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Essays on Public Finances and Inequality

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During my PhD, I experienced some of the happiest moments and many of the most difficult moments of my life: it goes without saying, then, that this thesis would not exist without the support of countless people. I would like to be able to mention them all: although I am terrified of forgetting some, I will organize them by sections to help myself.

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General introduction

The title of this dissertation, "Essays on Public Finances and Inequality", deliberately brings together two vast and complex domains of economic research. Although public finances and inequality have generated extensive scholarly attention across multiple disciplines, they are often explored separately; however, when they are combined together, we can envisage special opportunities, and therefore we can address some of the most pressing challenges currently facing welfare states across the developed world.

The combined evaluation of public finances and inequality involves many of the fundamental questions about the role of the state in modern market economies, since it may allow to address persistent or growing inequality while maintaining economic efficiency and fiscal sustainability.

The three chapters of this dissertation are very different from each other in their temporal focus, methodological approach, and research questions.

Each of them examines different phenomena that occur in different historical periods: the first analyses income tax reforms in developed countries from 1980 to 2019, the second investigates the taxation of goods in the early decades of the Kingdom of Italy, while the third focuses on financing a fair environmental transition from today until 2050 (the European deadline for Net Zero Carbon Emissions).

Such studies need different conceptualization and measurement of inequality; therefore, our focus ranges from top income shares in contemporary data (first chapter) to the study of regressive tax policies in the XIX century (second), to environmentally related inequality (third).

Despite these methodological, spatial, and temporal differences, the three chapters all convey a basic message: public finances and inequality are deeply interlaced phenomena that cannot be properly understood in isolation from one another. Each chapter, in its own way, demonstrates how fiscal policy decisions, whether about tax structure, revenue collection methods, or subsidy allocation, inevitably determine distributional outcomes, while inequality patterns simultaneously influence the political feasibility and economic effectiveness of different fiscal approaches.

This interconnectedness suggests that analyses of public finance or inequality, for maximum effectiveness, should account for their mutual influence and feedback effects.

Chapter I: Dual Income Taxation and Inequality

The first chapter provides a comprehensive analysis of the distributional consequences of Dual Income Taxation (DIT) systems, i.e. systems that tax progressively the labour income but apply flat rates to capital income. This study contributes in two ways to understand the shift in tax policy from comprehensive taxation to DIT in developed

economies.

First, it proposes a classification of income tax systems from 1980 to 2019 in advanced economies. It discusses inconsistencies in existing literature regarding which countries implemented DIT and when, especially on the very concept of what is to be labelled "dual income taxation". Then it describes the differences among the full DIT systems, the comprehensive income tax systems, and the mixed regimes.

The second contribution of this chapter consists of a comprehensive multi-country causal analysis of DIT's effects on income concentration using state-of-the-art difference-in-differences methodologies. The study is applied in two frameworks: a "relaxed" one, which considers 15 countries with 11 of them that introduced flat taxation on capital income; then a "strict" framework, which considers 8 countries and 4 of them transitioned cleanly from comprehensive progressive taxation to DIT.

Our findings provide evidence that the DIT introduction is associated with statistically significant increases in income concentration, with the top 10% income share increasing by 0.67 percentage points and the top 1% share by 0.50 percentage points following reform implementation. Although numerically modest, these increases provide economically meaningful insight that enriches the ongoing debate about optimal tax design and the redistributive issues of contemporary tax systems.

Chapter II: Tax on Flour in the First Decades of the Kingdom of Italy (1861-1894)

This chapter provides a historical perspective on the relationship between public finances and inequality through a detailed reconstruction of flour taxation in post-unification Italy from 1861 to 1894. This study examines two major and interacting tax institutions: the "tassa sul macinato" (grist tax), introduced in 1868 and managed by national authorities, and the "dazio di consumo" (consumption duty), a locally administered but state-regulated indirect tax levied on flour, bread, and other goods. Originally conceived as an investigation into the grist tax only, our study evolved into a broader investigation of the dual taxation system that affects this essential commodity.

Using multiple sources of the time, not only we reconstruct a detailed timeline of the evolution of such taxes, but we also dive into specific features of their collection and implementation that deeply change the understanding of the consequences of those fiscal instruments. Then, after having assembled an original dataset from more than a dozen archival and published sources, we show and discuss some data regarding the effects of taxation on prices and their revenues. Of particular interest are the revenue data of tassa sul macinato: we show a deep connection with the degree of application of mechanical counters and a surprising cyclical pattern.

The analysis has revealed that this dual taxation system created significant adminis-

trative challenges and unintended distributional consequences, including distortive effects also caused by the slow diffusion of mechanical counters.

The chapter contributes to understanding how taxation influenced the political economy and social geography of post-unification Italy, while providing groundwork for quantitative studies of the distributional impacts of taxation on basic necessities.

Chapter III: A Plan for Green Jobs and Sustainable Mobility

The third chapter aims to evaluate the economic, social, and environmental impact of a set of policies designed to promote the electrification of mobility in Italy, which is a widely recognized means of decarbonizing the transport sector.

We propose a policy package, called the "Plan for Green Work and Sustainable Mobility" (PGWSM), consisting of three lines of intervention: stimuli for the adoption of private electric vehicles and equitable mobility access, investments in charging infrastructure, and development of public transport systems. This plan would be completely financed by the elimination of *Environmentally Harmful Subsidies* currently in place in the automotive sector, estimated at 13.5 billion euros.

Our evaluations are made through an input-output demand-led ecological macroeconomic model, developed by some of this chapter's authors, called "Eurogreen".

