

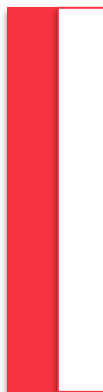
MASTER IN ECONOMICS OF BUSINESS AND STRATEGY

The Cost of Dominance: A Strategic Efficiency Analysis of the Portuguese Primeira Liga

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M

2026



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Dissertation
Master in Economics of Business and Strategy

Supervised by
José Abílio de Oliveira Matos

2026

Acknowledgments

I want to express my sincere gratitude to Professor José Matos for all his support throughout this whole endeavour. His help and advice were invaluable in going through the rough patches

I also want to thank my family. My parents and brothers for always being there for me, always wanting to help and encouraging me. My grandmothers for always providing when I needed. My Godparents for always nagging me about the subject.

My friends, for all the discussions we have had and for all the times I could distract myself from this work, allowing me to come back with a different energy.

My colleagues from MEBS for all the discussions we have had over the subject of our dissertations.

Abstract

This dissertation assesses the operational and strategic efficiency of clubs in the Portuguese Primeira Liga (2014/2015–2023/2024). Drawing on the Resource-Based View (RBV), it investigates whether the historical dominance of the ‘Big Three’ stems from superior management competence or from an overwhelming scale advantage. To answer this question, the study employs a two-stage semi-parametric approach. Firstly, Data Envelopment Analysis (DEA) decomposes overall efficiency into pure technical and scale components. Subsequently, a truncated regression with double bootstrap identifies the exogenous determinants of operational performance.

The empirical results support the ‘Cost of Dominance’ hypothesis. Although market leaders exhibit almost perfect pure technical efficiency (VRS), they operate under strong diminishing returns to scale in order to maintain their dominance in the domestic market. On the other hand, medium-sized clubs optimise their survival by approaching an optimal scale but remain constrained by their limited financial resources.

Contextual factors also play a decisive role. The regression analysis shows that frequent managerial dismissals act as a destructive frictional cost, actively pushing clubs away from the efficiency frontier. By contrast, participation in UEFA competitions acts as a systemic catalyst for efficiency.

Ultimately, this study concludes that, in a ‘Selling League’ where resources are scarce, absolute scale determines structural dominance. However, pure technical efficiency remains the foundational pillar of institutional sustainability.

Keywords: Efficiency, Data Envelopment Analysis (DEA), Liga Portugal, Resource-Based View (RBV), Football Economics, Scale Efficiency

JEL Classifications: Z21; D24; L25; C14

Resumo

Esta dissertação avalia a eficiência operacional e estratégica dos clubes da Primeira Liga Portuguesa (2014/2015–2023/2024). Com base na Visão Baseada nos Recursos (RBV), investiga-se o domínio histórico dos «Três Grandes» decorre de uma competência de gestão superior ou de uma esmagadora vantagem de escala. Para responder a esta questão, o estudo recorre a uma abordagem semiparamétrica em duas fases. Em primeiro lugar, a Análise de Envolvimento de Dados (DEA) decompõe a eficiência global em componentes técnicos puros e de escala. Posteriormente, uma regressão truncada com bootstrap duplo identifica os determinantes exógenos do desempenho operacional.

Os resultados empíricos apoiam a hipótese do «Custo do Domínio». Embora os líderes de mercado apresentem uma eficiência técnica pura (VRS) quase perfeita, operam sob fortes rendimentos decrescentes de escala, a fim de manter o seu domínio no mercado interno. Por outro lado, os clubes de média dimensão otimizam a sua sobrevivência aproximando-se de uma escala ótima, mas continuam limitados pelos seus recursos financeiros restritos.

Os fatores contextuais também desempenham um papel decisivo. A análise de regressão mostra que as demissões frequentes de gestores atuam como um custo de fricção destrutivo, afastando ativamente os clubes da fronteira de eficiência. Em contrapartida, a participação nas competições da UEFA atua como um catalisador sistémico da eficiência.

Em última análise, este estudo conclui que, numa «Liga de Vendas» em que os recursos são escassos, a escala absoluta determina o domínio estrutural. No entanto, a eficiência técnica pura continua a ser o pilar fundamental da sustentabilidade institucional.

Palavras-chave: Eficiência, Análise de Envolvimento de Dados (DEA), Liga Portugal, Abordagem Baseada nos Recursos (RBV), Economia do Futebol, Eficiência de Escala

Classificação JEL: Z21; D24; L25; C14

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Abbreviations

UEFA: “Union of European Football Associations”

FBref: “Football Reference”

1. Introduction

The Portuguese Primeira Liga operates at the extreme edge of the globalized football economy. Stripped of the massive broadcasting revenues that shield Europe's top divisions, domestic clubs are forced to navigate a quintessential 'Selling League' paradigm. Survival demands human capital exportation. To maintain institutional solvency, Portuguese structures have developed a severe, structural dependency on developing and selling athletic talent at a premium. Yet, this volatile outward dependency coexists with a remarkably rigid domestic oligopoly. The competitive landscape remains historically suffocated by the absolute hegemony of three dominant institutions: SL Benfica, FC Porto, and Sporting CP.

The dominance of the clubs (known as the 'Big Three') is often exclusively attributed to their financial superiority and overwhelming scale. However, this simple observation of the financial metrics obscures the important distinction between size and managerial competence. Sustainable competitive advantage does not derive solely from capital. According to the Resource-Based View (RBV), it stems from the organizational capacity to transform resources into tangible results. Efficiency is key. Yet, a significant gap remains in the literature. Are market leaders in resource-scarce environments genuinely superior in strategic management? Or do massive scale advantages simply shield them from competition, masking their underlying operational inefficiencies?

This study bridges this gap by evaluating the strategic and operational efficiency of Primeira Liga clubs over a ten-season period (2014/2015–2023/2024). Moving beyond a strictly mathematical frontier, the analysis anchors technical metrics to corporate football strategy. By using a two-stage semi-parametric approach, that starts with the utilization of Data Envelopment Analysis (DEA), the overall efficiency of these clubs is decomposed into technical and scale components. This will isolate managerial competence from the advantages or disadvantages of club size.

Three primary strategic mandates govern this empirical deconstruction. First, the analysis determines the operational scale of competing organizations, verifying whether market leaders suffer from decreasing returns to scale due to an over-expansion of baseline inputs. Second, it benchmarks managerial performance to test if budget-constrained, mid-sized clubs achieve superior pure technical efficiency relative to the elite. Finally, the framework quantifies the strategic impact of exogenous environmental determinants, specifically European

fixture congestion, managerial stability, squad average age and promotion effect, on a club's long-term operational success.

Ultimately, this study will highlight a complex interaction between scale and efficiency. While absolute scale remains the key factor of structural dominance and financial volume within the league, pure technical efficiency emerges as the critical anchor for long-term sustainability. Within this context, the Portuguese market is inherently volatile. Resources are scarce, and squad turnover is constantly high. In this environment, superior managerial competence rarely breaks the established oligopoly. Instead, it prevents capital-intensive models from collapsing into financial distress. It is, ultimately, the thin line between sustainable dominance and institutional failure.

The remainder of the dissertation is organized as follows: Section 2 reviews the relevant literature on football business models and efficiency measurement. Section 3 details the specific research problem and the institutional context of Portuguese football. Section 4 outlines the methodology, while section 5 describes the data. Finally, section 6 presents the results, and section 7 offers concluding remarks.

2. Literature Review

2.1 The economic nature of football: Objectives and business models

Football Globalization

The globalization of professional sports fundamentally transformed corporate revenue streams, driving a systemic transition away from localized business models. Historically, the traditional SSSL paradigm (Spectators-Subsidies-Sponsors-Local) anchored club finances strictly to their immediate geographic communities, relying on government subsidies, local ticket sales, and regional sponsorships. Yet, the turn of the 21st century unlocked a radically different MCMMG framework (Media-Corporations-Merchandising-Markets-Globalization). Elite clubs successfully penetrated international markets, leveraging lucrative broadcasting rights and global marketing networks to scale their operations exponentially (Andreff & Staudohar, 2000).

Crucially, this globalized model is inherently exclusionary. Access to these international revenue streams fractured the competitive landscape, engineering a severe and expanding financial chasm between the European elite and the broader 'middle class'. Empirical evidence starkly quantifies this polarization: while the absolute top-tier clubs command double-digit annual growth rates (averaging 11.7%), medium-sized structures stagnate at less than half that pace (4.3%) (Rohde & Breuer, 2016).

Faced with the recent stagnation of broadcasting revenues in major markets, clubs are aggressively pursuing alternative income streams. The current focus centers heavily on digital transformation (Schlimm & Breuer, 2023) and the monetization of physical assets through premium hospitality (UEFA, 2026). Highlighting the extreme edge of this digitalization, Andreff (2024) notes the emerging reliance on cryptocurrencies, fan tokens, and NFTs as global financing tools. Yet, the true paradigm shift is structural, not merely digital. Andreff (2024) conceptualizes this transition as the evolution from simple 'revenue globalization' to 'asset-driven globalization'.

The ultimate manifestation of this asset-driven era is the explosion of Multi-Club Ownership (MCO) networks. As Quansah & Breuer (2025) detail, these corporate structures engineer cross-border synergies to optimize player development and facilitate frictionless transfers between proprietor clubs. Consequently, attracting private equity has become the primary mechanism for maximizing efficiency, with private investors now acting as the main driver of capital injection (Rohde & Breuer, 2016). The sheer velocity of this structural shift is starkly captured by institutional data: while UEFA reports from a decade ago scarcely

acknowledged the model, the current landscape recognizes MCOs as the dominant governance trend in modern European football (UEFA, 2016; UEFA, 2026). In fact, 271 transactions were recorded between 2020 and 2025, contrasting with the 118 in the period between 2015 and 2019 (UEFA, 2026). Furthermore, according to the UEFA report, 16% of top-division clubs in Europe now have a cross-investment relationship with one or more clubs. Contrary to initial expectations, the MCMMG model did not bring more financial stability to clubs. Andreff (2024) highlights the arms race clubs took upon trying to collect all the major talents worldwide. This hyper-commercialization and inflation of squad costs is quantitatively supported by the CIES Football Observatory (Monthly Report 97), which highlights a continuous exponential growth in global transfer fees over the last decade, further widening the financial gap between elite buyers and peripheral selling clubs (Poli et al., 2024a). This resulted in inflated wage spending. The growth in revenues therefore resulted in weaker financial performance. It is in this context, along with the 2007 financial crisis, that UEFA develops its Financial Fair Play (FFP) rules. The first iteration ran from 2010 to 2022 and operated in a break-even system in a rolling 3-year period. This aimed to restrict the “sugar daddy” business model that was starting to appear in Europe. The idea of these rules was to function as a wage ceiling and reduce the wage-to-turnover ratio in order to boost club profitability. The cost was, however, the competitive balance. After a first obstacle from globalization, smaller clubs found new obstacles when trying to compete with the elite clubs. Consequently, and after the COVID pandemic, UEFA replaced FFP rules with new sustainability regulations, most notably the 70% squad cost-to-revenue rule, intended to impose stricter financial discipline across the European elite.

Uncertainty of outcome

As globalization exponentially widens the financial chasm between the elite and the middle class, it actively threatens the core product of the football industry: competitive balance. The foundational premise of sports economics dictates that consumer demand relies heavily on unpredictable matches. Rottenberg (1956) originally formalized this as the Uncertainty of Outcome Hypothesis (UOH), arguing that perfect predictability destroys entertainment value. Szymanski (2001) empirically validated this framework, demonstrating that extreme financial inequality actively drives audiences away. Thus, clubs cannot operate as pure monopolies; the market strictly requires 'coopetition' among rivals to sustain global interest. Yet, modern literature fiercely contests this universal demand for uncertainty. Jespersen and Pedersen (2018) fracture the traditional consensus by distinguishing between audience types.

They argue that local, stadium-going fans actually reject unpredictability; they demand a high probability, or even an absolute guarantee, of victory for their team. Conversely, television viewers seek competitive tension and outcome uncertainty (Forrest, Simmons, & Buraimo, 2005). In fact, when monitoring minute-by-minute audience data, research shows that television viewers will tune out when matches become unbalanced or trend toward predictable outcomes (Alavy et al., 2010). Consumer intent is fundamentally divided.

Resolving this consumer paradox does not require absolute sporting equality. In fact, perfect parity is economically suboptimal. A concentration of the biggest stars in a lower number of teams will create a more pleasant show when those teams are facing each other (Garcia-del-Barrio & Reade, 2024). Furthermore, absolute parity would allow the natural 'home advantage' to dominate, systematically guaranteeing home victories and paradoxically destroying the uncertainty of the sport (Forrest & Simmons, 2002a). Ultimately, the economic architecture of a league, its prize distribution and regulatory constraints, must be meticulously engineered to preserve the delicate equilibrium between sporting incentive and outcome uncertainty (Szymanski, 2003).

Clubs as Hybrid organizations

Operating within this delicate balance of cooptation and globalized market pressures, professional football clubs cannot be governed through traditional corporate frameworks. Instead, they function as 'hybrid organizations', forced to constantly reconcile the pursuit of financial sustainability with their historical social logic, namely their community identity and on-field success (Besharov & Smith, 2014; Gammelsæter, 2010). Theoretically, this creates a model where financial profit is not an end in itself, but rather a necessary mechanism to finance sporting glory (Morrow, 2013). Yet, modern sports economics fiercely debates the viability of this romanticized equilibrium. While Giulianotti (2002) warns that hyper-commercialization has already subordinated social identity to marketing imperatives, Storm and Nielsen (2012) offer a much more cynical economic critique: the hybrid nature of clubs is frequently weaponized by club boards as a convenient shield to justify systemic management inefficiencies and recurrent financial crises.

This chronic mismanagement is deeply rooted in the structural incentives of European football. As Lago et al. (2006) demonstrate, European clubs predominantly operate as win-maximizers rather than profit-maximizers, systematically overspending on playing talent to secure sporting prestige. This aggressive pursuit of on-pitch success frequently overrides basic financial prudence, driving organizations into structural deficits.

