

Agricultural Subsidies and Trade protection in the European Dairy sector.

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Abstract: Although agricultural subsidies and non-tariff measures play an important role in the dairy sector by providing financial assistance and regulatory protection for producers, only a few studies have examined the relationship between sectoral concentration and the level of subsidies and NTMs intensity within the dairy sector under a unified political economy framework. This study aimed to examine the relationship between sectoral concentration and the level of subsidies and NTMs in the dairy sector. The thesis utilized panel data from 10 European countries over the period of 2010 to 2023. Sectoral concentration was measured by the Herfindahl-Hirschman Index (HHI), while subsidy was measured using the subsidy per output and NTMs measured as the number of NTMs applied in the dairy sector. The thesis combined the Grossman-Helpman Protection for Sale theoretical framework as well as a two-way fixed effect regression model for analysis while also controlling for country and year effects along with other economic factors such as GDP per capita, population size, import, and average farm size. The results showed a statistically positive relationship between sectoral concentration and increased subsidy level and NTMs. This relationship strengthened after the 2015 CAP reform abolishing milk quota. Among the control variable, import exposure was also identified as a strong predictor of NTMs suggesting that NTMs are used to protect domestic dairy producers from external pressure. There was also a complementary relationship between subsidies and NTMs suggesting that these policy tools jointly enhance the competitiveness of dairy producers in both domestic and international markets. This study concludes that how the dairy sector is structured is related to both the financial support received and policy applied. Also, sectoral structure and interaction of policy instruments should be considered in Agricultural policy design.

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1 Introduction

Agricultural policy remains one of the most economically sensitive and significant policy areas in the European Union, reflecting its importance for food security, rural development, and environmental sustainability. The Common Agricultural Policy (CAP) is one of the world's largest and most comprehensive agricultural support systems, encompassing direct income payments, market intervention instruments, and rural development schemes (European Commission, 2023). Despite successive reforms aimed at increasing market orientation and reducing trade distortions, agricultural subsidies continue to represent a central feature of the EU's agricultural policy framework.

Recent reforms under the 2023–2027 CAP Strategic Plans have sought to shift support toward decoupled payments, enhanced market orientation, and sustainability objectives. However, through direct payments, market interventions, and regulatory measures, the CAP continues to influence production incentives, farm incomes, and competitiveness across EU member states. Historically, agricultural subsidies under the CAP were introduced to ensure food security and stabilize farm incomes, but over time they have also become instruments for managing political and budgetary pressures within the agricultural sector (Rotunno & Ruta, 2024). CAP reforms have frequently been associated with external pressures arising from international trade negotiations and World Trade Organization (WTO) commitments. As traditional market-price support and export subsidies became increasingly constrained, the EU shifted toward less visible forms of support, including decoupled payments and regulatory measures. Several agricultural sectors have been particularly successful in preserving support during these reform periods, highlighting the role of political-economy factors in shaping the evolution of the CAP (Giuliani & Baron, 2025).

Empirical evidence has highlighted the persistent economic significance of agricultural subsidies. Anderson, Martin, and Valenzuela (2006), and more recently Anderson et al. (2023), show that although border protection has declined under trade liberalization, domestic support has increasingly become an important source of distortions in agricultural markets and global welfare losses. In the EU context, Matthews (2017) and Száltekin et al. (2024) demonstrate that CAP payments continue to influence competitiveness, production structures, and resource allocation across agricultural sectors. These findings suggest that subsidies remain an important instrument of agricultural protection, even in a period of reduced reliance on traditional trade barriers.

Alongside domestic support, the European Union's agricultural trade regime also influences market access and competition. With successive rounds of multilateral trade negotiations and EU trade agreements reducing tariff protection on agricultural products, market access is increasingly

influenced by non-tariff measures (NTMs). NTMs, including sanitary and phytosanitary (SPS) measures, technical barriers to trade (TBT), and quality and environmental standards, play an important role in regulating market access within the EU agricultural sector. While these measures are formally justified on grounds of food safety, environmental protection, and consumer welfare, their trade effects depend on regulatory design and implementation (Santeramo & Lamonaca, 2018).

The political economy of agricultural policy formation is important for understanding these dynamics within the EU. Agricultural subsidies and NTMs are shaped not only by efficiency considerations, but also by sectoral interests, member-state preferences, and CAP budgetary negotiations. Politically organized producer groups may influence both subsidy allocation and regulatory design. Early political economy analysis shows that subsidy allocation and policy design are influenced by producer economic importance and institutional bargaining (Xiao, 1998). More recent studies emphasize that agricultural policy outcomes in the European Union reflect institutional constraints and distributional conflicts alongside economic objectives (Matthews et al., 2023). This perspective provides a basis for examining the relationship between agricultural subsidies and trade protection in the EU.

These dynamics are particularly visible in the dairy sector. From a policy perspective, the CAP has traditionally provided substantial support to the dairy sector. Dairy producers continue to receive direct payments, market intervention support, and risk-management instruments, even after the abolition of milk quotas in 2015 and subsequent CAP reforms aimed at improving market orientation. Organized producer groups such as the European Dairy Association (EDA), may also influence policy discussions concerning CAP rules and regulatory standards affecting dairy production (Carreras, 2024).

However, despite extensive research on EU agricultural policy, existing studies largely analyse agricultural subsidies and trade protection instruments separately. One strand of literature focuses on the determinants and impacts of CAP subsidies (Swinnen, 2018; Giuliani & Baron, 2025), while another examines tariffs and non-tariff measures as drivers of trade flows (Disdier, Fontagné, & Mimouni, 2008; Santeramo & Lamonaca, 2022). There remains limited empirical evidence on how sectoral concentration may be associated with both domestic subsidies and non-tariff measures within the same analytical framework, particularly in the EU dairy sector.

Motivated by this research gap, this study addresses the following research questions:

1. How is sectoral concentration associated with the level of CAP subsidy allocated to the dairy sector?

2. Do CAP subsidies and NTMs exhibit a complementary relationship in the context of trade protection within the EU dairy sector?

This thesis contributes to existing literature in three ways. First, it provides sector specific empirical evidence on the political economy of agricultural subsidies, particularly the role of sectoral concentration in the EU dairy sector (Marchant, Neff, & Xiao, 1997; Swinnen, 2016). Second, it examines the relationship between sectoral concentration and non-tariff measures within the EU agricultural policy framework (Santeramo & Lamonaca, 2018; Kuenzel, 2024). Third, by analysing subsidies and NTMs together, the study contributes to a broader understanding of how domestic support and regulatory trade instruments may interact within EU agricultural policy formation (Grossman & Helpman, 1994; Matthews et al., 2023).

The thesis is structured as follows. Chapter 2 reviews the theoretical background on agricultural subsidies, trade protection in terms of non-tariff measures (NTMs), and political economy within the European Union. Chapter 3 presents the empirical methodology, specifically the GH model, with a focus on agricultural subsidies and NTMs, and describes the data used in the study. The results of the analysis are presented in Chapter 4. Chapter 5 discusses the key findings and provides recommendations for future research. Finally, Chapter 6 offers the overall conclusions of the study.

2 Theoretical Background

2.1 Common Agricultural Policy and Agricultural Subsidies in the European Union

Agricultural subsidies in the European Union are primarily shaped by the Common Agricultural Policy (CAP), established in the early 1960s with the objectives of stabilising agricultural markets, ensuring food security, and supporting rural livelihoods across Member States. The policy emerged in a post-war context characterised by food shortages and market instability, which justified extensive state intervention in agriculture. The original CAP was based on administratively determined price supports and trade protection measures. Minimum prices were guaranteed for key commodities such as cereals and milk, while tariffs and import restrictions protected domestic producers from external competition (European Commission, 2018). Although commonly presented as a response to market instability, the CAP was also shaped by political considerations, particularly the influence of agricultural interest groups and their capacity to shape income support policies (Swinnen, 2019). This suggests that CAP subsidies are not purely efficiency-driven instruments but also reflect politically mediated allocation processes.

From a theoretical perspective, agricultural support can be explained through welfare economics and political economy approaches. Welfare economic theory justifies intervention based on structural market failures, including price volatility, inelastic demand, and exposure to external shocks (Gardner, 1987; Just, Hueth, & Schmitz, 2024). However, this framework does not account for variation in subsidy allocation across sectors. Political economy theory addresses this limitation by emphasising the role of organised interest groups, where sectors with greater organisational capacity are more likely to obtain policy support (Olson, 1965; Becker, 1983). This distinction is relevant to this study as it implies that subsidy allocation is not uniform across sectors but is systematically influenced by sectoral organisation and structure. Sectoral concentration is expected to affect the ability of producers to coordinate and influence policy outcomes. As a result, sectoral concentration constitutes a key explanatory factor in understanding variation in CAP subsidy distribution across agricultural sectors.