We conceptualised four scenarios, and for each of them, we performed extensive simulations on the Eurogreen model. The results show that the full application of the plan successfully fosters emission reduction while having a positive effect on employment, generating approximately 700,000 additional jobs by 2050.

This study also highlights the challenges of managing the distributional impacts of the ecological transition: even in scenarios where on the long run we are able to reconcile positive environmental and social outcomes, in the short term we see an increase in inequality as measured by the Gini index. However, our research proposes and studies complementary policies to the PGWSM - such as working time reduction – showing that they are able to mitigate negative short-term effects.

In general, this chapter constitutes an example of 'good practice' on how we can design public policies with positive effects on both environmental and social dimensions.

Chapter 1
Dual Income Taxation and Top Income Shares[1]

Abstract

The first chapter provides a comprehensive analysis of the distributional consequences of Dual Income Taxation (DIT) systems, i.e. systems that tax progressively the labour income, but apply flat rates to capital income.

The chapter contributes to understanding this significant tax policy shift in developed economies in two main directions. First, we provide a classification of income tax systems across advanced economies from 1980 to 2019, addressing substantial inconsistencies in the existing literature regarding which countries implemented DIT and when. Our systematic country-by-country analysis reveals considerable heterogeneity in what has been labelled "dual income taxation" and establishes a rigorous three-group taxonomy that distinguishes between full DIT systems, comprehensive income tax systems, and mixed regimes. Second, we conduct the first comprehensive multi-country causal analysis of DIT's effects on income concentration using state-of-the-art difference-in-differences methodologies that account for staggered treatment timing and treatment heterogeneity. Our analysis employs two frameworks: a "relaxed" framework encompassing 15 countries with 11 of them that introduced flat taxation on capital income;flat taxation on capital income, and a "strict" framework focusing on 8 countries with 4 of them transitioning cleanly from comprehensive progressive taxation to DIT.

The relaxed framework yields evidence that DIT introduction is associated with statistically significant increases in income concentration. We find that the top 10% income share increases by 0.67 percentage points, and the top 1% share rises by 0.50 percentage points following reform implementation. While numerically modest, these effects represent economically meaningful redistributive shifts—approximately 2-5% relative increases in top earners' income shares. The effects materialize immediately after reform, consistent with behavioural responses such as income shifting and capital reallocation, but tend to plateau over the medium term. The strict framework, instead, produces more ambiguous results due to the limited sample size and a high sensitivity to methodological choices; this prevents obtaining definitive conclusions about the specific effects of removing progressivity from capital income taxation.

Keywords: *Dual Income Taxation; Income Inequality; Nordic countries; Tax policy; Causal Inference; Capital Income Taxation; Difference-in-Difference.*
JEL Classification: *D63, H23, H24, H20*

[1] *This chapter has been co-authored with Roberto Iacono from NTNU and Fernando Rios-Avila from Levy Economics Institute.*

1.1 Introduction

The introduction of Dual Income Taxation (DIT) regime over comprehensive taxation is one of the most significant tax policy shifts in developed economies over recent decades. Traditional comprehensive income tax systems applied progressive rates to all forms of personal income; DIT, instead, introduces a neat separation between labour and capital income: labour income continues to be taxed under a progressive schedule, while capital income is subject to flat, typically lower, tax rates. This design reduces the overall progressivity of the tax system, particularly in societies where capital income is highly concentrated among top earners.

Advocates of DIT maintain that having lower marginal tax rates on capital, can reduce tax avoidance, broaden the capital tax base, and increase economic efficiency without necessarily reducing revenue. They also note that these advantages are particularly important as capital mobility increases with financial globalization. On the other hand, critics highlight the risk brought by this system of increased income concentration, since capital income is mainly held by high earners.

Despite of a widespread adoption of DIT-type systems across OECD countries, empirical understanding of their distributional effects is still limited due to two key challenges.

First, the literature shows significant inconsistencies in identifying which countries have implemented DIT systems and on the moment of time when these reforms occurred. Comparative studies by Joumard (2001), Genser (2006), and Hourani et al. (2023) propose conflicting classifications of the same countries and time periods, creating ambiguity that undermines empirical evaluations. This classification is a fundamental prerequisite for a causal inference study since a mistaken identification of treatment and control groups would cause wrong results.

The second challenge is that while several studies examine individual country experiences with DIT, according to our knowledge no research has conducted a comprehensive multi-country causal analysis of how these reforms affect income distribution. This gap is significant, because DIT effects likely vary across institutional contexts, and single-country studies cannot isolate reform impacts from country-specific factors.

This dissertation addresses both challenges through two complementary contributions. First, we provide a classification of income tax systems across advanced economies from 1980 to 2019. In this country-by-country examination we establish a rigorous three-group taxonomy that distinguishes between full DIT systems, comprehensive income tax systems, and mixed regimes, enabling more precise empirical identification.

Second, we investigate whether DIT implementation leads to higher income concentration through the first comprehensive multi-country causal analysis. Using recent developments in difference-in-differences methodology that account for staggered treatment timing and treatment heterogeneity, we examine two frameworks: a "relaxed" framework

encompassing 15 countries that introduced flat taxation on capital income, and a "strict" framework focusing on countries that transitioned cleanly from comprehensive progressive taxation to DIT.

The relaxed framework provides evidence that DIT implementation is associated with statistically significant increases in income concentration: the top 10% income share increases by 0.67 percentage points and the top 1% share rises by 0.50 percentage points following reform implementation. While numerically modest, these effects represent meaningful redistributive shifts (approximately 2-5% relative increases in top earners' income shares). The effects materialize immediately after reform, as typical behavioural responses such as income shifting and capital reallocation, but tend to plateau over the medium term.