Taking a more radical perspective on this market dynamic, Kennedy & Kennedy (2012) argue that the commercialization of football represents the imposition of a neoliberal agenda, in which the community culture and historical identity of clubs are actively dismantled to serve the interests of global capital accumulation. From this perspective, “market logic” does not coexist with the social; it colonizes it, transforming the club into a commodity and the fans into passive consumers. This theory is interestingly relevant in analysing the Portuguese League, or indeed any league that can be labelled as a “Selling League”. Under this lens, pursuit of efficiency can be interpreted as the optimization of a production chain in which the players are treated as commodities destined for export. This perspective suggests that financial success and technical efficiency, while necessary for survival in the current ecosystem, may come at a “hidden cost”: the alienation of the fan base and the sacrifice of sporting stability in favour of immediate profits. Thus, the analysis of technical efficiency should not be viewed merely as a metric of managerial success, but also as a reflection of the systemic pressure on Portuguese clubs to operate as efficient production units within the globalized football labour market.

For peripheral leagues, player development is a literal production chain. Portuguese top-tier clubs perfectly illustrate this model. They rank among the most prolific academies globally, operating as high-efficiency human capital factories for Europe's elite (CIES Football Observatory, 2025).

This structural reality defines the 'Selling League' paradigm. While traditional revenue streams, such as ticketing and merchandising, remain essential, they are insufficient to sustain the escalating costs of modern football. As a result, it is export efficiency that dictates a club's survival. When domestic markets are too small, the ability to sell talent at a premium becomes the ultimate indicator of financial sustainability (András & Havran, 2014). To these clubs, exporting players becomes a strategic escape route to generate extra revenues, when merchandising and ticket revenue are not enough. Therefore, investment in youth development programs and visibility in international competitions are seen as key factors in turning athletic talent into financial profit and ensuring the economic survival of sports organizations.

Profit vs utility maximization.

Because clubs must navigate these dual institutional logics, their fundamental economic objectives differ wildly from standard corporations. Consequently, the debate emerges considerably around profit vs. utility maximization. While the classic American model, as described

by Rottenberg (1956), sees clubs seeking profit maximization, European clubs have historically been perceived as utility maximisers (Sloane, 1971). They ruthlessly prioritize winning matches, operating under a soft financial constraint that merely requires them to survive without distributing dividends (Storm and Nielsen 2012). Winning takes precedence over profit. This differentiation in focus explains why some clubs spend beyond the most efficient point in the efficiency curve, sometimes going to, or even beyond, the break-even point, as opposed to retaining their profits.

This relentless pursuit of sporting glory is primarily financed through personnel costs. Gasparetto and Barajas (2021) empirically validate this dynamic, demonstrating that aggregate wage expenditure remains a robust predictor of on-field success, despite the operational complexities and risks posed by internal wage dispersion. However, this binary vision overlooks an important third pillar: fan welfare and sustainability. Fan welfare maximization, as explained by Madden (2012), can sometimes lead clubs to prioritize community utility at the expense of their financial position. This is particularly evident in governance models where supporters hold significant democratic power, such as Germany's "50+1" rule or the "sócio" system in Portugal, where presidential elections force boards to align with fan expectations for immediate success.

Ultimately, organizational objectives are neither static nor strictly binary. Game-theoretical models demonstrate that pursuing a hybrid strategy is inherently advantageous: clubs that actively blend sporting ambition with financial discipline generate higher profits at equilibrium than organizations strictly pursuing absolute financial gain (Arrondel et al., 2023). Consequently, strategic priorities dynamically oscillate according to environmental pressure. A structurally secure mid-table club possesses the strategic breathing room to optimize baseline costs and maximize corporate value for future sale (Prinz & Thiem, 2021). Conversely, an organization locked in a fierce title race or relegation battle is forced to ruthlessly prioritize sporting utility, consciously absorbing short-term financial deficits to secure immediate institutional survival or glory.

2.2 Methodological Frontiers: The Evolution of Efficiency Measurement

The dual objectives of professional football actively break traditional financial metrics. Standard accounting models assume strict relations and completely exclude non-financial information, such as strategic management capability (Guzman & Morrow, 2007). Furthermore,

football clubs rarely follow standard corporate objectives. In major leagues, win-maximization mindsets routinely sideline financial profit (Garcia-del-Barrio & Szymanski, 2009).

To bridge this gap, Data Envelopment Analysis (DEA) offers an ideal non-parametric alternative. The method evaluates relative efficiency by mapping multiple inputs directly to diverse sporting and financial outputs, eliminating the need for pre-assigned weights, which are often unknown in professional sports management (Haas, 2003). Beyond general efficiency, this method's flexibility allows technical performance to be decomposed into distinct offensive and defensive metrics, revealing how different league cultures, such as Italy and Spain, prioritize specific tactical outputs to achieve success (Boscá et al., 2009). This decomposition approach serves as the foundation for the model proposed here. Whilst at the micro level tactical variables determine conversion efficiency on the pitch, at the macro level it is financial resources (wages and depreciation) that test the management's ability to generate points and operating revenue, justifying the shift from a purely sporting analysis to a hybrid assessment of strategic efficiency.

Framing with the Resource Based View (RBV), which proposes analysing organisations based on their internal resource endowment rather than their market position (Wernerfelt, 1984), it is important to understand which resources are rare and valuable enough to generate competitive advantages (Barney, 1991). In the specific context of the football industry, dynamic managerial capabilities are increasingly recognized as one of these central, valuable resources required to sustain competitive advantage (Holzmayer & Schmidt, 2020; Wolfe et al., 2005).

DEA in football was first introduced by Haas (2003). His work constructed an efficient frontier based on the best-performing unit in the sample, comparing it with the other units to obtain a relative efficiency score for each club. Using this method, a club can determine whether the same level of athletic and financial performance would be possible with fewer resources.

Early applications of DEA to sports economics suffered from a major structural flaw. The traditional model was strictly deterministic, treating every deviation from the efficient frontier as pure managerial incompetence and completely ignoring random variations such as statistical noise, data errors, or match-day luck. This deterministic frontier remains highly sensitive to outliers and inherently lacks statistical inference (Mergoni et al., 2025).

To resolve this, initial methodological upgrades focused on data integrity and explanatory power. Techniques like Canonical Correlation Analysis (CCA) were employed to prevent irrelevant variables from polluting the efficient frontier (Guzman & Morrow, 2007). Concurrently, two-step Tobit regressions attempted to explain performance determinants. Yet, these early fixes fell short. They yielded invalid statistical inferences due to unknown serial correlation among the efficiency estimates.

To definitively overcome this structural bias, modern sports economics relies on a double-bootstrap truncated regression algorithm (Simar & Wilson, 2007). This advanced approach estimates bias-corrected efficiency scores and constructs valid confidence intervals. It successfully accounts for exogenous shocks, such as long-term injuries or random noise, while cleanly isolating true strategic competence.

Efficiency in professional football is inherently two-dimensional. Global performance must be decomposed into pure technical efficiency, which measures internal management, and scale efficiency (Haas, 2003). This distinction is vital for capital-intensive structures. A club can display flawless internal operations yet appear highly inefficient due to a suboptimal scale of operation. In fact, when teams operate under sharp decreasing returns to scale, they are too large in size and over-consume resources (Barros & Leach, 2006). Win-maximization strategies regularly push market leaders beyond their optimal economic size, forcing them into zones of diminishing marginal returns where overinvestment turns into systemic operational waste. The most efficient clubs will be those that maximize their sporting output relative to their resources. It is also important to note that on-field success doesn't automatically translate into financial success, and that poor financial results may hinder future sporting success (Barros & Leach, 2006).

2.3 Strategic Efficiency

Across the global football industry, clubs face the continuous challenge of optimizing human capital to maximize efficiency. A central theoretical debate in sports economics regarding this optimization revolves around how clubs financially incentivize their squads. Optimizing human capital remains a continuous operational challenge across the global football industry, governed by a sharp theoretical paradox regarding financial incentives. On one side of the spectrum, tournament theory dictates that a highly convex wage structure maximizes individual effort, encouraging lower-paid players to perform at their physical limits to secure elite

contracts (Lazear & Rosen, 1981). However, fairness theory introduces a critical operational limit. In highly interdependent team sports, excessive wage disparity generates severe internal friction and actively dismantles tactical solidarity (Akerlof & Yellen, 1990). Uncontained inequality ultimately damages team cohesion and collective output, meaning the optimal compensation structure depends heavily on the degree of task interdependence (Depken, 2000; Levine, 1991). Consequently, football clubs globally must navigate a delicate equilibrium: establishing a wage gap significant enough to incentivize ambition (tournament) yet contained enough to preserve tactical solidarity (fairness).

Testing these microeconomic dynamics empirically presents a significant structural barrier due to the strict confidentiality of individual player contracts. Without publicly available microdata on internal wage dispersion, directly measuring this inequality becomes impossible. To bypass this barrier, modern literature relies on aggregates. Operating without salary caps, the European player market adheres strictly to the efficient market hypothesis, meaning athletic talent is accurately priced. Consequently, the absolute wage bill, recorded as the 'Cost of Employees', functions not merely as an accounting expense, but as a highly robust proxy for overall squad quality and a direct predictor of collective performance (Szymanski, 2015). This aggregate provides the essential financial input to operationalize the subsequent performance analysis.

Beyond financial resources, technical leadership stability represents a paramount non-financial determinant of strategic efficiency. Rather than resolving performance crises, frequent mid-season coaching changes systematically fracture tactical cohesion and damage collective output in the subsequent months, increasing short-term variance instead of guaranteeing immediate improvement (Audas et al., 2002). Mid-season dismissal operates essentially as a high-risk gamble. Empirical evidence from elite leagues confirms that replacing a manager yields no statistically significant impact on points won or goals conceded (De Paola & Scoppa, 2012). Because sackings typically follow an unusual run of poor results, any apparent subsequent stabilization represents a mere mathematical regression to the mean, known as the classic Ashenfelter dip. Rather than a strategic solution, the managerial change frequently serves as an institutional scapegoating mechanism to divert blame away from the board. Within an econometric framework, this instability acts as a disruptive exogenous shock, generating severe friction costs through severance pay and overlapping salaries that heavily penalize pure technical efficiency.

Participation in continental tournaments introduces a highly ambivalent exogenous shock into efficiency equations, enforcing a direct trade-off between international competition and domestic sporting outcomes (Depken & Globan, 2021), a dynamic that ultimately pits national success against continental financial maximization. On the resource side, access to elite European fixtures guarantees transformative capital injections that reshape an organization's operational dimension. Institutional data underscores this immense financial leverage: total distributions from European governing bodies have crossed the €3 billion threshold, accounting for a substantial 25% of the total revenues generated by the continent's leading structures (UEFA, 2026). Yet, translating this financial windfall into sustained domestic success involves severe operational friction. International campaigns force squads into dense, congested schedules typically characterized by rest periods of four days or less. This continuous physical strain triggers a sharp escalation in the overall incidence of player injuries (Page et al., 2022). Beyond the immediate clinical risk, fixture saturation actively degrades tactical execution on the pitch, systematically draining a team's attacking strength during domestic league matches (Stüttgen, 2025). Mitigating this systemic fatigue requires continuous squad rotation and workload management. These necessary athletic compromises ultimately explain the temporary drops in domestic efficiency when facing local opponents who benefit from full weeks of physical recovery (Stüttgen, 2025).

The status of a newly promoted team introduces a highly atypical resource structure to the efficiency analysis. Driven by a strict logic of absolute scarcity, these transitioning clubs frequently operate at the absolute peak of technical efficiency. To survive in the top tier, bottom-table organizations must extract maximum functional results from minimal operational resources (Guzmán & Morrow, 2007). This functional optimization is heavily fuelled by the 'underdog effect'. As established in the literature, underdogs compensate for severe external disadvantages by amplifying their passion, determination, and collective effort (Paharia et al., 2011). Furthermore, this drive is sustained by the positive 'psychological momentum' (Valle-rand et al., 1988) accumulated during their successful promotion campaign. Unlike elite structures shielded by massive capital, newly promoted clubs leverage this momentum, characterised by heightened motivation and perceived control, along with the intrinsic pressure of survival to remain at the efficiency frontier.

Yet, a contradictory financial dynamic constantly threatens this temporary sustainability. Promoted clubs arrive in the first division with low legacy costs but immediately face immense competitive pressure to bridge the expanding financial chasm that separates them from es-

established top-tier organizations (UEFA, 2026). To avoid instant relegation, these organizations are frequently forced into rapid market expansion, replacing sustainable lower-division salaries with expensive first-tier wages and premium acquisitions. This aggressive pursuit of competitive convergence can trigger a sudden inflation in both wage bills and amortization costs, presenting a severe financial risk to the corporate structure.

Finally, the average age of the squad operates as a critical structural indicator of efficiency, particularly within the strict confines of a 'selling league'. To maximize economic asset value, peripheral clubs frequently deploy highly youthful rosters, transforming their teams into literal production units for export (CIES Football Observatory, 2025). While highly profitable on the balance sheet, this development strategy routinely compromises short-term sporting output. The underlying cause stems from clear athletic thresholds. Statistical performance analysis demonstrates that a footballer's peak performance does not occur in the early developmental stages, but usually between the ages of 25 and 27 (Dendir, 2016). Positional demands shift this baseline slightly, with forwards reaching their athletic peak closer to 25 and defenders maturing around 27.

Excessively young squads offer substantial commercial upside but operate consistently below the optimal threshold of tactical and physical maturity. This immaturity inherently compromises the team's ability to translate raw talent into consistent league points. Conversely, squads exceeding this optimal age bracket benefit from collective experience but face steep declines in physical durability during demanding schedules, alongside a sharp drop in market value.

3. Research Problem

Building upon the theoretical framework established in the previous section, this chapter shifts its focus to the empirical reality of Portuguese professional football. The institutional landscape here is governed by a 'Selling League' paradigm. Consequently, the following sections examine how a deep structural reliance on player transfers coexists with the historical dominance of the 'Big Three'. By exploring the institutional diversity of domestic clubs and their ongoing corporate transitions, this analysis ultimately isolates the critical research gap regarding strategic efficiency that this study aims to resolve.

3.1 The “Selling League” paradigm

In the globalized football ecosystem, the financial disparity between Europe's elite 'Big Five' and peripheral leagues has grown exponentially. Dominant continental clubs anchor their business models in massive broadcasting rights and global commercial partnerships. Portuguese football, however, operates under a strictly inverted economic reality. Domestic revenues are structurally insufficient to sustain organizational balance. This deficit forces professional clubs into a quintessential 'Selling League' paradigm, where a permanent reliance on exporting talent requires a complete redefinition of operational efficiency.