The early CAP system based on price supports generated unintended consequences, including persistent overproduction and large surpluses commonly referred to as butter mountains and wine lakes. By the 1980s, these surpluses created fiscal pressures and attracted criticism from international trading partners within the GATT and WTO frameworks (WTO, 1995; OECD, 2020; Swinnen, 2018). In response, a sequence of reforms gradually altered the structure of agricultural support.

The MacSharry Reform (1992) marked a major shift by replacing price guarantees with direct income payments. Although this reform changed the form of support, it did not significantly reduce

overall transfer levels, but rather decoupled payments from production (Josling, 2008). This development is consistent with political economy models of reform under constraint, which suggest that governments tend to adjust policy instruments rather than reduce redistribution when political pressures persist (Daughbjerg & Swinbank, 2007). Agenda 2000 and the 2003 reform further strengthened decoupling and introduced cross-compliance requirements linking payments to environmental and land management standards. This indicates that agricultural subsidies increasingly serve multiple objectives including income support, environmental regulation, and compliance with international trade commitments.

The 2013 CAP reform also introduced greening requirements by linking a share of direct payments to environmentally beneficial farming practices (Pe'er et al., 2019). This reflects an increasing integration between subsidy schemes and environmental regulatory objectives. The CAP Strategic Plans (2023–2027) further reinforce decentralised implementation by allowing Member States to design national strategies within a common EU framework increasing cross-country and sectoral variation in subsidy allocation, thereby strengthening the relevance of structural factors such as sectoral concentration (European Commission, 2023).

Subsidies also have important economic effects on competitiveness. By altering relative production costs, they may generate market distortions such as price suppression, inefficient resource allocation, and welfare losses for non-subsidised producers (Matthews, 2017; Anderson et al., 2013). From a political economy perspective, subsidies may also create incentives for rent-seeking behaviour, where resources are directed toward securing transfers rather than improving productivity (Krueger, 1974). These dynamics may reinforce structural patterns in agriculture, as more organised or larger-scale sectors are often better positioned to access policy support which may contribute to increasing sectoral concentration over time (Ciaian et al., 2010).

This relationship is particularly relevant for the empirical analysis of this thesis, which examines how sectoral concentration is associated with subsidy allocation. Existing empirical literature suggests that agricultural subsidies are not merely redistributive instruments but are politically mediated policies shaped by structural and organisational factors. In addition, subsidies serve broader political and social functions by stabilising farm incomes and supporting rural cohesion within the EU policy framework (Giuliani & Baron, 2025; Swinnen, 2018). This reinforces their interpretation as both economic and political instruments and provides a basis for examining their interaction with trade-related policy instruments in subsequent analysis.

2.2 Trade Protection and Non-tariff Measures (NTMs)

The European Union's agricultural trade policy has evolved considerably over recent decades, shaped by both internal policy objectives and external trade commitments. Since the establishment of the World Trade Organization (WTO) and the implementation of the Agreement on Agriculture in 1995, the EU has progressively reduced tariffs and other traditional forms of border protection on agricultural products (WTO, 1995; Josling, 2009). However, the reduction of tariffs did not eliminate protection within the agricultural sector. Instead, protection increasingly shifted toward less visible regulatory instruments, particularly in sensitive sectors such as dairy, where concerns over income stability, food standards, and market volatility remain politically important forming an important baseline for this thesis that trade protection has not fully disappeared under liberalization but rather changed in form (Hahn, 2017).

Within this context, non-tariff measures (NTMs) have become increasingly significant instruments of trade regulation and market protection. NTMs include sanitary and phytosanitary (SPS) measures, technical barriers to trade (TBT), labelling requirements, traceability systems, and environmental standards governing food production and market access. Although these measures are formally justified on public policy grounds such as food safety, consumer protection, and environmental sustainability, studies increasingly show that they may also produce trade-restricting effects by raising compliance costs and limiting market access for foreign producers (Maskus et al., 2005; Cadot et al., 2018).

Nilsson (2018) and Grubler and Reiter (2021) also noted that NTMs have expanded in both prevalence and economic significance as tariffs have declined globally. For this study, the key implication is that NTMs should not be treated solely as neutral regulatory instruments. From a political economy perspective, they may also function as indirect forms of protection that shape competitive conditions within agricultural markets. Unlike tariffs, NTMs are often less transparent and can remain consistent with WTO obligations while still influencing trade flows and domestic market outcomes. This creates an important analytical link to the research question examining whether CAP subsidies and NTMs operate in a complementary manner within the EU dairy sector.

The growing importance of NTMs is closely linked to the broader restructuring of global trade governance. As tariff liberalization reduced governments' ability to rely on traditional border measures, regulatory standards increasingly became central determinants of market access (Anderson & Nelgen, 2012). Research on the political determinants of NTMs suggests that these measures are often influenced by sectoral interests and pressures. Ruckteschler, Malik, and Eibl (2019), for example, show that tariff reductions under trade agreements are frequently followed by

increases in technical barriers to trade, particularly in politically sensitive sectors. This finding is consistent with political economy theories which argue that governments may substitute visible forms of protection such as tariffs with less visible regulatory instruments when facing international trade constraints.

This interaction is particularly important in the dairy sector, where CAP support and SPS regulations coexist extensively. Subsidies may lower the private costs of compliance with environmental, quality, and food safety standards for EU dairy producers, whereas foreign competitors must absorb these costs without equivalent financial support. NTMs and subsidies may together strengthen the competitive position of domestic producers while limiting external competition. This possibility forms the central theoretical basis for the second research question of this thesis which examines whether CAP subsidies and NTMs exhibit a complementary relationship in the context of trade protection. (Maskus et al., 2005; De Melo & Nicita, 2018).

Therefore, this thesis treats NTMs not simply as technical regulations, but as policy instruments embedded within broader political and economic structures. Their interaction with CAP subsidies provides an important framework for understanding how trade protection may continue to operate in the EU dairy sector despite the broader trend toward tariff liberalization.

2.3 Political economy of Agricultural policy

Agriculture has historically been characterized by extensive government intervention across both developed and developing economies. However, these interventions cannot be explained solely through efficiency or welfare-maximization frameworks. Agricultural and food policies are inherently redistributive, generating concentrated benefits for producers while dispersing costs across consumers and taxpayers. This creates strong incentives for rent-seeking and political bargaining, making agricultural policy particularly susceptible to influence from organized interest groups. Although reforms associated with the broader shift from state-led to market-oriented governance have altered the instruments of agricultural support, they have not eliminated the redistributive nature of agricultural policy (Atapattu, 2022). For this thesis, the key implication is that agricultural support should not be viewed as purely corrective market intervention, but as an outcome shaped by political incentives and institutional bargaining.

This perspective is particularly relevant in the European Union where reforms of the Common Agricultural Policy (CAP) have reduced reliance on traditional trade barriers while maintaining substantial support through subsidies and regulatory instruments. As Doukas et al. (2023) argued, recent CAP reforms reflect negotiated political outcomes rather than purely technical policy adjustments. The gradual shift from visible protection instruments such as tariffs toward less visible regulatory measures has occurred alongside WTO constraints on trade-distorting support

and the expansion of public and private standards in global agri-food markets. Analytically, this suggests that trade liberalization may alter the form of protection without necessarily reducing the level of protection provided to politically sensitive sectors which also provides a basis for examining whether subsidies and NTMs operate together as complementary forms of trade protection within the dairy sector.

Political economy theory provides a framework for understanding why some sectors are more successful than others in securing policy support. The interest-group model developed by Gene M. Grossman and Elhanan Helpman argues that organized groups with concentrated interests are more capable of influencing policy outcomes than diffuse groups facing collective action problems (Grossman & Helpman, 1994). In agricultural sectors where producers are relatively concentrated and politically organized, lobbying incentives are stronger because the benefits of protection are substantial and concentrated among a smaller number of actors. This theoretical argument is also directly linked to the first research question of this thesis.

Within the EU, these dynamics are reinforced by the Union's multi-level governance structure. Agricultural policy outcomes emerge through interactions among farmer organizations, national governments, the European Commission, and the Council of the European Union. This institutional structure creates multiple channels through which organized producer groups can influence subsidy allocation and regulatory outcomes. CAP support is not distributed uniformly across sectors, but is shaped by bargaining power, institutional access, and sectoral political importance.

These dynamics are particularly visible in the dairy sector. Historical and empirical evidence shows that dairy producers, often represented by powerful farmer organizations and cooperatives, have consistently secured favourable policy treatment through price supports, coupled payments, and production quotas (Xiao, 1998; Swinnen, 2018). Although successive CAP reforms sought to increase market orientation and reduce trade distortions, support mechanisms have largely persisted in modified forms. Member states with politically influential dairy industries have continued to shape CAP negotiations in ways that stabilize producer incomes and protect domestic market shares (Duchêne, Szczepanik, & Legg, 2023).