The strict framework produces more ambiguous results due to limited sample size and a high sensitivity of the outcome to methodological choices, which prevents clear conclusions about the specific effects of removing progressivity from capital income taxation.

1.2 Literature review

1.2.1 Factor income taxation

The theoretical foundations for differential taxation of labour and capital income are the basic tool to understand DIT systems and their distributional consequences: while early optimal tax theory suggested zero long-run capital taxation (Chamley 1986, Judd 1985), this result relies on restrictive assumptions that are violated in realistic settings with market incompleteness and heterogeneous agents.

The literature has established that positive capital taxation can be optimal when realistic assumptions about market incompleteness, heterogeneous agents, and political economy constraints are incorporated into theoretical models. Straub and Werning (2020) demonstrate that when the intertemporal elasticity of substitution is below one optimal long-run capital taxes are positive and substantial. Aiyagari (1995) shows that with incomplete markets and borrowing constraints, positive capital taxation corrects inefficient precautionary saving, which is particularly relevant since capital ownership is highly concentrated among top earners.

More relevant to our empirical analysis, Saez and Stantcheva (2018); indeed they show that optimal capital tax rates depend critically on the concentration of capital ownership and behavioural elasticities. This theoretical guidance motivates our focus on top income shares as the key outcome variable, since capital income concentration among high earners makes them most responsive to DIT reforms.

1.2.2 Dual Income Tax

The Dual Income Tax (DIT) system was developed starting from the late eighties of the twentieth century as a response to the tension between capital mobility and the redistributive goals of taxation. One of the first researchers to analyse it with rigour was Sørensen (1994), which proposed a system that combined a progressive tax on labour with a flat-rate tax on capital income.

Genser and Reutter (2007) explored the DIT implications for international tax competition. Their work shows that taxing capital income at a low and uniform rate, while keeping progressivity on income, could reduce tax avoidance and evasion in open economies. However, they underlined that that this distinction requires to establish clear rules to avoid income shifting and arbitrage between tax bases.

Sørensen (2001) documented the practical application of DIT in Nordic countries, showing, that its design varied significantly across them. These implementations typically relied on strict rules to allocate income from self-employment and corporations between labour and capital components. Sørensen (2005) refined, after nearly ten years, his already quoted paper dated 1994, now highlighting the conditions under which a DIT can pursue simultaneously efficiency and equity objectives.

Cnossen (2000) analyses the Nordic experiences as potential models for EU tax coordination; this study shows that administrative simplicity and reduced tax arbitrage opportunities can offset efficiency costs of brackets (schedular) taxation.

The recent paper IMF (2022) evaluates schedular taxation on a global scale; in particular, it discusses how administrations can make DIT-type systems attractive in developing countries.

Alstadsæter and Jacob (2016) analyses behavioral responses to DIT systems; they document that significant income-shifting occurred between wages and dividends in Sweden with heterogeneous effects across different firms.

Gordon and Slemrod (2000) analyze similar income-shifting behaviour; they show that tax avoidance through entity choice can significantly reduce DIT's revenue and distributional impacts. These responses are important to understand how DIT affects income concentration—the mechanical effect of lower capital tax rates is amplified by taxpayers' strategic responses to exploit rate differentials.

Boadway (2004) and Eggert and Genser (2005) survey international DIT experiences. Thet highlight difficulties in calibrating capital versus labour income for closely-held businesses and the difficulty of preventing income-shifting that can undermine both revenue and equity objectives.

1.2.3 Income inequality and tax redistribution effects

he relationship between tax progressivity and income concentration has received renewed attention following Piketty and Saez (2003) and Atkinson and Piketty (2007): they document a sharp rise observed in top income shares in many developed countries since the 1980s and relate these trends to both a decline in top marginal and effective tax rates and an increase in returns on capital. Such studies started an entire strain of the literature connecting inequality and degree of progressivity of tax systems.

Rubolino and Waldenström (2020), for instance, provided the methodological and substantive foundation for our analysis. They analysed some major tax reforms in Australia, New Zealand, and Norway, and found that reductions in tax progressivity led to 15-30% increases in top income shares that persisted for at least a decade. Their innovation lies in applying synthetic control methodology to tax progressivity analysis, to address known endogeneity concerns in cross-country inequality research. Most importantly for our work, they demonstrate that the effects operate primarily through capital income concentration.

Recent studies strengthen this evidence base. Hope and Limberg (2022) evaluated some major tax cuts for the rich occurred in 18 OECD countries in the years 1965-2015. They found that these cuts had significant inequality increases without growth effects. Duncan and Sabirianova Peter (2016) use instrumental variables in panel data to establish negative causal relationships between tax progressivity and inequality. Bachas et al. (2022), which analyses high-income countries in the years 1965-2018, shows that even though the capital tax rates fell in those countries from 40% to 32%, distributional consequences varied substantially among them, because of differences in institutional contexts.

Lambert, Nesbakken et al. (2010) and Lopez-Laborda, Vallés-Giménez et al. (2017), both confirm that preferential treatment of capital income, as in DIT systems, can reduce redistributive effects. A very recent piece of research from Campbell et al. (2024), which used U.S. administrative data, shows extreme capital gains concentration, in which the top 1% received 45.3% of gains with effective tax rates of only 5.2%. This effectively illustrates how differential factor taxation can dramatically affect inequality measures.