Clubs within this localized ecosystem navigate an intense dual pressure: maintaining immediate on-field competitiveness while generating continuous export value to ensure corporate survival. In peripheral structures, exporting efficiency, defined as the organizational capacity to develop and monetize human capital at a premium, serves as the primary indicator of long-term sustainability (András & Havran, 2014). Global financial flows provide stark empirical validation for this outward dependency. Over the 2015–2024 decade, the Portuguese Primeira Liga generated a net transfer surplus of +€2.34 billion, ranking as the highest positive balance in world football (Poli et al., 2024a). This extraordinary figure confirms that talent exportation is no longer an auxiliary revenue stream, but the foundational engine of the entire domestic football economy.

This financial model, however, introduces a profound outward-facing vulnerability. Spatial tracking of transfer revenue streams confirms that the overwhelming majority of Portuguese capital gains originates from international transactions rather than domestic circulation (Poli et al., 2024b). As an extreme outlier in its reliance on foreign capital markets, the ecosystem remains highly exposed to external macroeconomic shocks. Attracting international buyers under these volatile conditions demands flawless operational efficiency. Yet, this permanent reliance carries a severe structural trade-off. In export-driven ecosystems, financial sustaina-

bility requires an uninterrupted cycle of squad turnover (András & Havran, 2014). To maintain liquidity, organizations are forced into systematically liquidating their most valuable human assets, a necessity that typically coincides with the players reaching their athletic peak (Dendir, 2016). This creates a permanent strategic dilemma: structures must repeatedly sacrifice long-term sporting stability and squad cohesion to achieve the financial efficiency required to prevent institutional failure. Continuous optimization of recruitment and internal processes is not a tactical choice; it is a mandatory condition for survival.

Figure 1 - Associations whose clubs have received the most transfer indemnities and origin of the revenues, € Million, 2014-2023

		Total	National	International	(%)	
	England	13,879	8,793	5,086	37%	
	Italy	9,866	5,166	4,700	48%	
	France	8,072	2,148	5,924	73%	
	Spain	7,738	2,340	5,398	70%	
	Germany	7,006	2,469	4,537	65%	
	Portugal	3,923	342	3,581	91%	
	Brazil	2,927	417	2,510	86%	
	Netherlands	2,769	278	2,491	90%	
	Belgium	2,088	277	1,811	87%	
	Argentina	1,883	327	1,556	83%	
	Russia	1,217	384	833	68%	
	Turkey	1,066	244	822	77%	
	Mexico	988	551	437	44%	
	Austria	860	24	836	97%	
	China	803	628	175	22%	
	Denmark	785	48	737	94%	
	Switzerland	691	65	626	91%	
	Ukraine	671	37	634	94%	
	Croatia	656	57	599	91%	
	USA	507	54	453	89%	

Source: Extracted from CIES Football Observatory, Monthly Report 92

3.2 The hegemony paradox and structural asymmetry

Historically, the 'Big Three' (Benfica, Porto, and Sporting) have overwhelmingly dominated Portuguese football. Conventional wisdom attributes this hegemony exclusively to financial superiority and an unattainable accumulation of resources. Yet, this purely financial lens overlooks a critical strategic distinction: the fundamental difference between sheer scale and true managerial competence. While the strategic use of wage inequality actively validates tournament dynamics among the league's elite (Ribeiro & Lima, 2012), accumulating capital solves only half the equation. Under the Resource-Based View (RBV), sustainable competitive advantage stems not merely from possessing valuable resources, but from the organizational capability to efficiently transform them into tangible outputs (Wolfe et al., 2005; Holzmayer & Schmidt, 2020).

This literature review exposes a profound dichotomy at the top of the league. The massive absolute wage bills of the market leaders theoretically guarantee their dominance. However, extreme size frequently triggers decreasing returns to scale, transforming excessive resource consumption into a symptom of an 'oversized' structure (Barros & Leach, 2006). This systemic risk is further amplified by a strict 'win-maximization' mindset, where the obsession with immediate sporting success regularly drives inefficient overinvestment (Garcia-del-Barrio & Szymanski, 2009).

Consequently, a critical empirical ambiguity remains. Does the hegemony of the 'Big Three' truly stem from pure technical excellence in internal management? Or does their overwhelming scale simply act as an economic shield, masking operational inefficiencies and absorbing management errors that would instantly bankrupt mid-sized clubs?

This structural trade-off, where massive absolute scale guarantees domestic hegemony while forcing the organization into severe diminishing marginal returns, constitutes the 'Cost of Dominance'. The subsequent empirical analysis provides evidence relevant to this ambiguity.

3.3 Institutional diversity and the research gap

The current institutional paradigm of Portuguese professional football took shape in 2013, driven by a strict legal imperative to ensure financial transparency, structural discipline, and the capacity to attract foreign investment. Under this framework, competing clubs were mandated to separate their social operations from their professional first-teams, adopting either a SAD (Sociedade Anónima Desportiva) or a SDUQ (Sociedade Desportiva Unipessoal por Quotas). The fundamental distinction lies in capital control. A SDUQ remains a single-share-

holder entity permanently tethered to the founding club. A SAD, conversely, operates as a joint-stock company, allowing private equity to acquire majority stakes and absolute management control. By adopting this structure, the 'management hand' becomes just as critical as the 'sporting hand', fully justifying the application of rigorous corporate metrics to evaluate organizational efficiency.

This corporate shift actively facilitated the influx of global capital, particularly through Multi-Club Ownership (MCO) networks. The SAD structure provides the precise legal vehicle for private majority investors to enter the market. Investors view Portuguese football as a highly strategic acquisition due to its proven status as a premium talent incubator. The ecosystem effectively functions as a high-efficiency production unit of human capital for Europe's elite (CIES Football Observatory, 2025). Integrating domestic SADs into global portfolios allows foreign capital to directly leverage the country's exceptional exporting capacity within the broader European market.

However, the corporate transition facilitated by the SAD model carries severe systemic risks. The Portuguese context provides stark empirical warnings of institutional collapse when the delicate balance between sporting ambition and managerial competence shatters. The high-profile legal and identity split between the Belenenses club and its SAD illustrates the potential for catastrophic governance failure (Gomes, 2023). Similarly, the severe insolvency processes experienced by entities such as Boavista FC (Costa, 2025) and CD Aves underscore the existential threat of operational inefficiency within a resource-constrained environment. Consequently, technical efficiency is not a mere theoretical optimization goal; it becomes a strict, mandatory condition for institutional survival.

Despite this rapid professionalization and the influx of foreign capital, a significant research gap persists. Existing literature on football efficiency overwhelmingly focuses on Europe's 'Big Five' leagues, where massive broadcasting revenues frequently act as a financial buffer to absorb management errors. The Portuguese 'Selling League' model remains severely under-explored. Few studies account for the unique operational pressure placed on domestic SADs to remain competitive while navigating profound financial asymmetries and a structural reliance on international exports. Resolving this ambiguity requires a methodology capable of moving beyond basic accounting ratios. By explicitly separating global technical efficiency from pure scale effects, this study aims to reveal whether mid-sized clubs truly possess superior strategic management or simply operate under different market constraints.

4. Methodology

To address the identified research gap and evaluate the operational performance of Portuguese clubs, this chapter details the quantitative methodology employed in the study. It outlines a two-stage semi-parametric approach, starting with the application of Data Envelopment Analysis (DEA) to decompose overall efficiency into technical and scale components. Following this, it describes the implementation of a double-bootstrap truncated regression, which isolates the impact of exogenous determinants on performance, ensuring the statistical validity of the estimated managerial competence.

4.1 The two-stage semi-parametric approach

To properly address the research objectives and overcome the limitations of traditional financial ratios in evaluating football clubs, this dissertation adopts a two-stage semi-parametric approach. As seen before, football clubs operate as complex hybrid organizations where the accumulation of financial resources doesn't automatically and linearly translate into success. It is therefore necessary to use a methodology capable of distinguishing genuine managerial competence from structural advantages or some contextual luck.

The first stage of this approach will employ Data Envelopment Analysis (DEA). DEA is a non-parametric method that evaluates the relative efficiency of Decision-Making Units (DMUs) by transforming multiple inputs into multiple outputs without assuming a rigid functional form. In this study, the DEA model is used to decompose overall efficiency into two distinct components: pure technical efficiency and scale efficiency. This decomposition is crucial to identify whether a club's inefficiency stems from poor internal management or from operating at a suboptimal scale (e.g., suffering from decreasing returns to scale due to excess size).

However, as seen before, traditional DEA scores are deterministic. They treat any deviation from the efficient frontier as pure inefficiency, failing to account for statistical noise, measurement errors, or factors that are beyond management control.

To correct for this and yield valid inferences, a second stage using a double-bootstrap truncated regression will be employed. This follows the methodological framework developed by Simar & Wilson (2007). In this phase, the bias-corrected efficiency scores obtained in the first stage are regressed against a set of exogenous and contextual determinants. This step is critical as it allows the model to isolate the impact of the environment from the true strategic competence of the clubs.

4.2 First stage: Data Envelopment Analysis

As outlined in the literature review, this study employs an output-oriented DEA model. The rationale for an output orientation lies in the fundamental operational reality of the Portuguese league: clubs must maximize their sporting success (points) and financial returns (operating revenues) given a relatively restricted level of resources (employee costs and amortizations).

Assuming a sample of n DMUs (clubs), where each DMU j uses m inputs x_{ij} to produce s outputs y_{rj} . For a specific club being evaluated (denoted as club o), the Global Technical Efficiency can be calculated using the Constant Returns to Scale (CRS) model, originally proposed by Charnes, Cooper, and Rhodes (1978). In its output-oriented envelopment form, the linear programming problem is formulated as:

$$\max \emptyset \tag{4.1}$$

Subject to:

$$\sum_{j=1}^n \lambda_j x_{ij} \leq x_{io} \quad (i = 1, \dots, m)$$

$$\sum_{j=1}^n \lambda_j y_{rj} \geq \emptyset y_{ro} \quad (r = 1, \dots, s)$$

$$\lambda_j \geq 0 \quad (j = 1, \dots, n)$$

Where $\emptyset$ represents the proportional increase in outputs that could be achieved by club o while holding inputs constant, and λ_j are the non-negative weights assigned to each club to construct the efficient frontier. The Global Technical Efficiency score (TE_{CRS}) for club o is defined as $1/\emptyset$, yielding a value between 0 and 1, where 1 indicates perfect efficiency on the frontier.

However, the CRS model assumes that clubs operate at their optimal scale, which is often not the case in professional football due to the existence of structural asymmetries. To isolate Pure Technical Efficiency, we apply the Variable Returns to Scale (VRS) model proposed by Banker, Charnes, and Cooper (1984). This model adds a convexity constraint to the linear program, ensuring that clubs are only benchmarked against others of a similar size:

$$\sum_{j=1}^n \lambda_j = 1 \quad (4.2)$$

The efficiency score obtained from this restricted model (TE_{VRS}) measures managerial competence isolated from scale effects. Finally, to determine if a club is suffering from scale inefficiencies (e.g., being "too large"), the Scale Efficiency (SE) is calculated as the ratio between the two efficiency scores:

$$SE = \frac{TE_{CRS}}{TE_{VRS}} \quad (4.3)$$

This decomposition allows the research to empirically determine whether the dominance of the 'Big Three' is a product of pure technical competence ($TE_{VRS} = 1$) or if it is heavily shielded by their scale.

To operate the linear programming problems described above, the general input and output vectors are strictly mapped to the specific financial and sporting variables selected for this study. The input index i ranges from 1 to 2 ($m=2$), where x_{1j} represents the Cost of Employees and x_{2j} denotes Depreciations. Conversely, the output index r ranges from 1 to 2 ($s=2$), where y_{1j} represents the League Points earned at the end of the season and y_{2j} corresponds to the Operating Revenue / Turnover. By explicitly anchoring these variables into the mathematical constraints, the frontier calculation directly reflects the multi-dimensional and hybrid strategic reality of the Portuguese Primeira Liga.

In its output-oriented formulation, the mathematical solution to the DEA linear programming problem yields an efficiency score ≥ 1.0 , representing the Farrell measure of technical efficiency. However, in accordance with widespread empirical literature, the descriptive statistics derived from this first stage are frequently converted into a $[0, 1]$ scale by calculating the reciprocal of this score (the Shephard distance function), providing a more intuitive percentage-based interpretation of efficiency.

4.3 Second Stage: Double-Bootstrap Truncated Regression

While the first stage isolates the technical and scale efficiency of each club, these scores alone don't explain why some organizations systematically outperform others. Furthermore, a club's efficiency is not strictly a product of internal managerial decisions; it is also heavily influenced by exogenous environmental factors. Therefore, the second stage seeks to regress the obtained efficiency scores against a vector of contextual determinants to isolate true

competence from contextual circumstances.

As previously discussed, traditional regressions yield invalid statistical inferences in a two-stage DEA due to the unknown serial correlation among the estimated efficiencies. Since the frontier is constructed relatively, the score of one DMU is fundamentally dependent on the scores of the others. To overcome this structural bias, this dissertation directly employs the double-bootstrap truncated regression procedure developed by Simar and Wilson (2007)¹. This semi-parametric algorithm allows for the estimation of bias-corrected efficiency scores in the first step and subsequently utilizes a bootstrapped truncated regression to construct valid confidence intervals for the explanatory variables.

The regression model can be formally expressed as:

$$\hat{\theta}_j = \beta_0 + \sum_{k=1}^K \beta_k Z_{kj} + \sum_{t=2016}^{2024} \gamma_t Year_{tj} + \varepsilon_j \quad (4.4)$$

Where $\hat{\theta}_j$ represents the bias-corrected technical efficiency score of club j . β_0 is the constant term, Z_{kj} is the vector of K exogenous variable that characterize the operational environment of the club, β_k are the parameters to be estimated (indicating the direction and magnitude of the impact). To account for the panel structure of the data and control for unobserved macroeconomic shocks over the decade, the model explicitly introduces time fixed effects through a set of year dummy variables, $Year_{tj}$, where γ_t captures the specific shift in the efficiency frontier for each season from 2016 to 2024, utilizing 2015 as the omitted baseline reference year. Finally, ε_j is a truncated, normally distributed error term ($N(0, \sigma_\varepsilon^2)$) capturing statistical noise.

The specific theoretical justification, selection, and operationalization of these $K=4$ contextual variables (average squad age, managerial instability, European participation, and promotion effect) are detailed in the subsequent Data section (Section 5.1.2).