This Political economy considerations also extend to non-tariff measures (NTMs). While SPS regulations, environmental standards, and technical requirements are formally justified on public policy grounds, their implementation can also generate protective economic effects. Empirical evidence from Sanjuán et al. (2023) shows that EU SPS measures impose significant trade costs in the dairy sector, reducing trade flows despite formal compliance with international trade rules. This suggests that NTMs may simultaneously serve regulatory and protective functions. From a

political economy perspective, regulatory standards therefore cannot be treated as entirely neutral instruments, since they may also reflect domestic political pressures and sectoral interests. Studies such as Santeramo and Lamonaca (2018) and Kuenzel (2024) suggest that subsidies and NTMs may therefore reinforce one another by simultaneously lowering compliance costs for domestic producers and raising entry barriers for external competitors also creating an important theoretical expectation for the second research question.

2.4 Interaction between Subsidies and NTMs

Domestic agricultural subsidies and non-tariff measures (NTMs) represent distinct but interrelated policy instruments within the EU's agricultural framework. They distort trade by impacting domestic production and import prices. While subsidies directly support domestic producers financially, NTMs function both as regulatory instruments and as indirect trade-protective measures. Recent literature emphasizes that these policy instruments do not function in isolation rather, they frequently operate together generating mutually reinforcing dynamics that intensify the protection of domestic sectors while simultaneously influencing the conditions of market access for foreign competitors (Fell & Duver, 2024).

Several studies demonstrate that domestic subsidies and NTMs can act as complementary policy instruments rather than alternative policy tools. Subsidies can incentivize the implementation of stricter NTMs by providing domestic producers with the resources needed to comply with rigorous regulatory requirements, which would otherwise impose high compliance costs (Irwin, 2022). European dairy producers benefiting from Common Agricultural Policy (CAP) payments are significantly better equipped to invest in the specialized infrastructure and traceability systems required to meet EU hygiene and labelling standards. This creates a distinct competitive advantage over foreign producers particularly those in developing nations who face the same regulatory hurdles but lack the financial cushion provided by the CAP to absorb the costs of compliance (Garrone et al., 2020; Santeramo & Lamonaca, 2022). This forms an important analytical implication for this thesis that subsidies may not only support production directly but may also increase the capacity of domestic producers to benefit from regulatory protection.

Furthermore, NTMs serve to reinforce the benefits of subsidies by limiting the scope of foreign competition, thereby allowing subsidized domestic producers to maintain higher prices and larger market shares. Further research also illustrates how EU agricultural support schemes, when combined with high safety standards help sustain domestic productivity and stabilize internal markets creating a protective buffer that subsidies alone could not achieve (Heidari et al., 2021). Even in times when tariffs are reduced, the continued use of NTMs often limits the expected increases in trade, illustrating a strategic relationship where regulatory measures serve as a safety

net for domestic support once traditional border protections are eliminated. This interaction is especially prominent in the EU Green Deal, where environmental NTMs are increasingly connected to eco-scheme subsidies. This linkage ensures that the financial burden of the green transition falls on the state rather than individual farmers, while foreign competitors must bear the full cost of meeting these standards to access EU markets (Wolf et al., 2024; Matthews, 2022).

In the dairy sectors, the coordinated use of subsidies support and NTMs measures especially SPS, has been demonstrated to decrease vulnerability to global price fluctuations while maintaining rigorous compliance with European hygiene standards (Sanjuán et al., 2023). This relationship creates a reinforcing feedback loop whereby subsidies lower the private costs associated with meeting NTMs, and the NTMs themselves serve as higher entry barriers for foreign competitors. As a result, domestic producers secure a larger market share, which further justifies the continuation of support policies. From a theoretical standpoint, this dynamic aligns with the interest group models of Grossman and Helpman (1994), which proposed that policymakers tend to respond to well-organized sectoral groups whose benefits from these joint policy tools are concentrated, whereas the associated costs are spread across a broader population of taxpayers and consumers. Therefore, this interaction reflects a strategic outcome driven by the EU's multi-level governance framework, where high standards are used to legitimize ongoing financial support for domestic producers.

2.5 Sectoral Focus: The EU dairy sector

The dairy sector represents one of the most economically and politically significant agricultural sectors within the EU, making it a particularly relevant case for examining the relationship between subsidies, trade protection, and sectoral concentration. The sector contributes approximately 12% of total EU agricultural output and plays an important role in farm income generation, rural employment, and value-added activities in processing and distribution (Benedek et al., 2017). Beyond its direct contribution to agricultural production, the dairy sector is closely linked to upstream industries such as feed and machinery suppliers and downstream industries including food processing, retail, and food services. This broad economic integration increases the sector's political and strategic importance within EU agricultural policy.

For this thesis, the significance of the dairy sector lies not only in its economic size, but also in its institutional and structural characteristics. Dairy products such as milk, cheese, and butter account for a substantial share of agricultural production across many EU member states, while approximately 90% of EU milk production is consumed within the internal market (Koutouzidou et al., 2022). This high level of domestic consumption increases the political sensitivity of the sector, particularly in relation to food security, price stability, and rural livelihoods. As a result, dairy

policy is often subject to stronger political pressures than less strategically important agricultural sectors.

Structurally, the EU dairy sector is highly heterogeneous, with substantial variation in farm size, productivity, and production systems across member states. Specialized and large-scale dairy farms are concentrated primarily in Northern and Western Europe, whereas smaller and less capital-intensive farms remain more common in parts of Eastern Europe (Zorn & Zimmert, 2022). This structural diversity is analytically important because it creates variation in sectoral concentration and organizational capacity across the dairy industry. From a political economy perspective, sectors characterized by higher concentration and stronger producer organization are expected to possess greater lobbying capacity and stronger influence over policy outcomes. This provides a direct theoretical link to the first research question examining whether sectoral concentration is associated with higher levels of CAP subsidy allocation.

The dairy sector also provides a useful context for examining the interaction between subsidies and trade protection instruments. Historically, the sector has been heavily supported under the CAP through price supports, production quotas, direct payments, and market intervention mechanisms. Although successive CAP reforms particularly after the Luxembourg reform shifted support toward more market-oriented instruments, substantial financial support remains embedded within the sector (Ongeneel & Gonzalez-Martinez, 2022). At the same time, dairy production is subject to extensive SPS regulations, quality standards, and traceability requirements that shape market access and competition.

External trade pressures have also increased the relevance of these dynamics. WTO disciplines on trade-distorting support and export subsidies have reduced the EU's reliance on traditional border protection, exposing the dairy sector more directly to international competition. However, the decline of tariffs and export subsidies has not eliminated protection within the sector. Instead, support increasingly operates through less visible mechanisms, including decoupled subsidies and regulatory standards. Analytically, this raises the possibility that CAP support and NTMs function together as complementary instruments that sustain domestic competitiveness despite broader trade liberalization.

Dairy cooperatives and farmer organizations are highly organized at both national and EU levels and have historically played an important role in CAP negotiations and regulatory debates. The combination of economic significance, sectoral concentration, and institutional organization enhances the capacity of dairy producers to influence agricultural policy outcomes. Therefore, the dairy sector provides a particularly appropriate case for analysing how political economy factors shape the interaction between subsidies and trade protection within the EU agricultural system.

2.6 Other related studies

Several empirical studies have examined how political economy factors influence agricultural protection and trade policy. Much of this literature is grounded in the protection for sale framework developed by Gene M. Grossman and Elhanan Helpman (1994), which argues that governments balance welfare objectives against pressure from organized interest groups. The model predicts that sectors with stronger organization and higher concentration are more likely to secure favourable policy treatment through lobbying and political influence.

Empirical evidence generally supports this argument. Studies such as Gawande and Hoekman (1994) and López and Hathié (2002) show that politically organized agricultural and food-processing sectors tend to receive higher levels of protection. Their findings suggest that sectoral concentration and organization increase the ability of producers to influence trade and subsidy policies, while increased import competition may weaken this influence. These studies are particularly relevant to this thesis because they provide a theoretical and empirical basis for examining whether concentration within the dairy sector is associated with higher CAP subsidy allocation.

Other studies focus more directly on the role of subsidies and non-tariff measures in shaping agricultural trade outcomes. Kondaridze and Luckstead (2023) show that agricultural subsidies influence trade patterns by lowering production costs and strengthening export competitiveness in dairy markets. Similarly, Herghelegiu (2018) finds that NTMs are more likely to emerge in sectors facing import competition and strong political pressure, suggesting that governments may increasingly rely on regulatory instruments when tariff protection becomes constrained under international trade agreements. Together, these studies imply that subsidies and NTMs may function as interconnected rather than independent policy tools. Research has also emphasized that trade liberalization does not necessarily reduce protection uniformly across sectors. Ruckteschler, Malik, and Eibl (2022) demonstrate that governments often adjust the form rather than the level of protection particularly in politically sensitive industries.