1.2.4 Causal inference studies

Difference-in-Differences estimation (DiD) for causal inference studies has been so largely used that the contexts in which the economic literature applied it have become more and more complex. Recently, there has been a so called "DiD revolution" since it has been proved that in many of these complex frameworks the standard DiD is indeed biased and new refined estimators have been proposed.

Goodman-Bacon (2021) decomposed the two-way fixed effects estimator and showed

that, when treatment changes over time, comparisons between early-treated and late-treated units can introduce errors on the estimated average treatment effect. These results caused new studies aimed to develop alternative estimators.

Callaway and Sant'Anna (2021) proposed an estimator that takes into account heterogeneity across groups and time of the treatment effect, allowing for more flexible inference in staggered adoption settings. Their framework is able to deliver group-time average treatment effects and to correct for biases in standard DiD. Their doubly-robust estimators are implemented in the Stata *csdid* package (Rios-Avila et al. 2021), making these methods accessible for applied researchers studying tax reforms implemented across different jurisdictions at different times.

Gardner (2022) develops an alternative "two-stage" approach that first estimates potential outcomes in the absence of treatment using only never-treated and not-yet-treated units, then computes treatment effects as simple differences. This method, implemented in the Stata *did2s* command (Butts 2021), offers computational advantages and allows easier incorporation of control variables as compared to other recent estimators.

Sun and Abraham (2020) showed that dynamic event studies can be biased under heterogeneous treatment effects. They developed an estimator that isolates proper counterfactual trends and avoids invalid pre-trend tests. Another method able to avoid regression-based extrapolation is proposed by Borusyak et al. (2024): it offers robust alternatives for staggered DiD designs.

Abadie (2021) and Abadie et al. (2010) extended the Synthetic Control Method (SCM), which constructs a counterfactual from weighted untreated units. Even though originally developed for single treated units, SCM has influenced multi-unit designs and is often used in conjunction with DiD.

In a recent paper, Wooldridge (2021) integrated these recent advances into an estimation framework based on Generalised Method of Moments (GMM) that ensures robust inference under multiple treatment dynamics.

These new estimators provided by the recent literature enable us to produce valid results evaluating DIT, which is typically adopted with different details (heterogeneus treatment) and at different times (staggered adoption) across countries.

1.3 Describing the Paradigm Shift: From Comprehensive to Dual Income Taxation

1.3.1 The Schanz–Haig–Simons (SHS) Comprehensive Income Tax

A central pillar of modern public finance theory is the definition of income. The comprehensive income concept, formulated by Georg von Schanz (1896), Robert Haig (1921), and Henry Simons (1938), has profoundly shaped how economists and policymakers conceptualize tax systems. This formulation, known as the Schanz–Haig–Simons (SHS) definition, proposes that an individual's income is equal to the sum of consumption and the net change in wealth over a given period:

$$\text{Income} = \text{Consumption} + \Delta\text{Wealth} \tag{1.1}$$

Equivalently, this can be framed in terms of potential consumption: the maximum amount an individual can consume without depleting their wealth. This definition is normatively appealing because it encompasses both realized and unrealized income flows, offering a measure of an individual's true ability to pay taxes. The SHS definition underpins the logic of taxing all sources of income (whether from wages, dividends, interest, or capital gains) under a single, unified, progressive tax schedule.

From a normative standpoint, SHS taxation satisfies key equity principles:

- Vertical equity: those with greater capacity to pay are taxed more heavily;
- Horizontal equity: individuals with the same total income are taxed equally, regardless of the income source.

Following the Second World War, the SHS model became the dominant approach in many advanced economies, coinciding with the expansion of the welfare state. The comprehensive tax system offered a powerful tool to fund social insurance, education, healthcare, and other redistributive policies, aligning well with the era's egalitarian objectives.

Yet, despite its theoretical elegance, the SHS model has long faced criticism from both efficiency and administrative perspectives. First, comprehensive income taxation can distort economic behaviour. High marginal tax rates on capital income may discourage saving, reduce investment, and bias portfolio choices—outcomes that are particularly problematic in a globalized economy with mobile capital (Feldstein 1978, Chamley 1986). Second, the aggregation of income over short periods (usually one fiscal year) creates intertemporal inconsistencies. Two individuals with identical lifetime incomes but different saving patterns may face very different tax burdens, undermining horizontal equity across

the life cycle (Genser 2006). Third, implementing a comprehensive tax base requires a detailed valuation of various income sources, including unrealized gains and imputed rents, which is both conceptually and administratively demanding.

As a consequence, many countries that nominally maintained comprehensive income tax systems progressively carved out exceptions, exclusions, and special treatments, especially for capital income. This erosion created de facto schedular systems and raised questions about the coherence and fairness of tax policy.

1.3.2 The Emergence of the Dual Income Tax (DIT)

In this landscape, the Dual Income Tax (DIT) system emerged in the late 1980s especially in the Nordic countries, as an alternative approach. It pursues a new balance of efficiency and equity in a globalized environment, separating taxation into two distinct components: labour income remains subject to a progressive tax schedule, while capital income, including interest, dividends, and capital gains, is taxed at a uniform, flat rate.

In its so-called "pure" form, the flat tax rate on capital income is aligned with both the corporate income tax rate and the lowest marginal rate on labour income: this ensures neutrality across income forms and legal entities, discouraging arbitrage between personal and corporate tax bases. Finland, Norway and Sweden introduced DIT system that are very close to this pure form.

The DIT model is a response to a set of economic and political challenges that globalization posed to welfare states: the mobility of capital in liberalized financial markets increased the difficulty of taxing capital income without inducing capital flight; moreover, growing interest in supply-side economics and endogenous growth theory emphasized the importance of investment-friendly tax policies.