To estimate this model empirically, Algorithm 2 from Simar and Wilson (2007) was applied. Given the computational complexity required to correct the bias inherent in DEA scores, the first stage of the bootstrap was run with $L_1 = 100$ iterations, estimating the corrected technical efficiency scores ($\hat{\theta}$). Subsequently, the truncated regression in the second stage was subjected to a bootstrap of $L_2 = 2000$ iterations to construct statistically valid 95% con-

¹ Simar & Wilson (2007) developed two distinct procedures within their framework. Algorithm 1 applies the bootstrap mechanism solely to the second-stage regression (single bootstrap). In contrast, Algorithm 2 introduces a double-bootstrap procedure that first addresses the deterministic bias of the initial DEA frontier scores before executing the truncated econometric estimation.

fidence intervals for the environmental variables. All estimates were computed using the rDEA package in the R programming environment.

Prior to estimation, the selected independent variables will be tested for multicollinearity using the Variance Inflation Factor (VIF) and Pearson's correlation matrix to ensure parameter stability.

5. Data

This chapter outlines the selection, collection, and preliminary analysis of the variables required to operate the proposed two-stage DEA model. It justifies the choice of specific financial inputs, such as employee costs and depreciations, alongside sporting and financial outputs that reflect the dual objectives of football clubs. Furthermore, it details the data extraction process from the SABI and FBref databases for the 2014–2024 period and concludes with an exploratory data analysis that highlights the structural asymmetries present within the Primeira Liga.

5.1 Variable selection

5.1.1 Input and output selection

The choice of inputs and outputs for this DEA model is strictly grounded in the established sports economics literature detailed throughout this section. These variables are specifically selected to capture the dual-objective nature of modern professional football clubs: the simultaneous maximization of sporting performance and financial sustainability.

The chosen inputs reflect human capital and investment of football clubs. First, personnel expenses, recorded as 'Cost of Employees', serve as the primary baseline. In professional football, aggregate wage expenditure is widely acknowledged as the most robust proxy for overall squad quality and the ability to attract elite talent (Szymanski & Smith, 1997; Forrest & Simmons, 2002b). Within the specific context of the Portuguese ecosystem, empirical evidence validates personnel costs as the fundamental resource driving financial returns (Ribeiro & Lima, 2012).

Second, the amortization of player rights, extracted as 'Depreciations' from the SABI platform, is included to capture the true capital investment in squad acquisition. While some contemporary studies rely on estimated squad market values extracted from crowdsourced platforms like Transfermarkt, these figures inherently represent a subjective and statistically biased perceived worth co-constructed by digital communities (Coates & Parshakov, 2022). Conversely, statutory amortizations represent the capitalized investment in playing talent,

which must be recognized to reflect a true and fair view of a football club's financial statements (Calahorra-López et al., 2024). While García-del-Barrio and Szymanski (2009) note that transfer spending relates to long-term capital investment rather than short-term season performance, this distinction is precisely why both metrics must be incorporated into a longitudinal model. Over a sustained ten-year period, excluding amortizations would severely underestimate the true financial effort required to assemble a competitive squad, fundamentally distorting the long-term efficiency frontier.

On the output side, league points represent the absolute measure of sporting efficiency, serving as the primary metric for assessing technical and tactical effectiveness on the pitch (Haas, 2003).

However, consistent with the strategic reality of a 'Selling League', the model concurrently incorporates total operating revenues (including capital gains from player transfers). Because clubs operate with multi-dimensional goals, financial performance must be evaluated alongside athletic results (Barros & Leach, 2006). In fact, total operating revenue is widely considered a primary output and a crucial indicator of a football club's overall efficiency (Pyatunin et al., 2016). Within the specific resource-scarce environment of a 'Selling League', the ability to continuously generate and scale this revenue through transfer exports becomes the ultimate indicator of long-term strategic competence and institutional survival (András & Havran, 2014).

5.1.2 Second-stage determinants

As extensively discussed in the literature review (Section 2.3), a club's overall efficiency is not exclusively a product of internal management but is also heavily influenced by exogenous environmental factors. To isolate these effects in the double-bootstrap regression, four contextual determinants were operationalized based on the established literature. The average age follows Dendir's (2016) findings regarding the optimal age of athletic peak performance. Operationally, instead of using a simple arithmetic average of the registered roster (which could be severely skewed by unused youth academy players), this variable was strictly weighted by minutes played. This ensures it provides a highly accurate representation of the team's effective maturity on the pitch. Consistent with the literature demonstrating the disruptive friction costs (Audas et al., 2002) and the overall ineffectiveness (De Paola & Scoppa, 2012) of mid-season managerial changes, the managerial instability variable is measured by the number of managers employed per season. To ensure this metric accurately reflects strategic instability rather than short-term administrative transitions, a methodological threshold

was applied: a coach was only recorded in the count if they were officially in charge for a minimum of three league matches. This criterion effectively excludes temporary interim (or caretaker) managers. To capture the severe trade-off between financial injections and physical match congestion (Stüttgen, 2025), a dummy variable regarding European participation was created. It takes the value of 1 if the club participated in any UEFA competition fixture during that season, including the preliminary qualifying rounds held in July and August, and 0 otherwise. This inclusion is crucial, as early-season qualifiers heavily disrupt pre-season preparation and induce premature match congestion. Finally, to capture the 'underdog effect' (Paharia et al., 2011) and the positive 'psychological momentum' (Vallerand et al., 1988) inherent to organizations operating under strict survival mandates and severe resource scarcity (Guzmán & Morrow, 2007), the model incorporates a binary variable, assigning a value of 1 to teams newly promoted to the Primeira Liga.

5.2 Data collection

All financial data was collected from the SABI database, which has the full financial records of over 900 000 Portuguese enterprises. The sample was narrowed down from the general SABI database to include only professional football structures (SADs or SDUQs) that competed in the Portuguese Primeira Liga during the analysed period. The full financial records were downloaded for every selected club. From that database, the following items were selected from the Income Statement: Cost of employees, Depreciations and Operating revenue/turnover, as well as Sales for all the years available for each club. The data set was then narrowed down to the selected years and variables of interest using Python. The account of Sales is merely used as an auxiliary variable. The sporting data, which consists of the points for each team from every season between 2014/2015 and 2023/2024. This table was constructed with help from the databases from FBref. Further data was extracted to support the second stage of the analysis. Data regarding European competition participation and newly promoted status extracted from the Zerozero portal (www.zerozero.pt), while the average age of the squad was retrieved from FBref. Finally, the number of managers employed per season by each club was sourced from Transfermarkt.

When analysing the financial data, some omissions were found in the database. The data for 2023 and 2024 weren't available for Boavista FC, as well as data for 2016 for FC Arouca and data for 2023 for FC Vizela. There is also missing data from the years 2019 and 2020 for CD Aves. The year 2019 is also missing from the Vitória FC data.

The identified data gaps for specific clubs and fiscal years within the SABI database are pri-

marily attributable to idiosyncratic administrative, legal, and insolvency events that precluded the official deposition of financial statements (IES). Specifically, the omissions for Boavista FC and CD Aves stem from severe governance crises, lack of auditor certification, and subsequent insolvency processes, which halted statutory reporting duties. The gap for FC Vizela is linked to delayed auditing during ownership transitions, while the omission for FC Arouca coincides with a structural reorganization between the club and its SDUQ entity. Furthermore, the absence of Vitória FC 2019 financial data is due to the fact that the company was, at the time, in a state of severe financial distress and is subject to a Special Revitalisation Process (PER), which made it impossible to certify and submit its annual accounts in accordance with the law. Consequently, these data points remain unavailable in public records, reflecting the actual reporting irregularities of the entities during those periods.

Although the theoretical maximum for the 10-year period is 180 observations (18 teams per season), these administrative and insolvency gaps inherently limited the available financial sample to 173 units. This establishes a final, robust dataset of 173 Decision-Making Units (DMUs), totalling 865 individual data points, ready for integration with the sporting records.

Table 1 - Inputs, Outputs and Auxiliary Variables

Variable	Role	Source	Description/Measurement
Points	Output	FBref	Total points earned by the team at the end of the league season.
Operating Revenue / Turnover	Output	SABI	Total turnover/revenue generated from core activities (including player sales).
Cost of Employees	Input	SABI	Total personnel expenses, including player wages and technical staff.
Depreciations	Input	SABI	Annual depreciation and amortization charges, used as proxy for the annual cost of player transfers (sporting rights amortizations)
Sales	Auxiliary	SABI	Used to compute new variables for exploratory data analysis

Source – Author's own elaboration

To pipeline the data, a string-matching dictionary was developed to standardize club names across both sources, ensuring data integrity. The initial cleaning phase addressed the structural 'noise' typical of financial exports. The first four rows of the raw files were removed as they contained metadata irrelevant to the analysis. To resolve alignment inconsistencies between year headers and data columns, the Forward Fill (`ffill`) method was applied. Subsequently, the dataframe was transposed to align observations (years) as rows and variables as columns, and all 'unnamed' empty columns were dropped.

Data types were converted to numerical format using the `to_numeric` function, with the `coerce` parameter ensuring that any non-compliant entries were treated as null values, pre-

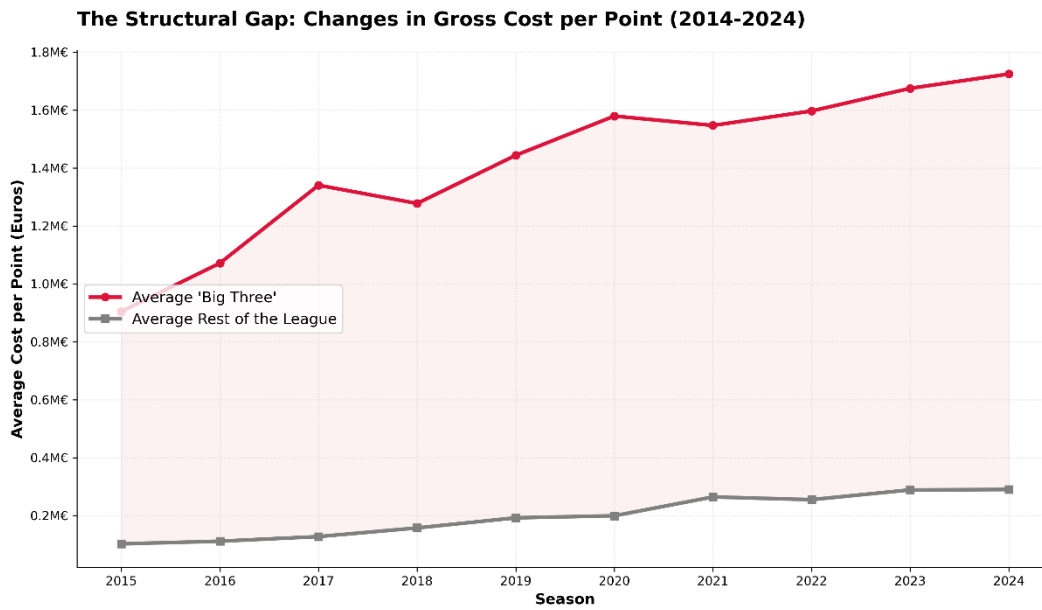
venting computation errors. A critical step involved temporal synchronization: dates were converted to a `datetime` format, with the script extracting the closing year of each season (e.g., '2022/2023' was standardized as '2023').

A priority logic was implemented for reporting periods: in instances where a club issued both June (end-of-season) and December (mid-season) reports, the June filing was prioritized to better reflect the sporting cycle. This was particularly relevant for cases like Boavista FC, which presented irregular reporting patterns. To ensure a unique Decision-Making Unit (DMU) per year, any remaining duplicates were removed. Finally, to integrate the financial and sporting datasets, an `inner join` operation was executed. In data processing, an `inner join` is a merging function that strictly retains only the records possessing matching identifiers in both tables, in this instance, the specific club and season. Consequently, this operation systematically discarded the 7 'orphaned' sporting records that lacked corresponding financial filings, preventing any asynchronous or incomplete data from polluting the model. This strict protocol guaranteed a final, robust, and verified dataset of exactly 173 fully matched DMUs, totalling 865 individual data points.

5.3 Exploratory data analysis

The initial step of this exploratory analysis sought to evaluate baseline efficiency through a rudimentary metric: the Gross Cost per Point. For this purpose, Total Costs (defined as the sum of wages and depreciations) were divided by the points earned in the respective season. The resulting visual distribution seen in Figure 2 highlights a massive disparity: the 'Big Three' clubs exhibit a substantially higher cost per point than the rest of the league, heavily suggesting diminishing returns to scale when looking solely at financial inputs.

Figure 2 - Gross cost per point (2015-2024)



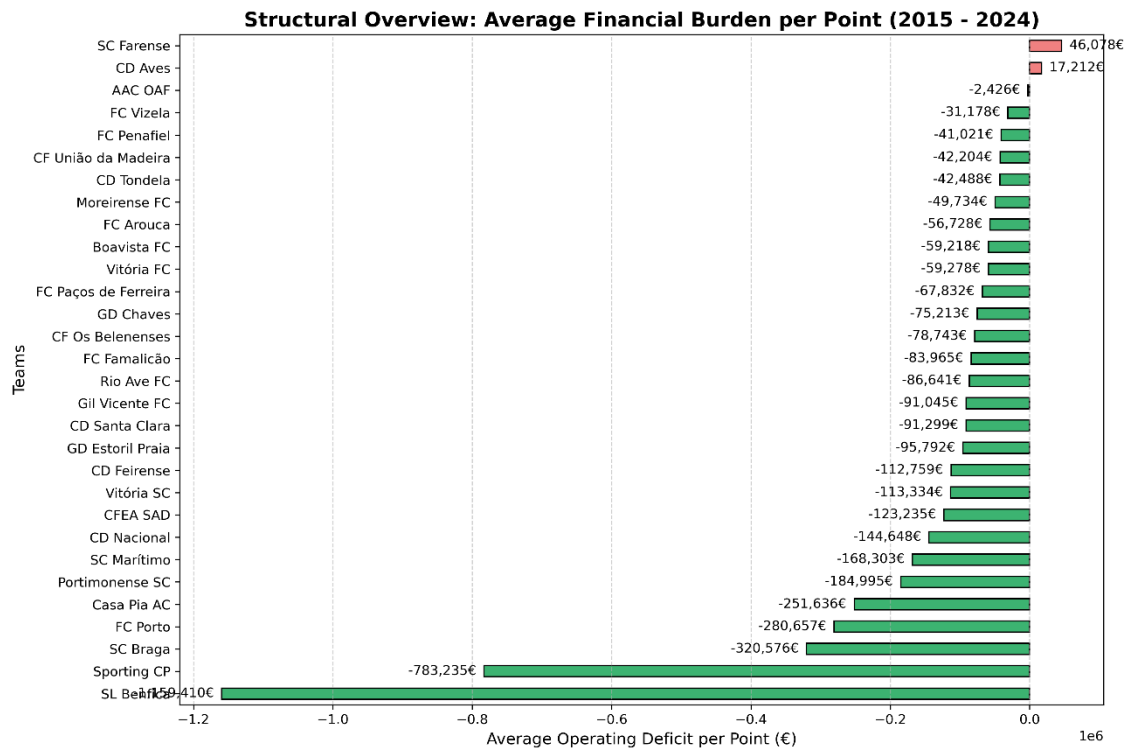
Source: Author's own elaboration based on SABI financial reports and FBref sporting reports

However, this unifocal metric is inherently limited, as it ignores the capacity of these clubs to generate revenue. To address this, a second metric was formulated: Net Financial Effort per Point. This variable assesses the operational deficit (Total Costs minus Operating Revenues / Turnover) required to secure a single point in the league. When analyzing the historical average of this net effort (Figure 3), the 'Big Three' drastically shift positions, emerging as the most sustainable clubs in the competition.