Despite these contributions, an important limitation remains within the existing literature. Much of the empirical work focuses either on the political determinants of trade protection or on the economic effects of individual policy instruments such as subsidies or tariffs. Few studies provide a unified empirical analysis of how different policy tools particularly subsidies, and non-tariff measures jointly interact within a political economy framework in the context of sectoral concentration. This gap is particularly relevant in the European Union context, where financial support under the Common Agricultural Policy operates alongside extensive regulatory standards governing food safety, quality, and environmental sustainability.

This thesis addresses this gap by adopting an integrated analytical approach that examines the relationship between sectoral concentration, agricultural subsidies, and non-tariff measures (NTMs). By focusing on European dairy sector, the study contributes to the literature by analysing how dairy sector structure is associated with both financial support and regulatory measures, and how these policy instruments interact within the sector. This approach provides a more comprehensive understanding of how agricultural support operates through multiple channels and how structural characteristics of the sector are linked to the use of both subsidies and NTMs within an increasingly complex policy environment.

3 Data and Methodology

3.1 Grossman-Helpman model

The Grossman–Helpman (1994) Protection for Sale (PfS) was adopted by this study to analyze how sectoral concentration within the European dairy sector relates the allocation of agricultural subsidies and the design of non-tariff measures (NTMs). The PfS model conceptualizes trade and domestic policy as the outcome of a political-economy process in which governments maximize a weighted objective function by seeking to balance aggregate social welfare against the political necessity of supporting highly concentrated and organized sectors. Within this framework, sectoral concentration is used as an appropriate substitution for lobbying influence given its potential for rents, political influence, and market power which can be informative as a determinant of lobbying capacity.

The degree of sectoral concentration is the primary determinant of policy distortion. Unlike fragmented industries where collective action is hindered by free-rider problems, the EU dairy sector exhibits high levels of concentration. This structural density allows the sector to deviate policy outcomes from socially optimal benchmarks toward protectionist measures (Grossman & Helpman, 1994). As a result, sectors with stronger concentration and political organizations tend to receive higher levels of protection through trade barriers, subsidies, or other regulatory measures. In the context of European countries, this framework is particularly relevant because dairy producers are among the most politically organized groups within the agricultural sectors. Through producer associations, cooperatives, and national farm unions, dairy producers coordinate their representation at both national and EU levels. These producers participate in formal consultation processes, and negotiations involving EU institutions and member states (Matschke, 2021). As a result, they can exert considerable influence on agricultural policy design and implementation. A key instrument through which this influence operates is the Common Agricultural Policy (CAP), which provides substantial financial support to agricultural producers including dairy farmers. Reinforcing the idea that CAP subsidies may not only function as income support mechanisms but may also reinforce the political capacity of producer groups by strengthening their economic position and organizational power.

NTMs have also become central instruments for regulating market access and protecting domestic producers. These measures can be adjusted under political influence serving both legitimate regulatory objectives and protective functions (Mitra, 2021; Assoua, Molua, & Nkendah, 2024). Within this context, CAP subsidies are expected to amplify the political influence of dairy producers, creating incentives to maintain or tighten NTMs to shield domestic markets from foreign competition. Empirical evidence supports this mechanism showing that despite reductions

in traditional trade barriers, NTMs continue to pose significant obstacles to agricultural trade in the EU, often disproportionately affecting foreign producers (Santeramo & Lamonaca, 2022). CAP subsidies further distort production and export incentives, generating political demand for standards that exceed purely safety or quality objectives (Matthews, 2016). These dynamics illustrate that subsidized producers exploit regulatory instruments to strengthen their market position, in line with PfS predictions. The PfS framework further suggests that domestic support and regulatory protection are codetermined. In the EU, the coalitions of dairy producer groups, member-state governments, and institutional actors that advocate for CAP subsidies simultaneously influence the design and enforcement of NTMs (Anderson et al., 2023).

Complementary theoretical perspectives also illustrate these dynamics. Public Choice Theory (Buchanan & Tullock, 1962; Olson, 1965) explains how collective action by highly concentrated and organized groups drives policy outcomes in ways that prioritize sectoral interests over broader social efficiency, while Rent-Seeking Theory (Krueger, 1974; Tullock, 1967) emphasizes how economic actors expend resources to capture policy rents, reinforcing the association predicted by the PfS model. Together, these frameworks suggest that higher subsidies in politically influential sectors such as dairy are naturally associated with stricter NTMs, and that sectoral concentration conditions the strength and enforcement of these regulatory measures. The PfS framework therefore provides a robust lens for analysing EU agricultural policy, highlighting how sectoral concentration viewed as a key conditioning factor shaping political economy forces is associated with both domestic support and regulatory protection. It suggests that higher levels of agricultural subsidies in politically influential and concentrated sectors, such as dairy are likely to be accompanied by stricter non-tariff measures, as organized producers leverage their influence to safeguard market positions. These dynamics also suggest that subsidies and NTMs are mutually reinforcing, rather than independent instruments of protection informing the empirical analysis of this study, which examines how CAP subsidies and NTMs are jointly determined in the EU dairy sector over time, reflecting the broader political-economy mechanisms underlying agricultural protection.

3.2 Data collection

The data used in this study were obtained from multiple authoritative European and international sources to ensure consistency, reliability, and comparability over the period 2010–2023. The analysis covers ten European countries: Finland, Austria, the Netherlands, Sweden, Denmark, Germany, Estonia, Italy, France, and Portugal. The sample was selected to capture systematic variation in the structure of the dairy sector across Northern, Western, Southern, and Eastern Europe.

These countries differ in key structural dimensions relevant to the research questions, including farm size distribution, production intensity, import orientation, and reliance on CAP support. This variation is analytically important as it allows the study to examine whether differences in sectoral concentration are associated with variation in subsidy allocation and the design of non-tariff measures (NTMs) across different dairy systems. To ensure comparability across countries and over time, all key variables are drawn from harmonised datasets with standardised definitions

Data on agricultural subsidies were obtained from the Farm Sustainability Data Network (FSDN) database, subsidy was measured in term of subsidy intensity in each country as the ratio of total subsidies to total agricultural output at the farm level. Following standard practice in literature, total subsidies are proxied using FADN variable SE605, which captures total subsidies on current operations, excluding investment subsidies. This variable includes payments received under the Common Agricultural Policy (CAP), such as decoupled direct payments and other forms of operational support while total agricultural output is measured using FADN variable SE131, which represents the total value of farm production. The subsidy intensity measure is therefore defined as:

$$\text{subsidy intensity} = \frac{\text{Total subsidies}(SE605)}{\text{Total output}(SE131)}$$

The resulting variable is a unit-free ratio, which can be interpreted as the share of agricultural output accounted for by subsidy support. To ensure representativeness at the sectoral level, the analysis applies FADN sampling weights in all aggregations. Specifically, subsidy intensity is computed as the ratio of weighted total subsidies to weighted total output:

$$\text{subsidyintensity}_t = \frac{\varepsilon_i w_i \cdot SE605}{\varepsilon_i w_i \cdot SE131}$$

where w_i denotes the sampling weight for farm i . This approach avoids bias associated with averaging individual farm ratios and ensures that the measure reflects the structure of the underlying farm population. The analysis also focuses exclusively on farms classified as specialist dairying under the FADN TF8 typology. This restriction ensured that the subsidy intensity measure accurately reflects policy support within the dairy sector, rather than broader agricultural activity. Data on sectoral concentration in the dairy industry were constructed using farm level production data from Eurostat. Sectoral concentration was measured using each farm share of total dairy

production computed as $S_i = \frac{\text{output}_i}{\sum_{j=1}^N \text{output}_j}$

where output_i is farm-level dairy production and N is the number of farms in a country.

Sectoral concentration is then measured using the Herfindahl–Hirschman Index (HHI) where $HHI = \sum_{i=1}^N S_i^2$. The HHI is a bounded index ranging from 0 to 1, where higher values indicate greater sectoral concentration and lower values indicate a more dispersed production structure.

Data on non-tariff measures (NTMs) were obtained from the UNCTAD TRAINS database (ntm_full_cov_nonH), which captures fully applied regulatory measures affecting dairy imports. The NTM variable reflects the presence of regulatory requirements such as sanitary and phytosanitary (SPS) measures, technical barriers to trade (TBT), and related product standards applied within each country-year observation.