Therefore, the proponents of DIT tried to design a policy that could maintain the redistributive capacity of the tax system without jeopardising capital accumulation.

Sørensen (1994, 2005), Nielsen and Sørensen (1997), and Boadway (2004) describe indeed such motives and the political climate in which DIT emerged. They affirm that DIT reduces the burden associated with taxing capital income at high marginal rates, and can approximate the optimal tax structure in a second-best world with capital mobility and limited enforcement capacity. Compared to the SHS framework, DIT achieves a more efficient allocation of savings and investment without excessively compromising the progressivity of income taxation.

Nevertheless, DIT comes with important trade-offs. In fact, since capital income is generally more concentrated at the top of the income distribution, taxing it at lower rates reduces the vertical equity of the system; at the same time, since individuals with the same total income may pay significantly different effective tax rates from each other, DIT undermines also the horizontal equity principle.

Table 1.1: Conflicting classification of tax systems proposed by the literature

Source	Full DIT implementation	Partial DIT implementation	Regimes with some DIT characteristics
Joumard 2001	Denmark, Finland, Netherlands, Norway, Sweden	Austria, France, Greece, Italy, Spain	Belgium, Germany, Netherlands
Genser 2006	Denmark, Finland, Norway, Sweden	Austria, Belgium, Italy	Greece, Netherlands
Hourani et al. 2023	Denmark, Finland, Greece, Israel, Italy, Netherlands, Norway, Spain	Belgium	Austria, France, Germany, Japan, Korea, Portugal

Moreover, DIT systems create strong incentives for income recharacterization. Self-employed individuals and closely held business owners may exploit legal and accounting channels to transform labour income into capital income, thereby minimizing their tax liability. Countries like Finland and Sweden have introduced specific rules (e.g. imputed returns on equity or dividend reclassification thresholds) to mitigate this risk, but these rules are often complex and can introduce new distortions.

Analysing the available sources, it is clear that only a few countries implemented DIT in its pure form; actually, most have introduced "impure DIT" systems, in which not only the alignment of tax rates is imperfect, but the treatment of the different kinds of capital income is not as uniform as it should be following the theoretical DIT's prescriptions.

Looking at the details of the policy implementations that the literature often classified as "dualization" of tax system was important to underline the actual differences. Some countries have adopted DIT temporarily and then stepped back, reintroducing some degree of progressivity in capital income taxation (e.g. Spain and the UK). Others did not apply a singular pivotal reform but incrementally have moved away from the SHS model (this, for example, increased the grey area between comprehensive and dual systems and has further complicated empirical comparisons and policy evaluations).

1.3.3 Reform identification and our classification

While the Dual Income Tax (DIT) system has been extensively discussed in the theoretical and policy literature, there is considerable ambiguity regarding its actual implementation across countries. As summarized in Table 1.1, studies by Joumard (2001), Genser (2006), and Hourani et al. (2023) propose classifications of which countries adopted DIT showing some inconsistencies on when reforms occurred, and whether they actually meet the criteria for a fully fledged DIT.

These inconsistencies make empirical analysis and normative evaluation challenging, since we need a clear and consistent taxonomy of tax regimes to identify treatment and control groups in cross-country studies. Moreover, meaningful comparative analysis must account for institutional heterogeneity, especially with regard to the treatment of capital income, which lies at the heart of the DIT logic.

To address these issues, a central part of this research is dedicated to constructing a rigorous country-by-country classification of income tax systems in OECD and high-

income countries over the period 1980–2019. This effort not only provides a clearer picture of global tax policy evolution but also lays the empirical foundation for our causal inference analysis and future research on DIT.

Methodological Approach

The classification is based on a systematic analysis of statutory tax rules and reform histories, guided by the following criteria:

- Structure of personal income taxation: we distinguish between unified (comprehensive) systems that apply a single progressive schedule to all types of income, and systems that adopt a schedular or dual design with separate treatment of labour and capital income.
- Taxation of capital income components: we study how different countries tax capital gains, dividends, and interest income—both in terms of statutory rates and rate structure (progressive vs. flat).
- Reform timing and policy shifts: we build a timeline of all the major tax reforms affecting the individual income tax system, paying particular attention to reforms that introduce or abandon flat taxation of capital income.
- Coordination with corporate taxation: we examine whether flat capital income tax rates are aligned with the corporate income tax rate or the first bracket of labour income taxation, an important characteristic of "pure" DIT.
- Tax credit imputation: since a issue of capital income taxation is the insurgence of double taxation of distributed profits, when necessary we underline changes in imputation rules.

A Three-Group classification

Based on the above-listed criteria (1.3.3), we classify the tax system in place in a given year and country into three groups:

1. **Tax systems with flat taxation of all capital income**. These tax systems apply a flat tax rate to all forms of capital income, interest, dividends, and capital gains, while maintaining a progressive schedule for labor income. Within this group, we distinguish between "pure" and "impure" DIT systems depending on the degree of alignment between the flat capital income tax and the corporate tax rate. (the "purity distinction" is used only descriptively and does not affect the empirical classification).
2. **Fully fledged comprehensive income tax systems**. These tax systems maintain a unified progressive tax schedule that applies equally to all major income categories, such as work, dividends, interest, and capital gains. They adhere closely

to the Schanz–Haig–Simons (SHS) model and serve as control group in our empirical analysis.

3. **Countries with mixed elements**. This group collects tax systems with a variety of situations: incomplete application of the SHS system (it is not rare to find capital gains tax exempt in countries described by the literature as comprehensive income tax system), transitory regimes, partial application of DIT core elements, etc.