This visual and mathematical contradiction creates an interesting paradox in performance analysis. It starkly reveals the inadequacy of regular financial ratios in evaluating true managerial competence. Using simple arithmetic measures, it becomes impossible to determine whether the dominance of the league leaders stems from genuine technical efficiency or if they are simply shielded by scale efficiencies. This fundamental ambiguity directly validates the necessity of applying the two-stage Data Envelopment Analysis (DEA) model proposed

in this study.

Figure 3 - Average Financial Burden per Point (2015-2024)



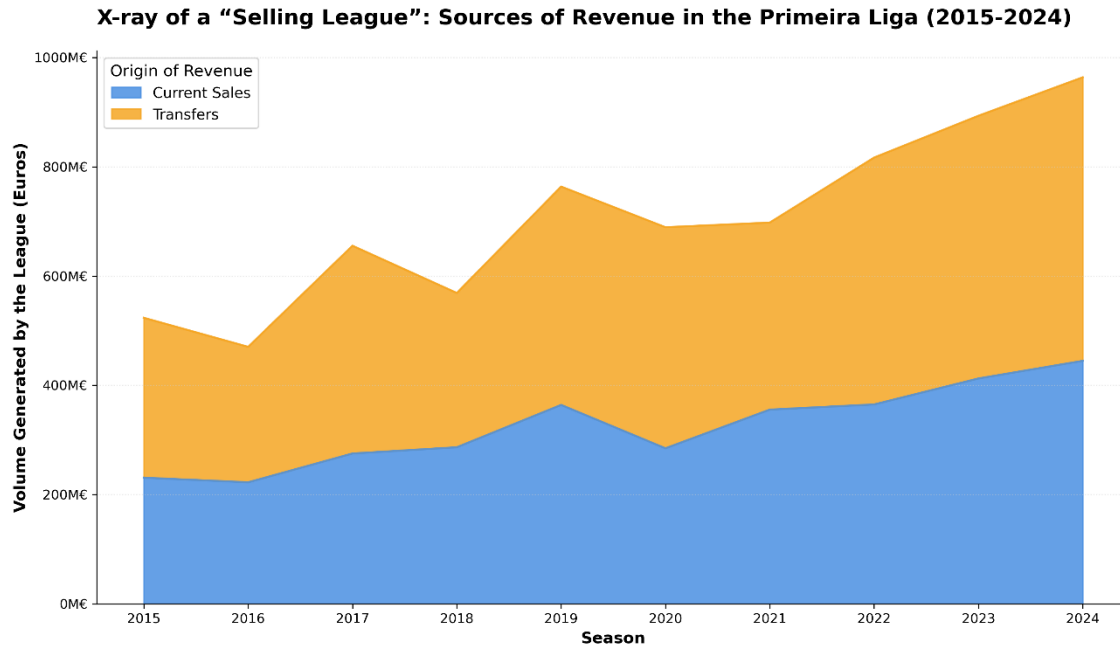
Source: Author's own elaboration based on SABI financial reports and FBref sporting reports

Another important aspect to understand in the Portuguese League is how big the gap between the 'Big Three' and the rest really is. For that, a scatter plot was designed considering on the X axis the average costs (Cost of employees and depreciations) over the ten-year period and the average points over the same period. The 'Big Three' clubs have also been distinguished from the rest of the clubs by colouring them red, against the common blue. Visually, it becomes evident that the 'Big Three' clubs operate in an entirely distinct paradigm, decoupled from the rest of the league in both sporting success and financial expenditure. Furthermore, the plot isolates SC Braga as a unique structural outlier, a club detached from the league's baseline yet still facing a significant financial chasm to reach the elite echelon. This may be important to understand where to consider Sporting Braga in further analysis. Given that the SABI database aggregates total operational income, a proxy for transfer earnings was derived mathematically by isolating routine commercial sales from the total Operating Revenue. This allows for a clear visualization of the 'Selling League' model, demonstrating that while overall revenues have grown, the structural dependency on player trading has deepened exponentially.

Visualizing these components longitudinally makes it easier to discern the proportion of

routine operational earnings versus transfer earnings. It is also important to understand that, while earnings have steadily improved, they are becoming more and more dependent on transfer earnings. This is the standard for the Selling League model, where transfer revenue is essential for the survival of these clubs.

Figure 4 - Revenue origins in the Primeira Liga (2015-2024)



Source: Author's own elaboration based on SABI financial reports

Finally, to systematically categorize the league's structural divisions, an unsupervised Machine Learning approach (K-Means clustering) was employed. The algorithm was fed three primary dimensions: Average Points (Sporting Success), Average Financial Ratio (Revenues over Costs, representing Sustainability), and Average Total Revenue (Financial Volume).

To ensure the mathematical validity of the algorithm, the dataset first underwent a strict standardization process (Z-score normalization). Because the selected dimensions exhibit radically different scales and units of measurement, ranging from double-digit league points to revenues in the hundreds of millions, this methodological step was critical. Standardizing the inputs prevents variables with massive absolute magnitudes from dominating the Euclidean distance calculations, guaranteeing that each metric carries an equitable weight in the formation of the clusters.

The optimal number of structural profiles (K) was not an arbitrary selection but strictly derived from the Elbow Method (detailed visually in figure A1 in the Annex). This technique evaluates the reduction in inertia, the Within-Cluster Sum of Squares (WCSS), across different partition values. The graphical analysis reveals that the marginal reduction in statistical

error loses its steep trajectory and stabilizes at $K=4$. While partitioning the data into five or more clusters yields mathematically lower inertia, the statistical gain beyond this threshold represents severe diminishing returns.

Furthermore, from an economic and strategic perspective, applying $K=5$ or higher to a highly restricted universe of only 18 teams would trigger severe overfitting. Forcing such hyper-segmentation would isolate clubs into statistically insignificant micro-groups, actively destroying the model's ability to identify replicable macro-structural patterns. Consequently, $K=4$ emerges as the optimal equilibrium between algorithmic precision and strategic interpretability. Anchored by this mathematical validation, the algorithm autonomously grouped the clubs into four distinct business models within the league (as illustrated in Figure 5):

The first cluster, identified as High-Ratio Outliers, captures clubs that have good financial ratio but can't transform that financial stability into points. These clubs will often maintain low base costs and benefit from the occasional transfer revenues. While mathematically profitable, this is a business model that sacrifices sporting competitiveness, resulting in lower number of points. Prominent examples include Marítimo and Nacional, clubs from the islands of Madeira that benefit from regional grants, but have also suffered spells in the second division, reflecting their lack of consistency.

The Consolidated Middle-Tier cluster represents the “middle-class” clubs of the league, consisting mostly of stable teams who have healthy finances and try to constantly fight for spots in the upper half of the league. Some notable exceptions in this cluster can be, on the one end, found in Sporting Braga, a team that, as previously stated, is found closer to the ‘Big Three’ than the rest. However, despite generating more points and revenue than its peers, the algorithm recognizes that its financial volume is still structurally closer to this middle-class than to the league's absolute elite. On the other end of the spectrum of this cluster are clubs like FC Penafiel and CF União da Madeira, that may mainly be outliers since they only have a season in the league, when they both were relegated.

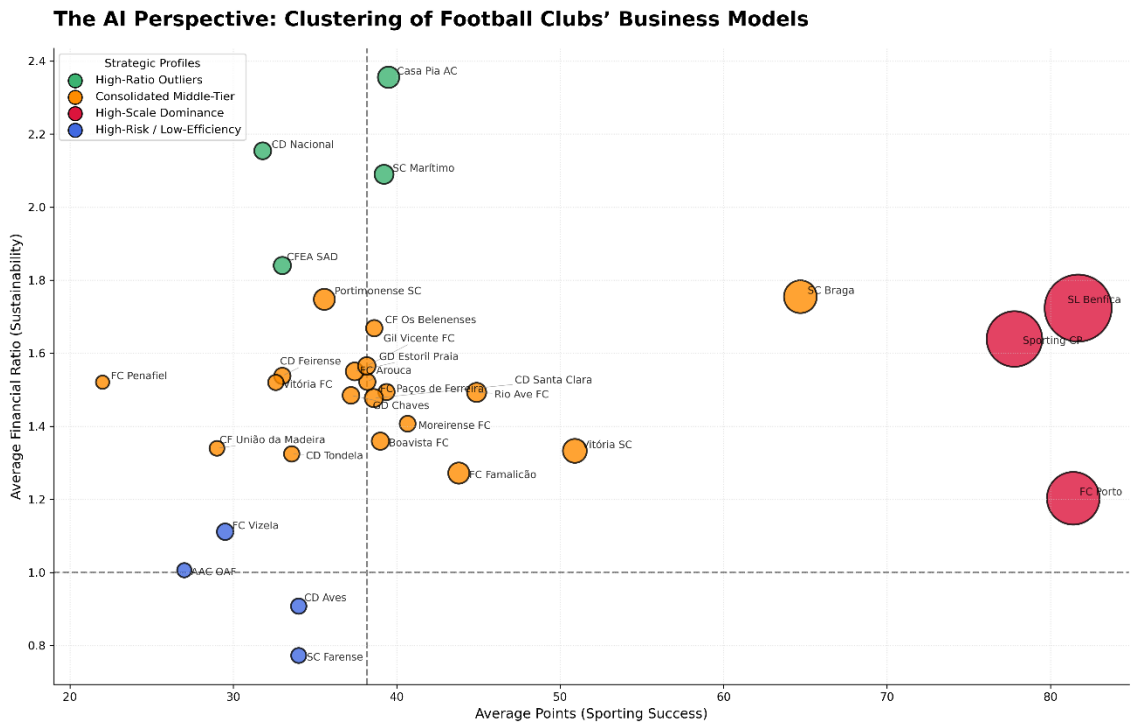
The High-Scale Dominance cluster consists of the ‘Big Three’ clubs. They were isolated into a unique cluster. The algorithm recognized them as statistical anomalies, not necessarily due to their financial ratio (which varies among them), but driven by the sheer astronomical volume of their revenues and their unparalleled average points. They operate a distinct, high-risk/high-reward macroeconomic model.

Finally, the High-Risk / Low efficiency cluster, in the bottom left of the matrix, finds clubs often in the danger zone. This cluster includes clubs suffering from a dual deficit: they oper-

ate below the financial sustainability line (Ratio < 1.0) while simultaneously struggling to earn points. Notably, this cluster accurately captured clubs like CD Aves and FC Vizela, which, as previously noted in the data collection phase, have suffered administrative and insolvency issues.

By clustering these teams mathematically, it becomes clear that evaluating the efficiency of Portuguese football requires a methodology capable of accounting for multiple distinct production models simultaneously.

Figure 5 - Club's Business Models Clusters



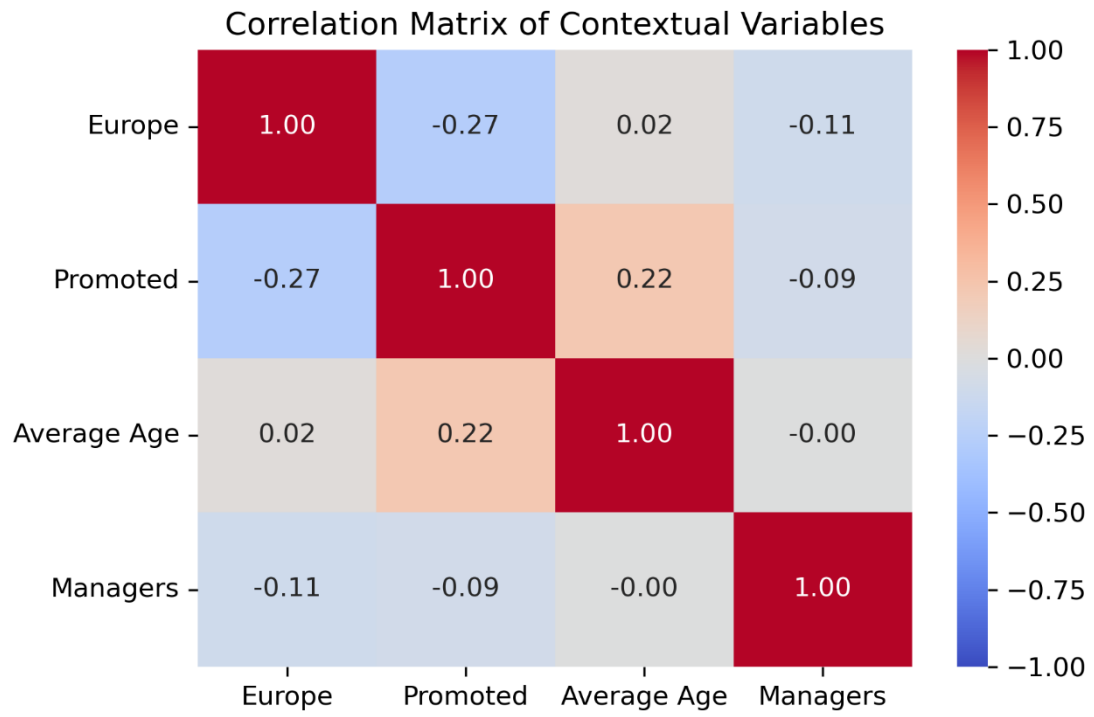
Source: Author's own elaboration based on SABI financial reports and FBref sporting reports

5.4 Diagnostic test on multicollinearity

Before running the second-stage double bootstrap regression, the vector of contextual variables (Z_{ki}) was checked for multicollinearity to ensure the statistical reliability of the estimated parameters. As illustrated in the correlation matrix (Figure 6), the highest correlation observed between any two variables is 0.27 (in absolute terms), well below the conventional threshold considered to be a cause for concern. Furthermore, the Variance Inflation Factor (VIF) was calculated for all exogenous variables. The resulting VIF values ranged from 1.02 to 1.16, remaining strictly below the conservative cut-off point of 5. These diagnostics confirm that there is no evidence of severe multicollinearity among the selected structural

determinants, ensuring that the coefficients extracted in the Simar and Wilson (2007) procedure are stable and robust.