However, the NTMs variable should be interpreted as a measure of regulatory coverage rather than enforcement intensity. While the classification of NTMs is harmonised, countries may still differ in implementation strictness, inspection intensity, and compliance costs. This implies that the variable captures the existence of regulatory measures rather than their full economic stringency, which should be considered when interpreting the results.

Control variables such as GDP per capita, population, dairy import, average farm size was gotten from Eurostat and were included to account for observable differences in economic development, relative importance of agriculture, agricultural trade and structural differences within the dairy sector respectively. The analysis was conducted using R.

3.3 Model Specification

Building on the Protection for Sale model framework, this study examined how sectoral concentration in the dairy sector is associated with subsidies and the design of measures (NTMs) in the dairy sector across European countries. The PfS framework predicts that policy outcomes are shaped by organized interest groups seeking rents. In this context, higher sectoral concentration is interpreted as a proxy for stronger collective action and political influence within the dairy industry. The analysis will focus on 10 European countries exploiting both cross-country and time variation to examine how sectoral concentration is related to the allocation of CAP subsidies and design of NTMs.

This empirical framework relies primarily on within-country variation over time, rather than cross-country differences. It examines how changes within the same country over time in sectoral concentration are associated with changes in subsidies and NTMs, after accounting for time-invariant country characteristics and common shocks. This is implemented through two-way fixed effects models with country and year fixed effects.

The empirical analysis models subsidies and NTMs as functions of sectoral concentration and a set of country-level economic controls. The dependent variable in the model is the natural logarithm of subsidy levels allocated to the dairy sector (log_subsidy). The key explanatory variable is sectoral concentration operationalized as Herfindahl-Hirschman Index (HHI) metric. Control variables

include GDP per capita ($\log_gdp$), population size ($\log_population$), average dairy farm size, and import levels ($\log_import$), capturing economic scale, sectoral structure, and trade exposure.

Two empirical specifications are estimated. First, a two-way fixed effects model is used to examine the relationship between sectoral concentration and subsidy levels. This specification exploits within-country variation over time, net of country-specific invariant factors (γ_i) and global shocks (δ_t). It therefore does not compare subsidy levels across countries but instead examines how changes in sectoral concentration within a country are associated with changes in subsidies over time.

3.3.1 Fixed Effect Regression Model

To examine the relationship between sectoral concentration and agricultural subsidy allocation, a two-way fixed effects regression model is estimated. This approach accounts for both unobserved country-specific heterogeneity and common time effects, allowing for more robust estimation of within-country variation over time.

The baseline empirical specification is given by

$$\log(subsidy_{i,t}) = \alpha + \beta_1 \text{sectoralconcentration}_{i,t} + \beta_2 GDP + \beta_3 population + \beta_4 import + \beta_5 \text{averagefarmsize} + \gamma_i + \delta_t + \mu_{it}$$

The dependent variable $\log(subsidy_{i,t})$ represents the logarithm of total agricultural subsidies in country i and time t . The key explanatory $\text{sectoralconcentration}_{i,t}$ captures sectoral concentration in the dairy industry, measured using the Herfindahl–Hirschman Index (HHI). The vector of control variables includes GDP per capita, population size, and import exposure, and average farm size. These variables account for differences in economic development, sector and structural size, and international trade exposure across countries. The term γ_i represents country fixed effects controlling for all time-invariant characteristics such as geography, institutional structure, and long-term agricultural conditions. The term δ_t represents year fixed effects capturing global shocks and policy-wide changes such as Common Agricultural policy (CAP) reforms. The error term ε_{it} captures all remaining unobserved factors affecting subsidy allocation.

It is expected that the coefficient β_1 of sectoral concentration will be positive, indicating a positive association between concentration in the dairy sector and the level of agricultural subsidies. This expectation is consistent with the Protection for Sale (PFS) framework, which suggests that more concentrated sectors may be better able to organize collectively and influence policy outcomes. All specifications included country and year fixed effects to control unobserved heterogeneity. Robustness is assessed through alternative functional forms and estimation techniques, including a

level specification of the dependent variable and a Poisson Pseudo-Maximum Likelihood (PPML) estimator to address heteroskedasticity and distributional concerns.

The fixed effect model was also estimated to evaluate whether sectoral concentration is associated with NTMs.

$$NTM_{i,t} = \alpha + \beta_1 \text{sectoralconcentration} + \beta_2 GDP + \beta_3 \text{population} + \beta_4 \text{import} \\ + \beta_5 \text{averagefarmsize} + \gamma_i + \delta_t + \mu_{it}$$

To test whether subsidies and NTMs are used as complementary policy instruments, an interaction model was estimated as follow

$$Subsidy_{i,t} = \alpha + \beta_1 NTMs + \beta_2 \text{sectoralconcentration} + \beta_3 (NTMs * \text{sectoralconcentration}) \\ + \beta_4 GDP + \beta_5 \text{population} + \beta_6 \text{import} + \beta_7 \text{averagefarmsize} + \gamma_i + \delta_t + \mu_{it}$$

This is expected to capture whether NTMs on subsidies depends on the level of sectoral concentration.

4 RESULT

This chapter presents the results of the econometric analysis conducted in this study. Section 4.1 presents the results of the descriptive summary statistics of the key variables used in the analysis. Section 4.2 presents result on the relationship between sectoral concentration and subsidy allocation and NTMs intensity in the dairy sector while also carrying out robustness checks using the level form estimation and the and Poisson pseudo maximum likelihood estimation. Section 4.3 presents result on heterogeneity analysis of subsidies pre and post 2015 CAP reform while section 4.4 presents the result on the complementary nature of subsidies and NTMs as policy agricultural instruments in the EU.

4.1 Descriptive summary statistics of key variables

Table 4.1 presents a descriptive summary statistic of the Average levels of key variables such as sectoral concentration, subsidy intensity per unit of output, and the prevalence of non-tariff measures (NTMs) in the dairy sector across ten European countries over a thirteen-year period. This descriptive analysis serves to illustrate the structural and policy-related heterogeneity observed both cross-sectionally and over time laying out the foundation for subsequent econometric investigation.

Significant variation is observed in the degree of sectoral concentration across countries, reflecting diversity in dairy market structures within the European countries. Countries such as Netherlands (mean concentration 0.406), Denmark (0.451), Sweden (0.445), Finland (0.431), and Germany (0.421) showed relatively high concentration levels in the dairy sector. This suggests that the dairy sectors in these countries are more consolidated, often characterized by the presence of large-scale producers or cooperative entities dominating production and market share. Countries such as Estonia (0.226) and Portugal (0.303) reported lower sectoral concentration indicating a more fragmented markets composed of numerous smaller scale producers. Such structural heterogeneity may be attributed to differences in agricultural tradition, competitiveness, economies of scale, or regulatory environments. The range of sectoral concentration among countries underscores the importance of controlling market structure when assessing policy impacts on the dairy industry.

The average subsidy allocated per unit of output also shows considerable cross-country differences, with Finland and Denmark having relatively high subsidy levels, reflecting substantial policy emphasis or sectoral dependency on financial support mechanisms. These high subsidy intensities may reflect national agricultural priorities, the relative influence of dairy producers, or structural factors necessitating greater support. Countries such as Portugal and Italy show lower subsidy intensities, suggesting comparatively limited financial assistance per unit of output within

their dairy sectors. The variation in subsidy intensity points to differentiated policy approaches or competing budgetary priorities among member states, which may reflect divergent political economy conditions and sectoral productivity levels.

Non-tariff measures (NTMs) represent an additional regulatory dimension influencing the dairy sector, which can restrict, regulate (and in some cases facilitate) trade flows. Larger economies such as Germany and France exhibit the highest prevalence of NTMs, suggesting a more stringent regulatory environment while smaller economies including Estonia are characterized by lower average NTM levels. The heterogeneity in NTM intensity may reflect differences in regulatory capacity, economic size, market openness, and strategic policy choices related to trade and domestic protection.

While there is considerable variation across countries in sectoral concentration, subsidy intensity, and non-tariff measures (NTMs), descriptive analysis does not show clear or consistent relationships between these variables as countries with more concentrated dairy sectors do not consistently receive higher subsidies or face stricter NTMs. This indicates that other factors such as institutional arrangements, political influence, and national policy priorities likely play an important role in shaping these outcomes. This heterogeneity therefore highlights the importance of using econometric approaches that focus on variation within countries over time while controlling unobserved country-specific characteristics as well as common time effects.