This grouping reflects our idea that the preferential low tax rate on capital gains is the fundamental characteristic of DIT that could deeply affect income inequality.

This 3-group country classification captures the diversity of income tax regimes in a more granular way than previous classifications and also facilitates a more meaningful interpretation of reform dynamics and their potential consequences in terms of income distribution.

The section 1.4 presents a detailed country-by-country analysis of the evolution of the tax system. The structure of this review reflects both the chronology of reforms and the way these reforms are discussed in the existing literature. In 1.4.1, we begin with the Nordic countries, where the Dual Income Tax model originated and was first implemented in the late 1980s and early 1990s. These cases provide a natural starting point, as they shaped the conceptual and policy foundations of the DIT framework. In 1.4.2, we then examine the countries commonly identified in the literature as having undergone a process of "dualization", that is, countries that introduced a separate preferential taxation for capital income without fully adopting the Nordic model. Following this, in 1.4.3 we analyze countries that initially moved toward dualization but later reverted to more integrated or comprehensive systems. Finally, in 1.4.4, we turn to countries that the literature describes as having never undergone a dualization of their income tax structure.

Strict and relaxed framework

By explicitly differentiating tax regimes based on the treatment of capital income sub-components, in particular capital gains, we ensure a precise and consistent definition of "treated" and "non-treated" countries. The heterogeneity among DIT adopters is preserved in the descriptive analysis, but for identification purposes, our empirical strategy is based on clearly defined treatment and control groups.

Thanks to the classification depicted in 1.3.3, we are able to perform the causal inference analysis with an exceptional level of clarity. In particular, we develop two distinct analytical frameworks:

- In the **strict framework**, the control group consists exclusively of countries that maintained a fully-fledged comprehensive income tax system (group 2). The treatment group includes only those countries that transitioned from a comprehensive

regime to one in which capital gains are taxed at a flat rate. This focused design isolates the effects of removing progressivity specifically on capital gains.

- In the **relaxed framework**, we relax our requirements to be considered a treated country; in particular, in the strict framework, we exclude a lot of countries that went through the dualization of their tax system but their initial tax system was not properly comprehensive and had a lot of tax exemptions for capital income. Selecting as treated units all the countries that introduced a flat taxation of capital gains regardless of the starting system is a less rigid approach, but it remains valuable and enhances the generalizability of our findings.

This two-tier strategy allows us to test the robustness of our findings under alternative definitions of treatment and to investigate whether the intensity and composition of capital income reforms matter for the distributional effects observed. Moreover, it helps clarify the divergence in existing empirical results, which often stems from inconsistent grouping of countries with fundamentally different tax designs. By disaggregating regimes and rigorously classifying reforms, our study offers a clearer and more policy-relevant understanding of the fiscal transition from comprehensive to dual income taxation.

1.4 Institutional country setting

1.4.1 The main advocates - The Nordic countries

Table 1.2: Marginal tax rates in the Nordic countries before and after the introduction of DIT

		Marginal tax rates on labour income		Marginal tax rates on capital gains		Marginal tax rates on corporate income	
	Year of the reform	SHS	DIT	SHS	DIT	SHS	DIT
Denmark	1987	48 – 73	50 – 68	48 – 73	50 – 56	40	50
	1994	-	38 – 58	-	38 – 44	-	34
Finland	1993	25 – 57	25 – 57	25 – 57	25	37	25
Norway	1992	26.5 – 50	28 – 41.7	26.5 – 40.5	28	50.8	28
Sweden	1991	36 – 72	31 – 51	36 – 72	30	52	30

Source: Sørensen (1994).

Denmark

Denmark is considered by the largest part of the literature not only as a country that applied the DIT, but the very first to do so. In our opinion, since Denmark still has some degree of progressivity in the capital gains tax, not only we cannot consider it as

a treated country but it could potentially be considered a control country. Due to this controversial point, we did not include Denmark in our causal inference study.

The Comprehensive Income Tax System of the 1980s

By the early 1980s, with a comprehensive income tax system, Denmark had some of the highest marginal tax rates in the world with top marginal rates reaching around 73% (Sørensen 1994). The combination of high taxes and generous welfare benefits was criticised to reduce the incentive to work, save, and invest. At the same time, globalization and financial liberalization were making capital more mobile, exposing Denmark to competitive pressures (Sørensen 2001).

The 1987 Tax Reform: Political Foundations

The 1987 tax reform that introduced elements of the DIT system emerged from a broad political compromise.

The goals of the reform reflected different political priorities: Conservatives and Liberals pushed for lowering marginal tax rates; while, Social Democrats insisted on preserving the progressivity of the system, particularly for labour income (Sørensen 2005).

This political balance explains key features of the 1987 reform (Sørensen 2001):

- Capital income was taxed at a proportional rate, but a small surtax was applied to high capital incomes to preserve some vertical equity.
- Labour income continued to be taxed progressively, though the top marginal rate was slightly reduced.

The 1994 Reform

The 1994 tax reform made some technical adjustment to the DIT framework established in 1987. In the literature this is often referred to as a major development of the DIT in Denmark (Sørensen 1994, Genser 2006) but, from our understanding, relevance relies more in politics than in economics: this reform was proposed by a government led by the Socialdemocrats, establishing the bipartisan support of this tax system.

The only major change is the treatment of interest income: positive net interest income above a certain threshold (DKK 40,000 per individual) was reintegrated into labour income (Sørensen 1994; Sørensen 2001). The rest of the DIT system remained unchanged with some changes on the tax rates.

