance Inflation Factors (VIF) were computed for all explanatory variables included in the weighted OLS regression model after propensity score matching. The mean VIF (2.45) is well below the conventional threshold of 10, indicating the absence of problematic multicollinearity among the regressors.

Figure 4: Distribution of residuals from the weighted OLS regression



Histogram of the regression residuals with the superimposed normal density curve. The distribution approximates normality, showing only mild right skewness. Given the large sample size and the use of robust standard errors, this deviation does not materially affect the reliability of inference.

Figure 5: Normal Q-Q plot of residuals from the weighted OLS regression



Quantile-Quantile (Q-Q) plot comparing the standardised residuals to the theoretical normal distribution. Most points lie close to the reference line, indicating an approximately normal distribution of residuals, with minor deviations in the upper tail.

Table 8: Robustness check using an alternative treatment definition (white list registrations by 2022)

EBITDA per employee	(1)	(2)
	OLS - Pre matching	Weighted OLS Post matching
WL2022	8.514*** (3.237)	14.834** (5.959)
micro_1	46.406*** (2.829)	54.269** (30.571)
micro_2	13.068*** (2.405)	9.428 (19.050)
micro_3	7.804*** (2.412)	49.356* (25.066)
micro_4	2.214 (2.268)	10.235 (17.068)
micro_5	1.179 (2.307)	16.825 (24.006)
small	2.504 (2.057)	.497 (17.872)
intermediate	2.129 (2.035)	5.929 (16.261)
medium	3.844 (2.707)	.163 (20.792)
sez1	-3.435 (2.199)	10.905 (23.529)
sez2	.801 (5.293)	-8.172 (26.075)
sez4	-6.006*** (1.343)	47.803 (44.441)
sez6	-15.798*** (1.610)	-3.495 (26.440)
sez7	-26.840*** (4.317)	-9.741 (25.472)
sez8	-22.426*** (2.341)	-64.704* (36.258)
sez9	-19.665*** (1.067)	7.643 (23.766)
sez10	35.439*** (4.275)	31.006 (27.101)
Age	.818*** (.091)	.955 (1.110)
Quadratic age	-.004** (.002)	-.010 (.015)
AR	.570 (1.891)	-25.321 (19.026)
FI	4.145*** (1.590)	-5.491 (13.724)
GR	-4.310* (2.260)	-2.522 (15.822)
LI	1.630 (2.054)	-6.887 (15.025)
LU	-.089 (1.827)	36.510 (39.767)
MS	6.345** (2.511)	-47.029** (21.477)
PT	-1.227 (2.068)	-20.411 (13.908)
PO	3.790 (2.158)	-42.198 (29.195)
SI	-1.506 (1.971)	45.740* (26.486)
Constant	13.661*** (2.745)	-9.254 (27.598)
N	18,775	721
r2	.130	.258

Robust standard errors in parentheses

\* p-value<0.1, \*\* p-value<0.05, \*\*\* p-value<0.01

*This table reports the estimated coefficients from the baseline regression, comparing pre-matching and post-matching results for firms registered on the White Lists by 2022. The analysis tests whether the positive impact of certification persists when restricting the treated group to firms already registered before 31 December 2022. The results show that the main findings remain robust, with the coefficient for white list registration remaining positive and statistically significant after matching. Statistical significance is indicated as follows: \* p-value < 0.1, \*\* p-value < 0.05, \*\*\* p-value < 0.01.*

Table 9: Impact of white list registration on firm performance: EBITDA-to-assets ratio (OLS and weighted OLS after PSM)

EBITDA/assets	(1)	(2)
	OLS - Pre matching	Weighted OLS Post matching
WL	.020*** (.004)	.15** (.008)
micro_1	.005 (.005)	.047** (.021)
micro_2	-.001 (.005)	.011 (.026)
micro_3	.003 (.005)	.050** (.023)
micro_4	-.001 (.005)	.077 (.047)
micro_5	-.010* (.006)	.036* (.021)
small	.008* (.005)	.032** (.015)
intermediate	.012** (.005)	.044*** (.013)
medium	.010 (.007)	-.002 (.032)
sez1	.002 (.005)	-.021 (.022)
sez2	-.025*** (.006)	-.048** (.023)
sez4	-.010*** (.003)	-.025 (.029)
sez6	-.030*** (.004)	-.008 (.029)
sez7	-.032 (.025)	-.080 (.045)
sez8	-.019** (.007)	-.043 (.043)
sez9	-.027*** (.003)	-.010 (.021)
sez10	-.028*** (.004)	-.005 (.017)
Age	-.002*** (.000)	-.001* (.000)
Quadratic age	.000*** (2.82e-06)	.000* (6.03e-06)
AR	.012** (.004)	-.067*** (.023)
FI	.013*** (.004)	-.032 (.021)
GR	-.009 (.006)	-.005 (.022)
LI	-.004 (.005)	-.059** (.023)
LU	-.000 (.004)	-.030 (.022)
MS	-.013** (.005)	-.067** (.032)
PT	-.006 (.005)	-.045 (.030)
PO	-.011** (.004)	-.019 (.028)
SI	.003 (.005)	.028 (.041)
Constant	.144*** (.006)	.142*** (.024)
N	19,164	1,399
r2	.024	.094

Robust standard errors in parentheses

\* p-value<0.1, \*\* p-value<0.05, \*\*\* p-value<0.01

Estimates report coefficients and robust standard errors (in parentheses). Statistical significance is indicated as follows: \* p-value < 0.1, \*\* p-value < 0.05, \*\*\* p-value < 0.01. Data are at the firm level and refer to the year 2023. The dependent variable is the EBITDA-to-assets ratio. The explanatory variables include white list registration (WL), firm size, location (province dummies), industry sector, and firm age (linear and squared terms). Reference categories: big firms (size), sez35 (industry), and Pisa (province). Results are presented for both the unmatched (left column) and post-matching weighted (right column) regressions.

La borsa di dottorato cofinanziata con risorse dell'Unione europea-*NextGeneration EU*  
Piano Nazionale di Ripresa e Resilienza Missione 4 – Componente 1 – Riforma 4.1 Riforma dei Dottorati – Inv.  
4.1 Borse PNRR patrimonio Culturale –*CUP H41J22000170002*