Table 4.1. Descriptive Summary Statistic of Key Variables

Country	Mean sectoral concentration	Mean subsidy intensity (subsidies/output $\times$ 10,000)	Mean NTMs (count)
Denmark	0.451	47043	283
Estonia	0.226	31928	225
Finland	0.431	56928	308
France	0.312	31822	470
Germany	0.421	39843	510
Italy	0.360	10063	431
Netherlands	0.406	21648	360
Austria	0.383	18721	197
Portugal	0.303	28442	277
Sweden	0.445	40000	323

Note: Subsidy intensity is constructed from FADN data as total subsidies divided by total farm output (SE131, measured in euros). The resulting ratio (subsidies/SE131) is rescaled by a factor of 10,000 for interpretability.

4.2 Fixed Effect Estimation of the relationship between sectoral concentration and subsidy levels

A two-way fixed effects model was also estimated to examine the relationship between sectoral concentration and subsidy allocation controlling for unobserved country-specific heterogeneity and common time effects. The results indicate a positive and statistically significant relationship between sectoral concentration and subsidy levels. Specifically, the coefficient on sectoral concentration is 0.124 ($p < 0.05$), suggesting that higher levels of sectoral concentration are associated with higher subsidy levels. Given that the dependent variable is specified in logarithmic form, the estimate suggests that higher levels of sectoral concentration are associated with higher subsidy levels conditional on the included covariate and fixed effect. The relationship remained robust after controlling for GDP, population size, average farm size, and import levels as well as country and year fixed effects with standard errors clustered at the country level.

Among the control variables, average dairy farm size is positively and statistically significantly associated with subsidy allocation, suggesting that structural characteristics of the dairy sector may play a role in explaining policy outcomes. GDP per capita, population, and imports are not statistically significant in the fixed effects specification. The model explains a substantial share of the within-country variation in subsidies over time, with a within R^2 of 0.455. This indicates that the model captures approximately 45 percent of the within-country variation in subsidy allocation over time conditional on country and year fixed effects.

The result is consistent with the Protection for Sale (PFS) model applied in this study. The positive and statistically significant relationship between sectoral concentration and subsidy allocation supports the theoretical prediction that more concentrated sectors may be better positioned to organise themselves to obtain political support in the form of subsidies. This is in line with theoretical expectations that higher concentration may reduce collective action problems and strengthen producers' capacity to influence policy through political influence. In addition, the positive association between average farm size and subsidies suggests that more structurally concentrated sectors may also benefit from stronger political influence, although this interpretation is conditional on the precise specification.

While the fixed effects approach accounts for unobserved time-invariant country characteristics and common time trends, potential endogeneity concerns remain. Reverse causality and omitted time-varying factors such as policy reforms or market shocks may jointly affect both sectoral concentration and subsidy allocation. Accordingly, the results provide evidence of a systematic

association between sectoral concentration and subsidy allocation, but do not establish a causal mechanism.

Table 4.2.1; Relationship between sectoral concentration and subsidy allocation in the European union (Log form)

OLS estimation, Dep. Var.: log_subsidy				
Observations: 130				
Fixed-effects: Country: 10, year:13				
Standard-errors: Clustered (Country)				
	Estimate	Std.Error	t value	Pr(> t)
Sectoral concentration	0.1236	0.0501	2.4672	0.0357 *
Log_GDP	0.2032	0.1634	1.2435	0.2451
Log_population	0.0031	0.0026	1.2276	0.2507
Log_average farm size	1.6156	0.6827	2.3666	0.0421 *
Log_import	-0.0651	0.2140	-0.3043	0.7678
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
RMSE: 0.0873 Adj. R2: 0.9048				
Within R2: 0.4549				

To further assess the robustness of the relationship between sectoral concentration and subsidy intensity, a fixed effects estimation was also conducted using the dependent variable in its original scale measured as subsidies per unit of output in levels. This specification provides an alternative way of describing the association between sectoral concentration and subsidy intensity compared to the log-linear model discussed earlier. By comparing results across these functional forms, the analysis tests the sensitivity of the findings to model specification thereby allowing an assessment of whether the observed association is sensitive to alternative functional form specifications.

Using the level model, the results of the fixed effects estimation also indicate a positive association between sectoral concentration and subsidies per output. The coefficient suggests a positive association between sectoral concentration and subsidy intensity within countries over time, although the statistical significance is weaker compared to the log specification. GDP per capita and population are not statistically significant within the fixed effects framework. This is likely due to the limited within-country variation in these variables over time, as much of their cross-sectional variation is absorbed by country fixed effects. As a result, their estimated coefficients capture only short-run deviations rather than long-run structural differences across countries. This consistency in sign across model specifications provides additional support for the stability of the observed

association, while highlighting some sensitivity in statistical precision depending on functional form.

Table 4.2.2; Relationship between sectoral concentration and subsidy allocation in the European union (Level form)

OLS estimation, Dep. Var.: subsidy per output				
Observations: 130				
Fixed-effects: Country: 10, year:13				
Standard-errors: Clustered (Country)				
	Estimate	Std.Error	t value	Pr(> t)
Sectoral concentration	3661.0240	1707.2880	2.1444	0.0606
GDP per capita	0.0048	0.1601	0.0301	0.9766
Population	-0.0060	0.0011	-0.5715	0.5817
average farm size	270.8879	118.3767	2.2884	0.0479 * *
Import	-4.2200	1.0800	-0.3909	0.7050
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
RMSE: 0.0873 Adj. R2: 0.9285				
Within R2: 0.6619				

The Poisson Pseudo-Maximum Likelihood (PPML) estimator with fixed effects was also employed to ensure the robustness of the estimated relationship between sectoral concentration and subsidy levels, particularly in the presence of heteroskedasticity and distributional concerns. The PPML approach is well-suited for modelling this type of data due to its non-negative nature and allows for consistent estimation even when the variance structure of the errors is misspecified. This method complements the fixed effects models by providing an alternative estimation technique that mitigates potential biases arising from heteroskedasticity and skewness in the dependent variable.

The PPML fixed effects model reveals a positive and statistically significant association between sectoral concentration and subsidy levels. Quantitatively, the coefficient on sectoral concentration (0.0111) implies that a one-unit increase in sectoral concentration is associated with approximately a 1.1% increase in subsidies, holding other factors constant. This interpretation follows the multiplicative nature of the PPML model. This finding is consistent with theoretical expectations suggesting that more concentrated sectors may be associated with lower collective action costs and higher observed levels of policy support.

Additionally, the model shows a statistically significant negative relationship between population size and subsidies, indicating that larger countries tend to have lower subsidy levels. Other variables such as GDP per capita, average dairy farm size, and import levels do not show statistically significant in this specification. These results provide additional support for the positive association between sectoral concentration and subsidy levels while also highlighting a significant inverse relationship between population size and subsidies. The high squared correlation (0.9803) suggests a strong correspondence between predicted and observed values although it should be interpreted cautiously as a goodness-of-fit measure in nonlinear models.

Table 4.2.3; Relationship between sectoral concentration and subsidy allocation in the European union (PPML fixed effect)

Poisson estimation, Dep. Var.:Subsidy per output				
Observations: 130				
Fixed-effects: Country: 10, year: 13				
Standard-errors: Clustered (Country)				
	Estimate	Std.Error	z value	Pr(> t)
Sectoral concentration	0.0111	0.0053	2.0984	0.0359*
GDP per capita	0.0213	0.0164	1.2973	0.1945
Population	-0.1654	0.0669	-2.4694	0.0135 *
average farm size	0.0028	0.0024	1.1377	0.2552
Import	-0.0026	0.0197	-0.1340	0.8934
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
Log-Likelihood: -208.6		Adj. Pseudo R2: 0.400117		
BIC: 527.7		Squared Cor.: 0.980331		

4.3 Relationship between Sectoral Concentration and Non-tariff measures (NTMs)

This section examines the relationship between sectoral concentration within the dairy industry and the intensity of regulatory policy as measured by non-tariff measures (NTMs). The analysis also employed a two-way fixed effects regression framework. The primary model regresses NTMs on sectoral concentration along with relevant control variables such as GDP per capita, population size, average dairy farm size, and import levels. The results presented in Table 4.3 indicated a statistically significant and positive association between sectoral concentration and NTMs. Specifically, the coefficient on sectoral concentration is approximately 7.73 ($p = 0.030$), implying that a one-unit increase in sectoral concentration is associated with an increase of about 7.7 units

in the level of regulatory measures (NTMs) within countries over time. This finding suggests that more concentrated sectors tend to be associated with higher levels of regulatory intensity. In the context of the dairy industry, this may reflect the increased ability of a small number of dominant firms to use their influence over regulatory processes. Rather than implying direct causation, the result is consistent with the interpretation that greater sectoral concentration is associated with stronger coordinating capacity and political influence within the sector. This capacity may enable firms to shape policy design to their advantage, potentially securing regulatory measures that raise barriers to entry and protect domestic producers from foreign competition. In this sense, regulatory policies may also serve as indirect forms of support alongside more direct instruments such as subsidies.