Figure 6 - Correlation matrix



Source – Author's own elaboration

6. Results

6.1 General longitudinal analysis

Table 2 presents an overall statistical summary of the efficiency scores calculated in the first stage of the methodology, detailing the values for Overall Technical Efficiency (CRS), Pure Technical Efficiency (VRS) and Scale Efficiency (SE).

Table 2 - Descriptive statistics of DEA results (2015-2024)

Statistic	Global efficiency (CRS)	Pure efficiency (VRS)	Scale efficiency (SE)
Observations	173	173	173
Mean	0,787	0,928	0,846
Std. Dev.	0,200	0,111	0,177
Min	0,226	0,586	0,226
Max	1,000	1,000	1,000

Source – Author's calculations

The macro results presented in Table 2 reveal a first and crucial empirical finding regarding the competitive structure of professional football in Portugal. The league's average Pure Technical Efficiency (VRS) reaches a markedly high value of 0.9279 (92.79%). From the perspective of the Resource-Based View (RBV), this indicator suggests that the clubs' management structures operate, on average, with a considerable level of internal competence, demonstrating organisational capacity to transform available financial resources (staff costs and depreciation) into concrete results (points and operating revenue).

In contrast, the Overall Technical Efficiency (CRS) is significantly lower, standing at 0.7869 (78.69%). Given that Scale Efficiency (SE) is obtained through the mathematical decomposition between the two frontiers, the average value of 0.8455 suggests that the main source of waste and sub-optimisation in Portuguese football does not stem from pure incompetence in internal operational management, but rather from severe scale mismatches. Clubs operate predominantly outside their optimal market size.

To understand how this trend has developed over time, Table 3 details the annual changes in the ecosystem averages.

Table 3 - Average annual efficiency in the Primeira Liga

Year	Global efficiency (CRS)	Pure efficiency (VRS)	Scale efficiency (SE)
2015	0,772	0,930	0,827
2016	0,696	0,919	0,755
2017	0,784	0,929	0,848
2018	0,840	0,957	0,877
2019	0,717	0,924	0,780
2020	0,848	0,949	0,888
2021	0,788	0,924	0,841
2022	0,810	0,930	0,865
2023	0,825	0,925	0,889
2024	0,783	0,890	0,882

Source - Author's calculations

An analysis of the trend over the ten seasons confirms an impressive consistency in the league's management competence. Even during a period characterised by soaring transfer market costs and the growing financial polarisation of European football, the average VRS remained consistently stable and robust (fluctuating within a controlled range of 0.91 to 0.95).

This long-term trend demonstrates that technical resilience is an intrinsic feature of the Portuguese football ecosystem: when faced with market fluctuations or budgetary pressures, clubs demonstrate operational flexibility in adjusting their inputs in order to ensure they continue to achieve results.

As a result, the volatility observed in Overall Efficiency (CRS) over the years is explained almost exclusively by fluctuations in Scale Efficiency (SE). Market forces and financial asymmetries constrain clubs' ability to stabilise at their optimal size, pushing organisations into zones of inadequate marginal returns. Having established this macro-level stability in management, it becomes crucial to isolate how this phenomenon manifests itself individually across the different realities of the league, starting with the dominant market leaders.

6.2 Efficiency analysis by Business Model profile (clusters)

Fusing the technical efficiency scores extracted from the DEA model with the strategic clusters generated by the K-Means algorithm (as detailed in Section 5.3) definitively maps how organizational competence is distributed across the league's distinct business models. The

complete ten-year average efficiency scores for all 30 clubs, which sustain this clustered analysis, are detailed in Table A3 in the Annex.

Historically, the Portuguese ecosystem operates as a highly concentrated oligopoly. The 'Big Three' (Futebol Clube do Porto, Sport Lisboa e Benfica, and Sporting Clube de Portugal) monopolize domestic title wins, the distribution of television rights, and the capture of UEFA prize money. Yet, a structural question remains. Does this absolute sporting and financial hegemony truly stem from superior managerial competence, or does it result entirely from an artificial expansion of scale that remains permanently unattainable for peripheral competitors? The cross-examination of the two methodologies offers empirical evidence to inform this question.

A longitudinal breakdown of the efficiency profiles for these elite structures reveals a sharp organizational paradox, providing empirical support consistent with the 'Cost of Dominance' hypothesis. Under the variable returns to scale (VRS) framework, which cleanly isolates management competence from size effects, the three market leaders display near-flawless performance. SL Benfica commands a ten-year average score of 0.995, followed closely by Sporting CP at 0.972 and FC Porto at 0.966. Evaluated through the Resource-Based View (RBV), these figures confirm that elite management is fundamentally non-wasteful. These clubs comprehensively master the technology of football production, optimizing their playing squads to maximize returns within their specific financial stratum (see Table 4).

Table 4 - Absolute Efficiency Scores for the Market Leaders (10-Year Average)

Club	Global efficiency (CRS)	Pure efficiency (VRS)	Scale efficiency (SE)
SL Benfica	0,794	0,995	0,798
Sporting CP	0,725	0,972	0,744
FC Porto	0,540	0,966	0,559

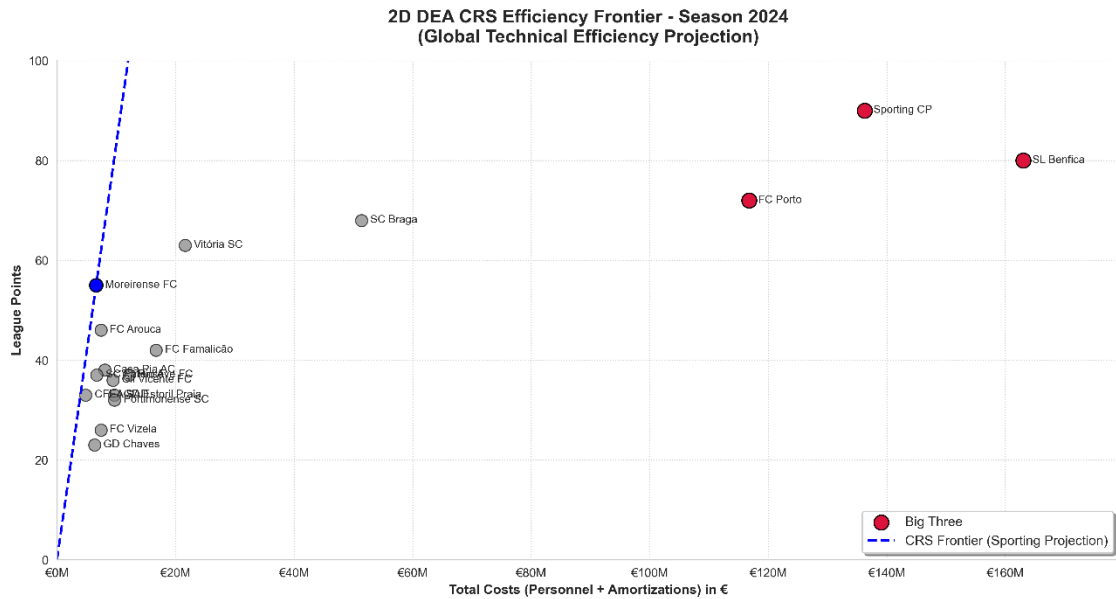
Source – Author's calculations

This flawless internal optimization collapses, however, once scale restrictions are removed. Under the constant returns to scale (CRS) frontier, the scale efficiency (SE) scores of the triumvirate experience a severe penalty: SL Benfica drops to 0.798, Sporting CP sinks to 0.744, and FC Porto exhibits critical scale distortion with an average score of 0.559. These severe scale distortions quantify the 'cost of dominance': to preserve their domestic monopoly and sustain baseline competitiveness within UEFA competitions, the 'Big Three' are forced to aggressively inflate their cost structures, exponentially increasing personnel ex-

penditures and player amortization charges far beyond the optimal economic scale of the local market.

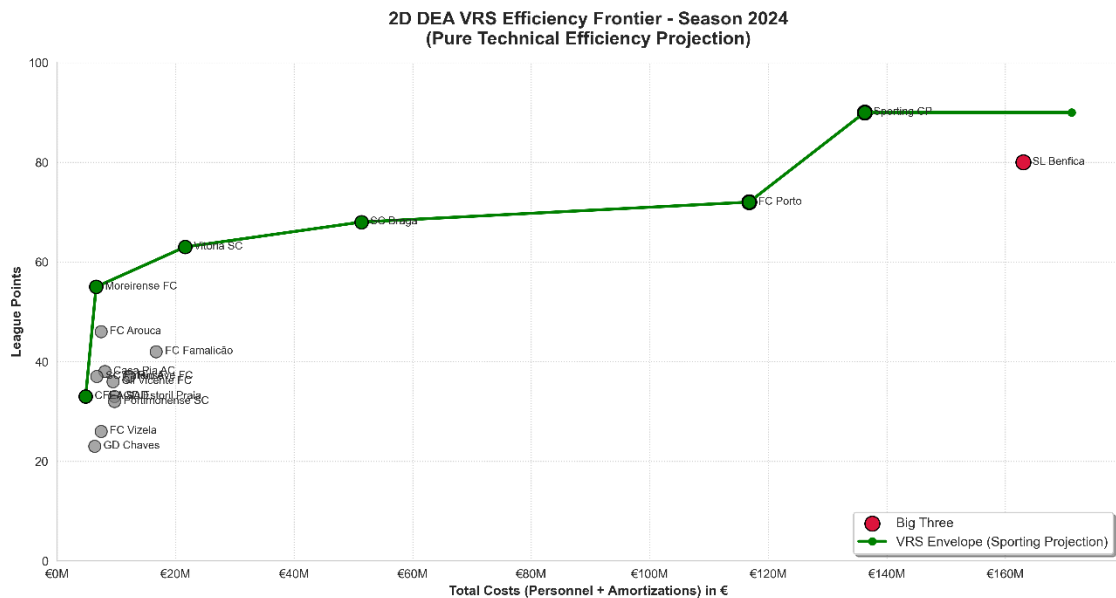
These graphical projections for the 2023/24 season illustrate the 'cost of dominance' in practice, confirming the scale compression experienced by clubs operating under the constant returns to scale frontier (Figures 7 and 8).

Figure 7 - Technical efficiency for the 2023/2024 season



Source - Author's own elaboration based on SABI financial reports and FBref sporting reports

Figure 8 - Pure technical efficiency for the 2023/2024 season (Total costs vs league points)



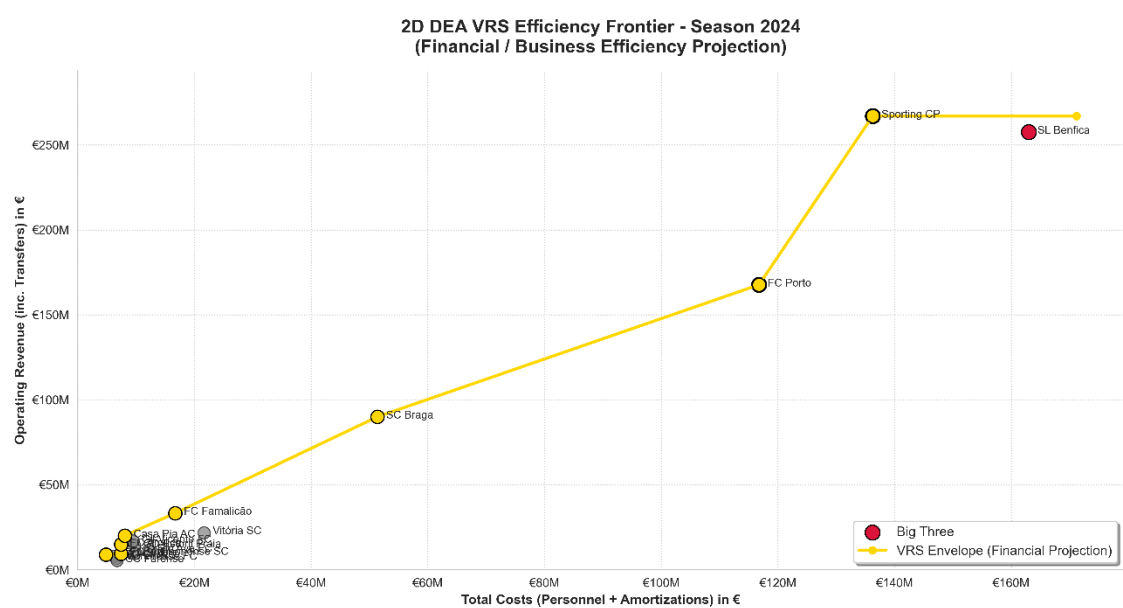
Source - Author's own elaboration based on SABI financial reports and FBref sporting reports

Visualizing these efficiency frontiers exposes the strict physical constraints of the sporting

ecosystem. The linear projection (Figure 7) inherently penalizes the 'Big Three' by assuming that an exponential increase in expenditure should yield a proportional increase in league points. Yet, professional football imposes an absolute ceiling on athletic output. Points are a strictly finite resource. Once a club approaches the maximum achievable points tally, continuous financial investment inevitably triggers severe marginal saturation. By accounting for this regulatory limit (Figure 8), the variable frontier accurately reflects the reality of the capital-intensive strata. Internally, market leaders extract the maximum possible athletic performance from their massive resource pools.