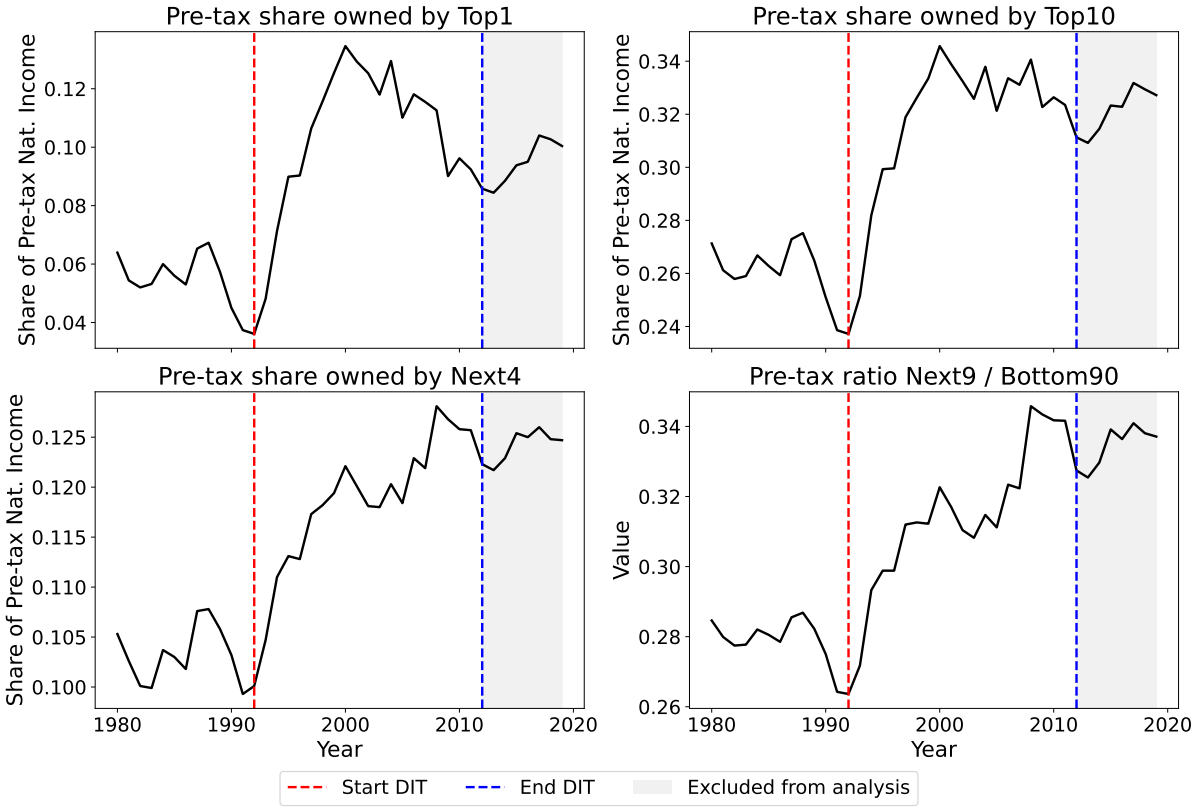
The Danish Tax System in 2019

As of 2019, Denmark maintained a dual income tax structure that combined progressive taxation of labour income with separate, lower taxation of capital income, especially

share-related income. Labour income was taxed under a progressive schedule with two state-level brackets, in addition to municipal taxes and a flat labour market contribution. The marginal tax rates on labour income ranged from approximately 37% to 55.8%, depending on income level and municipality (OECD 2020; OECD 2021). Capital income, by contrast, was taxed more lightly and under separate rules. Income from shares, including dividends and realized gains from listed shares, was subject to a two-tier flat-rate schedule: 27% on income up to DKK 54,000, and 42% on income above that threshold. These rates were independent of total income and did not interact with the progressive labour tax system, preserving the dual structure. Other capital income, such as interest, was taxed at the personal level and could be partially integrated into the broader tax base, but was generally subject to lower effective rates due to offsetting rules and deductions. The corporate income tax rate stood at 22%, unchanged since 2016. By 2019, Denmark's system retained the core design of the dual income tax: progressive taxation of labour income, and separate, preferential taxation of capital income with limited progressivity.