Additionally, the model reveals that import exposure has a highly significant and positive association with NTMs (coefficient 7.30, $p < 0.001$). This is consistent with agricultural trade theory suggesting that countries exposed to greater foreign competition may impose stricter regulatory standards to manage market access and maintain domestic standards. The average dairy farm size is negatively and statistically significantly related to NTMs (coefficient -2.40 , $p = 0.020$), implying that larger-scale production systems may face a lower regulatory burden, possibly due to greater compliance capacity and economies of scale. GDP per capita and population size do not exhibit statistically significant on the level of NTMs in this framework, suggesting that regulatory stringency is more closely associated with sector-specific market structure and trade exposure than with broader macroeconomic and demographic factors. The model within R^2 (0.70) indicates substantial explanatory power, suggesting that about 70% of the variation in NTMs within countries over time is accounted for by changes in sectoral concentration, imports, and other model covariates. This supports the relevance of market structure in shaping regulatory policy in the dairy sector in the EU. An interaction model exploring whether economic development (GDP per capita) modifies this relationship did not show significant moderation, suggesting that the positive association is broadly consistent across income levels.

Table 4.3; Relationship between sectoral concentration and regulatory policy (NTMs)

OLS estimation, Dep. Var.:NTMs				
Observations: 130				
Fixed-effects: Country: 10, year:13				
Standard-errors: Clustered (Country)				
	Estimate	Std.Error	t value	Pr(> t)
Sectoral concentration	7.7347	2.9986	2.5795	0.0297 *
GDP per capita	-5.6340	1.1363	-0.4958	0.6319
Population	2.6361	1.9959	1.3208	0.2192
Average farm size	-2.4019	8.4754	-2.8340	0.0196 *
Import	7.3000	1.2700	5.7615	0.0003 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

RMSE: 2.41891 Adj. R2: 0.9351

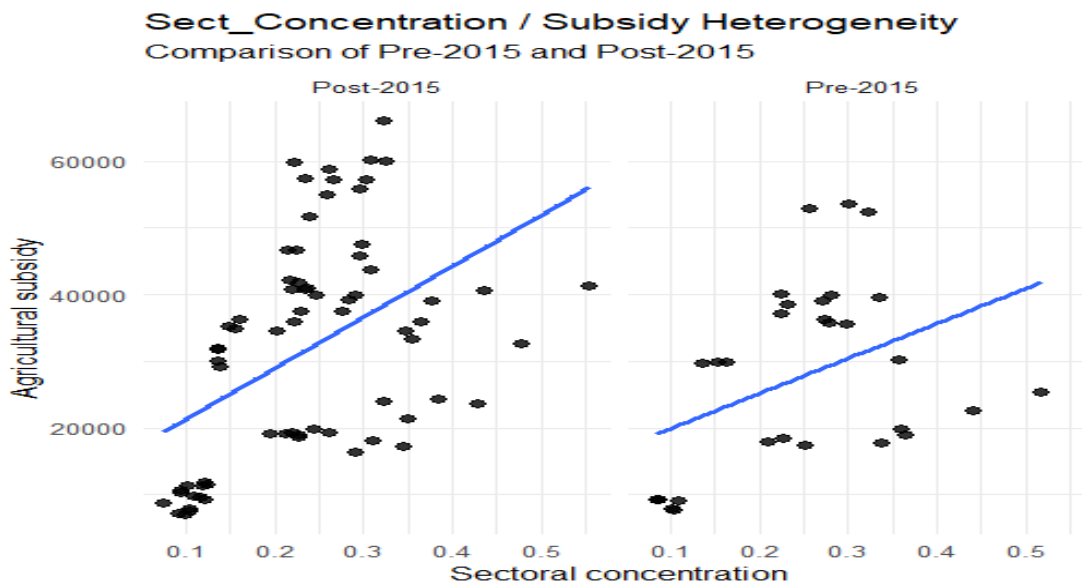
 Within R2: 0.6998

4.4 Heterogeneity Analysis of subsidy levels and sectoral concentration pre and post 2015

Building upon the fixed effects estimations which demonstrated a positive relationship between sectoral concentration and subsidy levels across EU member states, further analysis was conducted to examine how this relationship varies before and after the 2015 CAP reform. This distinction is relevant due to the abolition of milk quotas in 2015, which led to the liberalization of dairy production and increased exposure of producers to market forces. As production constraints were lifted, more competitive and larger-scale producers were able to expand output, potentially reinforcing sectoral concentration dynamics.

Prior to the 2015 CAP reform, the analysis indicates that subsidy distribution in the dairy sector was relatively less responsive to variations in sectoral concentration. Actors with comparable levels of influence were likely to receive similar levels of subsidy support, suggesting a more balanced allocation process in which sectoral concentration played a relatively limited role. However, the post-2015 CAP reform period following the abolition of milk quotas under the European Union exhibited a marked increase in heterogeneity. The relationship between sectoral concentration and subsidy levels appears stronger and more systematic, indicating that structural characteristics of the sector became more important in shaping subsidy allocation. Subsidy allocation also appears more concentrated among highly influential actors in the dairy sector, while actors with moderate

levels of influence exhibit greater variability in support, consistent with a more polarized distributional pattern.



4.5 Complementarity of Agricultural subsidies and NTMs in the dairy sector.

This section examines the relationship between agricultural subsidies and non-tariff measures (NTMs) within European dairy sector, with a particular focus on whether these policy instruments are applied in a complementary manner. The empirical specification includes NTMs and an interaction term between NTMs and sectoral concentration, allowing the analysis to capture not only the direct association between regulatory measures and subsidies, but also how this relationship varies with sectoral structure. The results presented in Table 4.4 indicate a positive and statistically significant association between NTMs and subsidy levels. Specifically, the coefficient on NTMs (0.387, $p < 0.05$) suggests that an increase in regulatory intensity is associated with higher levels of subsidies, holding other factors constant. Given the logarithmic specification of the dependent variable, this implies that a one-unit increase in NTMs is associated with an approximate 38.7% increase in subsidy levels. This finding provides evidence that governments may rely on multiple policy instruments simultaneously, rather than substituting between them when supporting the agricultural sector.

The interaction term between NTMs and sectoral concentration is also positive and statistically significant (0.215, $p < 0.05$). This indicates that the positive association between NTMs and subsidies becomes stronger as sectoral concentration increases. In more concentrated dairy sectors where producers are likely to be better organized, the combined use of regulatory and financial support mechanisms may appear more pronounced. This result is consistent with political

economy theories suggesting that concentrated interest groups are more effective in influencing policy outcomes and may secure a broader set of supportive measures. At the same time, sectoral concentration coefficient remained positive and statistically significant in relation to subsidy level, reinforcing earlier findings that sectoral structure might play a key role in shaping redistributive policy outcomes in the agricultural sector.

However, while the results point to a positive empirical association between subsidies and NTMs, they do not imply that these instruments are jointly determined by a single causal mechanism. Rather, the evidence suggests that they may serve distinct but overlapping functions within the policy framework. Subsidies provide direct financial support to producers, whereas NTMs may operate through regulatory channels, potentially affecting market access, standards, and competitive conditions. The coexistence of these instruments may therefore reflect a layered policy approach, where different tools are used to address multiple objectives simultaneously, including income support, market stabilization, and trade protection. The findings support the interpretation that subsidies and NTMs are positively associated and may be used in a complementary manner in practice, particularly in more concentrated sectors. However, this complementarity should be understood as an empirical regularity rather than definitive evidence of coordinated policy design, as underlying endogeneity and omitted variable concerns remain.

Table 4.4. complementarity of Subsidies and NTMs.

OLS estimation, Dep. Var.: log_subsidy				
Observations: 130				
Fixed-effects: Country: 10, year:13				
Standard-errors: Clustered (Country)				
	Estimate	Std.Error	t value	Pr(> t)
NTMs:sectoral_concentration	0.2146	0.0302	2.1287	0.0367*
NTMs	0.3870	0.0036	2.3968	0.0172*
Sectoral concentration	0.1499	0.0645	2.3215	0.0454 *
GDP per capita	0.1961	0.1737	1.1288	0.2881
Population	-1.5548	0.7013	-2.2167	0.0538
Average farm size	0.0033	0.0030	1.0833	0.3068
Import	-0.0629	0.224190	-0.2804	0.7854
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
RMSE: 2.4189 Adj. R2: 0.9145				
Within R2: 0.5653				

5 Discussion

This section discusses the main findings of the empirical analysis in relation to the theoretical framework and existing literature. This thesis investigates the relationship between sectoral concentration, agricultural subsidies, and non-tariff measures (NTMs) in the dairy sector, with a focus on how sectoral concentration is associated with patterns of agricultural support. Drawing on the Protection-for-Sale framework developed by Grossman and Helpman, the analysis provides evidence of a systematic association between sectoral concentration and subsidy levels in the dairy sector.