The true strategic vulnerability, however, is revealed by the severe horizontal isolation of these elite structures on the graph. To guarantee domestic hegemony and meet the minimum competitive thresholds of European tournaments, these organizations inflate their fixed costs far beyond the natural absorption capacity of the Portuguese market. Crossing international borders transforms into a chronic source of domestic economic inefficiency.

Figure 9 - Financial efficiency for the 2023/2024 season (Total costs vs operating revenues)



Source - Author's own elaboration based on SABI financial reports

Yet, this aggressive over-investment finds its justification in financial survival. When plotted strictly against operating revenues (Figure 9), the massive scale of the 'Big Three' unlocks access to highly non-linear income streams. Scale grants monopoly access to European capital. UEFA Champions League bonuses and premium positioning within the global transfer market directly offset the sporting saturation. This capital leverage thus justifies their efficiency within their own exclusive financial echelon.

Ultimately, the empirical evidence bifurcates the Primeira Liga into two distinct strategic realities: a dominant elite accepting scale inefficiency as the strict entry fee for European competition, and a broad 'middle class' forced to optimize survival near the optimal scale of the local economy. Stripped of the mandate to compete for the domestic title, this middle tier pursues radically different objective functions.

Within this segment, Sporting Clube de Braga operates as a unique transitional outlier (see Table A3). The club exhibits near-perfect technical competence (average VRS of 0.989), systematically outperforming its direct peers in both points and revenue. Yet, its scale efficiency (SE) drops significantly to 0.695. The ambition to break the historic oligopoly forces SC Braga to aggressively expand its cost structure into the zone of diminishing marginal returns, suffering a localized version of the elite's scale penalty.

At the opposite end of the spectrum, cross-referencing the data isolates critical statistical anomalies, most notably relegated clubs displaying maximum technical efficiency. FC Penafiel represents the extreme example of this paradox (VRS of 1.000). Operating on a microscopic budget during its single season in the top flight, the club inadvertently set the absolute minimum cost threshold for the entire league. The model registers a perfect score simply because no other organization extracted points from such a low input base. Yet, radical underinvestment is not a strategy. The team's immediate relegation proves that this apparent perfect efficiency operates merely as a mathematical artefact of short-term frontier anchoring, rather than a viable corporate model.

A different dynamic governs the first cluster, composed of organizations that explicitly prioritize financial sustainability over points maximization. Club Sport Marítimo exemplifies this defensive operational model. Over the assessed decade, the club combined top-tier technical management (VRS of 0.985) with outstanding scale efficiency (SE of 0.957), successfully maintaining baseline costs extremely low relative to generated revenue. However, operating strictly at this optimal economic scale inherently sacrifices on-pitch competitiveness. In this cluster, mathematical efficiency perfectly maps the optimization of corporate financial survival, but it offers absolutely no guarantee of sporting security.

Finally, the data explicitly maps the structural collapse of the 'danger zone', comprising institutions trapped in deep financial and athletic crisis. CD Aves mirrors its corporate insolvency through a threefold operational vulnerability: poor overall performance (CRS of 0.655), degraded technical management (VRS of 0.857), and inadequate scale (SE of 0.765). Moving beyond the straightforward categorization of these clusters, the algorithmic mapping

also exposes a critical methodological limitation regarding corporate transparency. This blind spot is perfectly exemplified by Boavista FC. While the club exhibits a deceptively stable pure technical efficiency (VRS of 0.9374), this metric is heavily distorted by reporting bias. As noted in the data collection, severe governance crises and successive Special Revitalization Proceedings (PER) prevented the club from filing official financial statements during its most recent and acute years of decline. Consequently, the DEA and K-Means models exclusively evaluate the club's performance prior to its ultimate structural collapse. This creates a classic case of survivorship bias within the dataset. Unlike CD Aves, whose operational degradation was already so profound before their reporting ceased that the algorithm still accurately captured them in the 'High-Risk / Low-Efficiency' zone, Boavista FC's missing data effectively masked its institutional freefall. By evaluating only the surviving years of relatively stable performance, the algorithm inadvertently places Boavista FC in the 'Consolidated Middle-Tier', artificially inflating its strategic position. This statistical illusion highlights a vital caveat in quantitative performance analysis: when systemic financial vulnerability leads to the cessation of official reporting, the resulting missing data can falsely anchor a failing institution in a sustainable cluster, completely obscuring the reality of its failure.

Ultimately, this first stage of analysis confirms a central thesis: inefficiency in Portuguese football is rarely a symptom of widespread technical incompetence. Instead, it is the direct consequence of extreme scale heterogeneity and the strict operational constraints imposed by market segmentation.

6.3 Second-stage analysis: the determinants of operational efficiency

To identify the exogenous factors driving the efficiency gaps observed in the first stage, the bias-corrected efficiency scores ($\hat{\theta}$) were regressed against the selected contextual variables and time fixed effects. Table 5 presents the estimated robust coefficients (β) and their respective 95% confidence intervals, computed via the Simar and Wilson (2007) double-bootstrap procedure with 2000 iterations.

Although the descriptive statistics presented in Section 6.1 showed the efficiency indices restricted to the range 0 to 1 for ease of reading, the double bootstrap algorithm of Simar and Wilson (2007) intrinsically uses the Farrell measure of output technical efficiency (the reciprocal of the Shephard distance function) to perform the truncated regression. Consequently, for the purposes of this second-stage estimation, the bias-corrected efficiency indices ($\hat{\theta}$) are constrained to a minimum of 1.0 (perfect efficiency), with higher values representing greater inefficiency. The interpretation of the parameters follows this specific logic: a negative coef-

efficient indicates that the variable reduces the distance to the optimal frontier (increasing efficiency), whilst a positive coefficient indicates an aggravating effect on organisational inefficiency.

Table 5 - Double-bootstrap truncated regression results

Variables	Robust coefficient (β)	Lower bound (2,5%)	Upper Bound (97,5%)	Significance
(Intercept)	1,242	-0,426	2,856	ns
Europe	-0,544	-0,760	-0,337	**
Managers	0,241	0,159	0,336	**
Average Age	-0,018	-0,082	0,047	ns
Promoted	-0,031	-0,232	0,185	ns
Year_2016	0,059	-0,279	0,393	ns
Year_2017	-0,044	-0,395	0,277	ns
Year_2018	0,168	-0,164	0,486	ns
Year_2019	0,135	-0,212	0,470	ns
Year_2020	-0,030	-0,381	0,299	ns
Year_2021	0,240	-0,078	0,535	ns
Year_2022	0,330	0,030	0,636	**
Year_2023	0,450	0,142	0,771	**
Year_2024	0,405	0,072	0,715	**

Source – Author's calculations

(Note: ** denotes significance at the 5% level; ns denotes not statistically significant, as the confidence interval contains zero)

6.3.1 The impact of structural and managerial variables

The empirical results provide clear statistical evidence regarding the strategic drivers of efficiency in the Portuguese league. The variable representing participation in UEFA competitions (Europe) exhibits a highly significant and strong negative coefficient ($\beta = -0.5437$). This is consistent with the interpretation that playing in European tournaments is associated with a substantial reduction in the club's inefficiency score. Despite the theoretical concerns regarding physical match congestion and domestic performance trade-offs (Stüttgen, 2025), these results suggest that the massive financial injections from UEFA prize money and the global exposure inherent to a "Selling League" may outweigh the operational friction. This is consistent with access to continental competition acting as a catalyst for operational efficiency in Portugal.

Conversely, managerial instability (Managers) presents a significant positive coefficient ($\beta =$

0.2408), indicating an association with reduced organizational efficiency. This finding is consistent with the arguments of Audas et al. (2002) and De Paola & Scoppa (2012) within the Portuguese context. Rather than providing a positive "shock" to the team, high turnover in the managerial role generates severe friction costs, such as overlapping salaries and severance pay, while destroying tactical cohesion. The direction and significance of this coefficient support the interpretation that frequent managerial changes are associated with inefficient use of resources.

Interestingly, the variables for average age and promoted status did not yield statistically significant results, as their confidence intervals cross zero. This suggests that the 'underdog effect' commonly associated with newly promoted teams (Paharia et al., 2011), or the pursuit of an optimal biological peak age (Dendir, 2016), do not systematically dictate efficiency in the Primeira Liga over the last decade when controlling for budget and other structural factors.

6.3.2 Longitudinal shocks and the rising cost of the league

The inclusion of time fixed effects (Year dummies) revealed a critical macroeconomic phenomenon within the ecosystem. Utilizing 2015 as the baseline reference year, the model shows that the efficiency frontier remained relatively stable until 2021 (coefficients are not statistically significant).

However, from 2022 onwards, the time coefficients become positive and statistically significant, culminating in $\beta = 0.4047$ in 2024. This structural shift indicates a systemic aggravation of inefficiency across the entire league in the post-pandemic period. In practical terms, Portuguese clubs were, from 2021, now required to invest substantially more inputs (personnel costs and amortizations) to generate the exact same level of outputs (points and revenues) as they did a decade before.

This econometric finding is consistent with the descriptive trend illustrated in Figure 2 (Section 5.3), which depicted a steep longitudinal rise in the gross cost per point within the league. By controlling for managerial and contextual variables in the second stage, the regression confirms that this inflation of costs per point is not a superficial anomaly, but rather a structural degradation of the ecosystem's operational efficiency. This longitudinal shift supports the "Cost of Dominance" hypothesis at a macro scale: while Section 6.2 demonstrated the internal scale penalty suffered by the market leaders, this temporal shock reveals the external inflationary pressure placed upon the rest of the ecosystem. The hyper-inflation of the global transfer market, coupled with the increasing financial effort required to retain talent and re-

main competitive against the ‘Big Three’, has made the operational environment of the Primeira Liga significantly more expensive and inherently less efficient over time.

6.4 Robustness checks

To rigorously test the sensitivity and validity of the baseline model, a robustness check was performed by modifying the specification of the time fixed effects. Instead of utilizing individual year dummies, which consume a larger number of degrees of freedom, the time control was condensed into a single binary variable: *Post_Pandemic*. This dummy takes the value of 1 for the seasons heavily impacted by the structural inflation of the global football market and post-COVID financial stabilization (2021/2022 to 2023/2024), and 0 for the preceding period.

The double-bootstrap truncated regression was re-estimated ($L_1=100$, $L_2=2000$) using this condensed specification. The results are presented in Table 6.

Table 6 - Robustness check: regression with a Post-Pandemic dummy

Variables	Robust Coefficient (β)	Lower Bound (2,5%)	Upper Bound (97,5%)	Significance
(Intercept)	1,253	-0,479	2,920	ns
Europe	-0,581	-0,797	-0,298	**
Managers	0,236	0,144	0,328	**
Average Age	-0,015	-0,0791	0,051	ns
Promoted	-0,036	-0,241	0,189	ns
Post_Pandemic	0,316	0,164	0,477	**

Source – Author’s calculations

(Note: ** denotes significance at the 5% level; ns denotes not statistically significant, as the confidence interval contains zero).

The outcomes of this alternative specification support the robustness of the core findings. The magnitude, direction and high statistical significance of the key management variables, namely the efficiency-enhancing effect of European participation ($\beta = -0.5811$) and the efficiency-detrimental nature of management instability ($\beta = 0.2359$), remained remarkably stable. This demonstrates that these strategic determinants are not artefacts of temporal controls, but rather genuine structural factors within the league.

Furthermore, the recently introduced ‘Post Pandemic’ dummy variable yielded a highly significant positive coefficient ($\beta = 0.3156$). This provides additional support for the longitudi-

nal deterioration discussed in Section 6.3.2. By aggregating the recent seasons, the model provides evidence to reject the null hypothesis of temporal neutrality. This is consistent with the view that the post-2021 environment of the Primeira Liga is structurally more expensive and inherently less efficient and strongly supports the hypothesis that the "Cost of Dominance" and overall operational survival have become significantly more costly in the current economic landscape.

To further assess the structural stability of the estimated parameters and address potential concerns regarding sample heterogeneity, driven by the significant financial asymmetry within the ecosystem, an additional robustness check was carried out by subdividing the sample. Given that the Portuguese Primeira Liga is historically characterised by a marked duopoly or oligopoly, the model re-estimated the truncated regression using double bootstrapping ($L_1=100$, $L_2=2000$) whilst completely excluding the observations corresponding to the market leaders: Futebol Clube do Porto, Sport Lisboa e Benfica and Sporting Clube de Portugal. This optimisation of the subsample restricts the data strictly to the 'mid-table' and lower divisions of the league.

The empirical evidence from this restricted specification provides compelling evidence of the structural robustness of the main findings, as the directional impact and statistical significance of the primary determinants remain remarkably stable. Specifically, the coefficient relating to managerial instability (Managers) remains positive, robust and highly significant ($\beta = 0.2272$; 95% CI [0.1238, 0.3280]). This allows us to reject the null hypothesis of neutrality ($H_0: \beta_{\text{Managers}} = 0$) at the 5% significance level. This is consistent with the disruptive friction and organisational costs of managerial turnover applying broadly across the league, regardless of budget category.

Similarly, the efficiency-enhancing effect resulting from participation in continental competitions (Europe) remains highly robust and statistically significant ($\beta = -0.3925$; 95% CI [-0.6048, -0.1279]). Although the absolute magnitude of the parameter is slightly reduced compared to the baseline model, access to international fixtures continues to operate as a vital structural catalyst for operational optimization among mid-tier clubs. This slight compression is logically explained by the smaller financial scale of the UEFA Europa and Conference Leagues, relative to the multi-million-euro Champions League prizes predominantly captured by the elite.

However, this empirical result must be interpreted in light of the hybrid nature of the DEA model's results. As highlighted in the literature review (Stüttgen, 2025), mid-tier clubs often

suffer sporting penalties at national level, such as the loss of league points, due to severe physical exhaustion caused by an excessive number of matches. Furthermore, this physiological burden is frequently exacerbated by early European qualifying rounds, which severely disrupt pre-season periodization and long-term squad planning. However, the robust negative coefficient ($\beta = -0.3925$) demonstrates that the extraordinary financial revenues generated by UEFA prize money and increased exposure in the player transfer market far outweigh these sporting losses at the national level in the calculation of overall efficiency. In essence, European qualification acts as a massive, high-yield financial windfall for the ‘middle class’: these clubs maximise their short-term operational efficiency through immense financial leverage, even if the accompanying athletic exhaustion explains why they struggle to maintain this leading status in subsequent seasons.