5.1 General Observation

This study provides several important insights into the political economy of agricultural policy in the dairy sector. First, the empirical results consistently indicate a positive and statistically significant association between sectoral concentration and subsidy levels across model specifications including fixed effects and PPML estimations. This finding supports the theoretical prediction that more concentrated sectors are better able to organize and may be more effective in influencing policy outcomes. In this context, sectoral concentration reflects structural conditions that reduce collective action problems and facilitate coordination among producers.

Focusing on the dairy sector, a strategically important and concentrated industry within the EU tend to receive higher levels of subsidies, suggesting that structural characteristics of production play a key role in shaping the distribution of agricultural subsidies. At the same time, these results should be interpreted as evidence of association rather than causation, as potential endogeneity concerns such as reverse causality or omitted time-varying factors cannot be fully ruled out (Zafar, 2025). The heterogeneity analysis further indicated that the relationship between sectoral concentration and subsidy allocation became more pronounced following the 2015 CAP reform, which abolished milk quotas and increased market orientation in the dairy sector. In the post-reform period, subsidy levels appear more closely aligned with sectoral structure, suggesting that this deregulation may have reinforced the role of more competitive and concentrated producers, indicating that while policy instruments have evolved, structural determinants of subsidies allocation remain important (DeBoe, 2020).

Turning to regulatory policy in the EU dairy sector, the analysis identifies a positive and statistically significant relationship between sectoral concentration and NTMs which suggested that more concentrated sector is also associated with higher levels of regulatory intensity in terms of non-tariff measure (NTMs). Import exposure emerged as a strong determinant of NTMs, suggesting that NTMs are shaped not only by domestic sectoral structure but also by external

competitive pressures. This highlights the dual role of NTMs as both regulatory and potentially protective instruments (Mendes, 2024). Importantly, the results also show a positive and statistically significant association between NTMs and subsidies, with the interaction term indicating that this relationship is stronger in more concentrated sectors. This suggests that sectors with higher concentration are more likely to be associated with the joint presence of financial and regulatory support (Beghin & Schweizer, 2020).

However, this should not be interpreted as evidence of a single underlying mechanism. Rather, the findings indicate that while both instruments may be used simultaneously, they are likely influenced by partially distinct drivers with the result suggested overall that agricultural support in the EU dairy sector operates through multiple, overlapping policy channels where subsidies and regulatory measures coexist and may reinforce each other, particularly in more concentrated sector like dairy.

5.2 Policy implication

The findings of this study carry important implications for agricultural policy design in the dairy sector. First, the results highlight that subsidies and regulatory measures are empirically linked and should not be analysed in isolation. Policymakers should therefore adopt a more integrated perspective when evaluating agricultural support as reforms targeting one policy instrument may influence the use of others. The positive relationship between sectoral concentration and subsidy allocation raises important considerations regarding distributional outcomes and structure. If more concentrated sectors systematically receive higher levels of support, this may reinforce existing structural inequalities within the agricultural sector. Policy should therefore be designed to support mechanisms that better account for structural differences across producers, ensuring that policy objectives such as equity, sustainability, and efficiency are balanced.

Also, the strong association between import exposure and NTMs suggests that regulatory measures may respond to external competitive pressures. While NTMs often serve legitimate purposes such as food safety and environmental protection, their use should remain transparent, proportionate, and consistent with international obligations to avoid unnecessary trade distortions.

Finally, the interaction between sectoral concentration and NTMs indicates that sectoral structure may amplify the combined use of different policy instruments. This underscores the importance of incorporating structural characteristics of sectors into policy design. A more sector-specific approach to agricultural policy and support may improve effectiveness while reducing the risk of excessive or overlapping forms of support.

5.3 Limitation and future Research directions.

While this study provides valuable insights into the relationship between sectoral concentration, agricultural subsidies, and non-tariff measures (NTMs) in the European dairy sector, several limitations should be acknowledged. Firstly, due to data limitations, sectoral concentration was used as a proxy for structural conditions that may influence policy outcomes. While this measure is grounded in the literature linking market structure to collective action capacity (Lee et al., 2018; Struben et al., 2025), it remains an indirect indicator and does not fully capture the underlying political processes through which influence may be exercised. In the absence of direct measures of lobbying activity or institutional access, the analysis cannot fully disentangle structural concentration from other dimensions of influence. Future research could improve upon this by incorporating more direct indicators such as lobbying expenditure data, political contributions, or measures of institutional engagement with government at both state and national levels.

The empirical analysis is restricted to ten European countries over the period 2010–2023. Although these countries capture variation in economic size, dairy sector structure, and policy environments, the relatively small sample limits the generalizability of the findings. Results may not fully extend to other European countries with different agricultural structures or to non-EU countries with alternative policy frameworks. Expanding the dataset to include additional countries and a longer time horizon would allow for more robust cross-country comparisons and stronger inference regarding long-run structural relationships.

Also, NTMs are operationalized as a quantitative count of regulatory measures applied to dairy imports. While this approach ensures comparability across countries and time, it does not capture differences in the type, intensity, or trade restrictiveness of individual measures. For example, sanitary and phytosanitary regulations may have very different economic impacts compared to technical barriers or labelling requirements. Also, enforcement intensity and compliance costs are not observed in the dataset, meaning that formal measures may not fully reflect actual trade restrictiveness. Future research could address this limitation by disaggregating NTMs by category and incorporating indicators of enforcement or economic impact.

Finally, the analysis could be extended to include other agricultural sectors to provide a broader representation of agricultural dynamics which may exhibit different relationships between market structure and policy intervention due to variations in organization, exposure to international trade, and historical policy treatment. A comparative sectoral analysis would therefore be a valuable extension of this research.

6 Conclusion

The aim of this thesis was to examine the relationship between sectoral concentration, agricultural subsidies, and non-tariff measures (NTMs) in the dairy sector, with particular emphasis on how sectoral structure influences subsidy allocation and regulatory trade protection, and whether this policy instruments operate as complements in shaping sectoral support.

The empirical results provide strong and consistent evidence that sectoral concentration is significantly associated with agricultural subsidy allocation. Using sectoral concentration as a proxy for the degree of organization and the ability of producers within the dairy sector to influence policy outcomes, the findings show that more concentrated sectors are associated with higher levels of subsidies. This result is consistent with the Protection-for-Sale framework developed by Gene Grossman and Elhanan Helpman, which predicts that sectors with greater capacity for coordination are more likely to obtain policy support. The results therefore suggest that agricultural policy outcomes in the EU are not driven solely by efficiency considerations but are also systematically associated with structural characteristics of the sector. The findings further indicate that the relationship between sectoral concentration and subsidy allocation became more pronounced following the 2015 reform of the Common Agricultural Policy (CAP), which increased market orientation in the dairy sector after the abolition of milk quotas. This suggests that in a more market-oriented environment, structural differences play an increasingly important role in shaping the distribution of policy support.

The relationship between sectoral concentration and NTMs is also found to be positive and statistically significant, indicating that more concentrated sectors tend to be associated with higher levels of regulatory measures in terms of NTMs. In addition, NTMs are strongly influenced by trade-related factors, particularly import exposure highlighting their dual role as regulatory instruments and potential tools of protection.

The results also shows that subsidies and NTMs are positively associated, suggesting that these instruments are often used alongside one another rather than as substitutes. The interaction analysis further indicated that this relationship is stronger in concentrated sector like dairy implying that market structure may reinforce the joint presence of financial and regulatory support. However, this relationship should not be interpreted as evidence of a single underlying mechanism. Instead, the findings suggest that subsidies and NTMs serve distinct but overlapping roles, shaped by different but partially interconnected determinants.

The analysis contributes to existing literatures by jointly examining financial support and regulatory trade measures within a common empirical framework, highlighting how different instruments of agricultural policy coexist and interact within the EU dairy sector. It underscores the importance of considering both sectoral structure and policy interactions when analysing agricultural support.

From a policy perspective, the findings suggest that policymakers should adopt a more integrated approach to agricultural and trade policy design as reforms targeting subsidies may have indirect implications for regulatory measures such as NTMs and vice versa. Ensuring transparency, proportionality, and consistency in the use of NTMs remains essential to avoid unintended trade distortions, while also maintaining legitimate regulatory objectives.

Finally, the persistence of agricultural support in the European dairy sector reflects the continued importance of structural factors in shaping policy outcomes. While policy instruments have evolved over time, particularly following CAP reforms, the relationship between sectoral concentration, subsidies, and NTM remains significant. Future research could extend this analysis to other agricultural sectors and incorporate more detailed measures of regulatory intensity and sectoral structure to further explore these dynamic.

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