Finally, the ‘Post-Pandemic’ time-dependent dummy variable exhibits a strong and significant positive coefficient ($\beta = 0.3374$; 95% CI [0.1738, 0.5060]). This consistency across the restricted sample lends support to the interpretation that the systemic deterioration of the efficiency frontier in the post-2021 period reflects a macroeconomic shock that cuts across the entire league structure, and is consistent with increased financial burden compromising operational sustainability across the Portuguese football pyramid, and not just its dominant leaders.

7. Conclusion

7.1 Main Findings

This study evaluates the operational and strategic efficiency of clubs in the Portuguese Primeira Liga to resolve whether the historical hegemony of the 'Big Three' stems from superior management competence or an overwhelming scale advantage. Decomposing organizational performance reveals that within a resource scarce 'Selling League', absolute scale dictates structural dominance, while pure technical efficiency anchors long-term institutional survival.

Empirical evidence strongly supports the 'Cost of Dominance' hypothesis. Market leaders exhibit near-perfect efficiency under a variable returns to scale framework, proving highly capable of maximizing sporting and financial returns within their specific weight class. Dominance, however, demands a steep economic price. Once constant scale constraints are introduced, these elite structures are forced to operate deep within a zone of diminishing marginal returns to protect their domestic monopoly and sustain European competitiveness. Conversely, medium-sized clubs optimize survival by aligning tightly with the local economy's optimal scale, though this financial prudence inherently prevents them from shattering the established oligopoly.

By isolating the environmental determinants of these efficiency gaps, the empirical evidence raises serious concerns about managerial instability. Frequent mid-season coaching changes systematically fracture tactical cohesion and generate destructive friction costs, decisively debunking the pervasive industry myth of a positive short-term 'shock'. Far from a strategic reset, the econometric results are consistent with managerial churn operating as a strict, self-inflicted operational penalty.

Furthermore, the model finds no statistical support for two secondary industry assumptions. Contrary to conventional narratives, neither the pursuit of an optimal biological peak age nor the psychological 'underdog effect' of newly promoted teams appear to significantly predict long-term efficiency when controlling for structural budget constraints.

Conversely, international exposure is associated with improved operational efficiency, consistent with acting as a systemic catalyst. Despite intense match congestion and its inherent physical toll, the transformative financial injections distributed by UEFA fundamentally maximize the operational success of domestic structures. Crucially, the integration of time fixed effects exposes a profound macroeconomic structural shift in the post-pandemic era. Driven by hyper-inflation in the global transfer market and the escalating expense of retaining talent,

the entire Primeira Liga environment has become structurally more expensive since 2021. Organizations are now forced to consume substantially more inputs to secure the exact same baseline of points and revenue.

7.2 Institutional and Managerial Implications

Beyond the literature review, these empirical conclusions deliver critical institutional implications for the modern governance of Portuguese SADs. The data provides a strict strategic lens to evaluate three immediate industry challenges: the rapid influx of private equity via Multi-Club Ownership (MCO) networks, the imminent regulatory shock of centralized broadcasting rights, and the persistent mismanagement of technical leadership.

Regarding the growing popularity of MCO models, foreign capital frequently targets domestic clubs to absorb their proven talent-exporting efficiency into broader international portfolios. Yet, this integration masks profound structural vulnerabilities. If global investors treat Portuguese institutions merely as passive production nodes, injecting capital to artificially inflate wage structures and premium transfer acquisitions, they inevitably trigger destructive diseconomies of scale. Furthermore, imposing a strictly globalized market logic upon a local ecosystem exacts a severe hidden cost: the rapid dismantling of the club's historical identity and community utility. Capital alone cannot replace competence. MCO strategies that rely exclusively on blind financial consumption, actively neglecting pure technical optimization (VRS) and the hybrid social nature of sports institutions, guarantee more than just operational inefficiency. They engineer profound institutional alienation and long-term financial collapse.

Simultaneously, the empirical framework offers profound insights into the impending centralization of television broadcasting rights in Portuguese football. Historically, the extreme concentration of media revenues has operated as a financial buffer for market leaders, shielding operational errors through sheer liquidity. Transitioning to a centralized broadcasting model introduces a massive institutional shock destined to reshape the league's competitive balance. For the middle class, which currently optimizes survival close to the efficiency frontier through strict cost containment, a more equitable distribution of broadcasting capital will automatically expand organizational scale. Yet, financial windfalls carry severe disruption risks. If mid-table clubs exploit this capital influx to engage in a localized arms race, recklessly inflating player wages and legacy costs without upgrading technical management capabilities, they will merely replicate the diminishing returns to scale that penalize the elite. This transition would dangerously transform a sustainability mechanism into an engine of operational

waste.

Finally, the econometric results deliver a definitive critique of reactive technical leadership management. The highly significant positive coefficient linked to managerial instability provides robust evidence that mid-season dismissals operate as a purely destructive friction cost within the domestic pyramid. Rather than providing a positive performance shock, frequent coaching changes systematically fracture tactical cohesion and generate toxic overlapping salary obligations that push the organization further away from the efficiency frontier. Scapegoating is an inefficient strategy. Consequently, this study urges sporting directors and corporate boards to abandon short-term reactive sackings and prioritize managerial continuity as the primary baseline for strategic stability.

7.3 Limitations and Future Research

This macroeconomic analysis evaluates structural efficiency at the aggregate level. Yet, the profound opacity of the European football labour market imposes strict empirical boundaries. Without public microdata on individual player contracts, aggregate personnel costs and amortizations must serve as the fundamental proxies for human capital. Should internal wage structures eventually become transparent, the next empirical frontier must definitively quantify how intra-squad salary dispersion actively accelerates or destroys tactical cohesion. Furthermore, the rapid integration of domestic SADs into global MCO networks introduces a critical new operational dimension. The exact impact of these cross-border corporate synergies on the exporting efficiency and pure technical output of peripheral clubs remains severely under-explored. Efficiency dictates survival. Ultimately, mastering the delicate equilibrium between sustainable economic scale and elite technical competence remains the defining strategic challenge in the modern sports industry.

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9. Annex

Table A1 – Teams

Club name	Club logo	Seasons in Primeira Liga	Notes
Académica Coimbra (AAC OAF)		2 (2014/2015, 2015/2016)	
Boavista FC		10	Missing data for 2022/2023 and 2023/2024
Casa Pia AC		2 (2022/2023, 2023/2024)	
CD Aves		3 (2017/2018, 2018/2019, 2019/2020)	Missing data for 2018/2019 and 2019/2020
CD Feirense		3 (2016/2017, 2017/2018, 2018/2019)	
CD Nacional		5 (2014/2015, 2015/2016, 2016/2017, 2018/2019, 2020/2021)	
CD Santa Clara		5 (2018/2019, 2019/2020, 2020/2021, 2021/2022, 2022/2023)	
CD Tondela		7 (2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2020/2021, 2021/2022)	
CF Os Belenenses		 8 (2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2020/2021, 2021/2022)	
CF União da Madeira		1 (2015/2016)	
CS Marítimo		9 (2014/2015, 2015/2016, 2016/2017,	

		2017/2018, 2018/2019, 2019/2020, 2020/2021, 2021/2022, 2022/2023)	
Estrela Amadora (CFEA SAD)		1 (2023/2024)	
FC Arouca		6 (2014/2015, 2015/2016, 2017/2018, 2021/2022, 2022/2023, 2023/2024)	Missing data for 2015/2016
FC Famalicão		5 (2019/2020, 2020/2021, 2021/2022, 2022/2023, 2023/2024)	
FC Paços de Fer- reira		8 (2014/2015, 2015/2016, 2016/2017, 2017/2018, 2019/2020, 2020/2021, 2021/2022, 2022/2023)	
FC Penafiel		1 (2014/2015)	
FC Porto		10	
FC Vizela		3 (2021/2022, 2022/2023, 2023/2024)	Missing data for 2022/2023
GD Chaves		5 (2016/2017, 2017/2018, 2018/2019, 2022/2023, 2023/2024)	
GD Estoril		7 (2014/2015, 2015/2016, 2016/2017, 2017/2018, 2021/2022, 2022/2023, 2023/2024)	

Gil Vicente FC		6 (2014/2015, 2019/2020, 2020/2021, 2021/2022, 2022/2023, 2023/2024)	
Moreirense FC		9 (2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2020/2021, 2021/2022, 2023/2024)	
Portimonense SC		7 (2017/2018, 2018/2019, 2019/2020, 2020/2021, 2021/2022, 2022/2023, 2023/2024)	
Rio Ave FC		9 (2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020, 2020/2021, 2022/2023, 2023/2024)	
SC Braga		10	
SC Farense		2 (2020/2021, 2023/2024)	
SL Benfica		10	
Sporting CP		10	
Vitória FC		6 (2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019, 2019/2020)	Missing data for 2018/2019



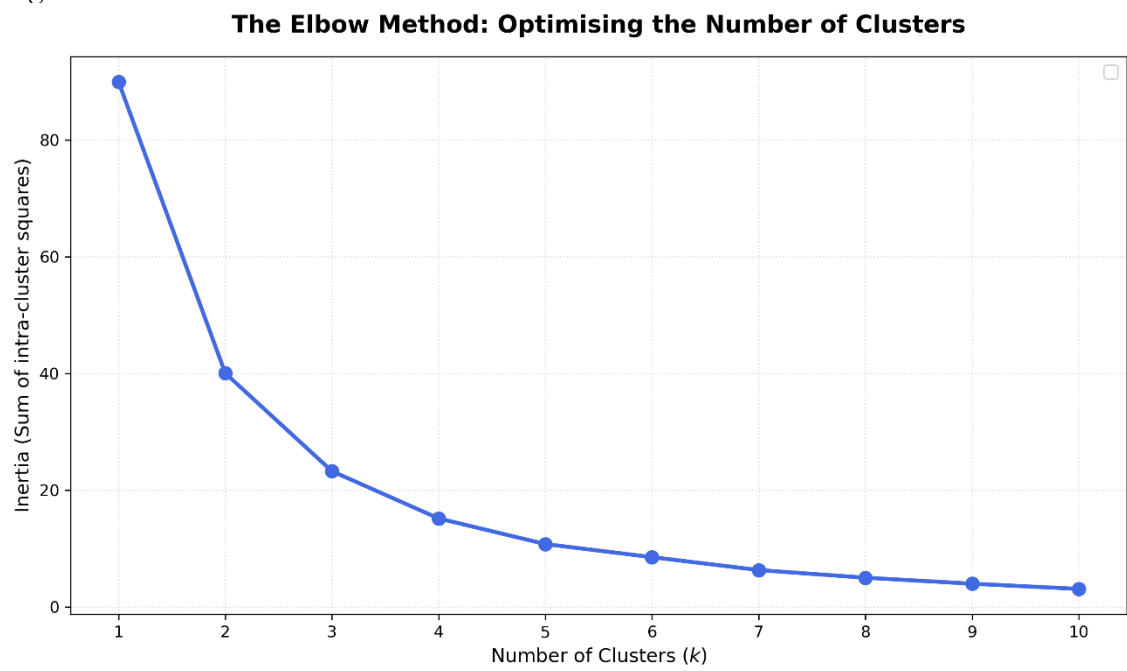
Source – Author's own elaboration based on SABI financial reports and FBref sporting reports

Table A2 - Descriptive Statistics of Base Variables

Variable	Obs.	Mean	Std. Dev.	Min	Median	Max
Cost of employees (€)	173	18 885 000	27 495 249	1 400 743	5 939 416	114 697 736
Depreciation (€)	173	7 655 969	14 758 501	6 461	666 149	60 505 508
Operating revenue (€)	173	40 714 442	66 806 213	1 323 657	10 347 413	285 108 929
Sales (€)	173	18 744 441	30 556 555	146 852	5 272 840	132 792 741
Points	173	47,32	18,32	20,00	42,00	91,00
Europe	173	0,32	0,47	0,00	0,00	1,00
Promoted	173	0,13	0,34	0,00	0,00	1,00
Average age (Years)	173	26,09	1,06	22,90	26,10	28,90
Managers	173	1,66	0,79	1,00	1,00	4,00

Source – Author's own elaboration based on SABI financial reports and FBref sporting reports

Figure A1 – The Elbow Method



Source – Author's own elaboration

Table A3 – Ten-Year Average Efficiency Results

Team	Global Efficiency (CRS)	Pure Efficiency (VRS)	Scale Efficiency (SE)
Académica Coimbra (AAC OAF)	0,417	0,638	0,652
Boavista FC	0,849	0,937	0,886
Casa Pia AC	1,000	1,000	1,000
CD Aves	0,655	0,857	0,765
CD Feirense	0,877	0,945	0,926
CD Nacional	0,836	0,945	0,884
CD Santa Clara	0,866	0,967	0,894
CD Tondela	0,844	0,895	0,946
CF Os Belenenses	0,923	0,967	0,956
CF União da Madeira	0,547	0,811	0,674
CS Marítimo	0,943	0,985	0,957
Estrela Amadora (CFEA SAD)	1,000	1,000	1,000
FC Arouca	0,920	0,948	0,971
FC Famalicão	0,651	0,890	0,720
FC Paços de Ferreira	0,887	0,939	0,946
FC Penafiel	0,762	1,000	0,762
FC Porto	0,540	0,966	0,559
FC Vizela	0,678	0,790	0,870
GD Chaves	0,818	0,852	0,953
GD Estoril	0,714	0,843	0,847
Gil Vicente FC	0,865	0,882	0,980
Moreirense FC	0,902	0,950	0,948
Portimonense SC	0,820	0,856	0,939
Rio Ave FC	0,675	0,880	0,762
SC Braga	0,689	0,989	0,695
SC Farense	0,692	0,860	0,805
SL Benfica	0,794	0,995	0,798
Sporting CP	0,725	0,972	0,744
Vitória FC	0,907	0,966	0,937
Vitória SC	0,671	0,887	0,757

Source – Author's calculations

Table A4 – Robustness Check: Truncated regression excluding the ‘Big Three’

Variables	Robust Coef- ficient (β)	Lower Bound (2,5%)	Upper Bound (97,5%)	Significance
(Intercept)	1,234	-0,581	3,079	ns
Europe	-0,393	-0,605	-0,128	**
Managers	0,227	0,124	0,328	**
Average Age	-0,014	-0,086	0,057	ns
Promoted	-0,056	-0,262	0,182	ns
Post_Pandemic	0,337	0,174	0,506	**

Source – Author’s calculations

*(Note: ** denotes significance at the 5% level; ns denotes not statistically significant, as the confidence interval contains zero).*

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