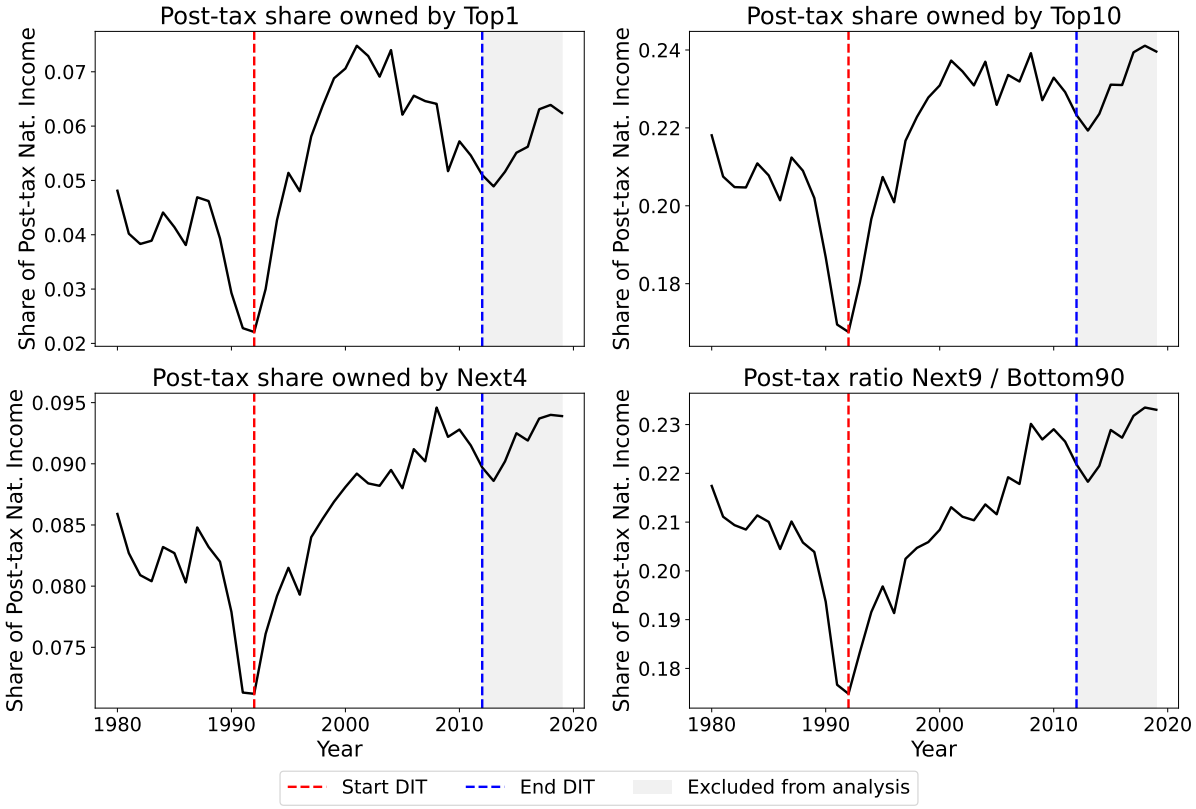
Finland

Figure 1.1: Evolution of some relevant pre-tax income concentration metrics for Finland



Source: own elaboration on WID data.
"Next 4%" include the individual between the 95th percentile and the 99th; "Next 9%" include the individual between the 90th percentile and the 99th. Next4 and Next9 are a useful proxy for income concentration because look at the high income earners without considering the individuals at the very top that often have peculiar dynamics. Finland is excluded from our causal analysis after 2012 because a treated country cannot become again untreated in our econometric methods.

Figure 1.2: Evolution of some relevant post-tax income concentration metrics for Finland



Source: own elaboration on WID data.

For the first decades, Finland sees a straightforward application of the theoretical framework of DIT and so it is among our treated countries from 1993. After 2012 Finland reintroduce a very mild progressivity in the capital gains income tax; this is troublesome for our analysis so we will drop the country from 2012 onward. Finland is a treated country in both our frameworks.

The Comprehensive Income Tax System of the 1980s

In the early 1980s, Finland had a comprehensive income tax system. At the time, tax avoidance and evasion were common, particularly among capital owners, who could exploit tax shelters, exemptions, and international arrangements to lower their tax liabilities. The political debate was focused on those loopholes and distortions introduced by the high tax rates (Sørensen 1994).

The 1990s Reforms and the Introduction of the Dual Income Tax

In the early 1990s, Finland experienced a deep recession triggered by the collapse of the Soviet Union (Finland's major trade partner) together with policies of financial liberalization. This changes were clashing with the comprehensive tax system (Ministry of

Finance Finland 2006, 2010, 2013, Pirttilä and Selin 2011).

The influence of economists advocating for dual income taxation, which had been discussed in the Nordic countries, also played a role in shaping the direction of tax system (Sørensen 1994).

In this context, the 1993 tax reform introduced a Dual Income Tax (DIT) system. Labour income continued to be taxed under a progressive rate schedule, while capital income was taxed separately at a flat rate, initially set at 25%. Capital income was broadly defined to include interest, dividends, rental income, and capital gains (Sørensen 1994, Genser 2006).

For the self-employed and business owners, a formula was introduced to distinguish between labour and capital income. The normal return on business assets, calculated using a notional interest rate, was classified as capital income. The excess was treated as labour income and taxed accordingly (Pirttilä and Selin 2011).

The corporate tax rate was aligned with the capital income tax rate at 25% as theory required. This alignment aimed to prevent income shifting between personal and corporate tax bases and to simplify the overall structure of taxation (Ministry of Finance Finland 2006, 2010, 2013).

Adjustments and the Reintroduction of Progressivity in Capital Income Taxation

Beginning in the mid-2000s, a series of reforms incrementally altered the DIT model. In 2005, the capital income tax rate was increased to 28%; however, the most significant structural change occurred in 2012.

Finland reintroduced progressivity into the capital income tax schedule. A two-tier system was introduced: capital income up to €50,000 was taxed at 30%, while income above that threshold was subject to a 32% rate (Ministry of Finance Finland 2013). This reform was motivated by growing concerns about the fairness of the tax system, particularly the perception that high-income individuals, especially those who derive large dividend incomes, were paying lower effective rates than wage earners (OECD 2017; (OECD 2020a).

In 2013, the income threshold for the higher rate was lowered from €50,000 to €30,000, while maintaining the 32% top rate. In 2015, the top marginal rate on capital income above €30,000 was further raised to 34%, where it remains as of 2024 (Pirttilä and Selin 2011).

These reforms were part of a broader effort to enhance vertical equity and limit opportunities for tax arbitrage, especially income shifting by business owners (OECD 2017). This evolution reflects the challenges of maintaining a DIT model in a political and economic environment increasingly focused on tax fairness and income distribution (Ri-

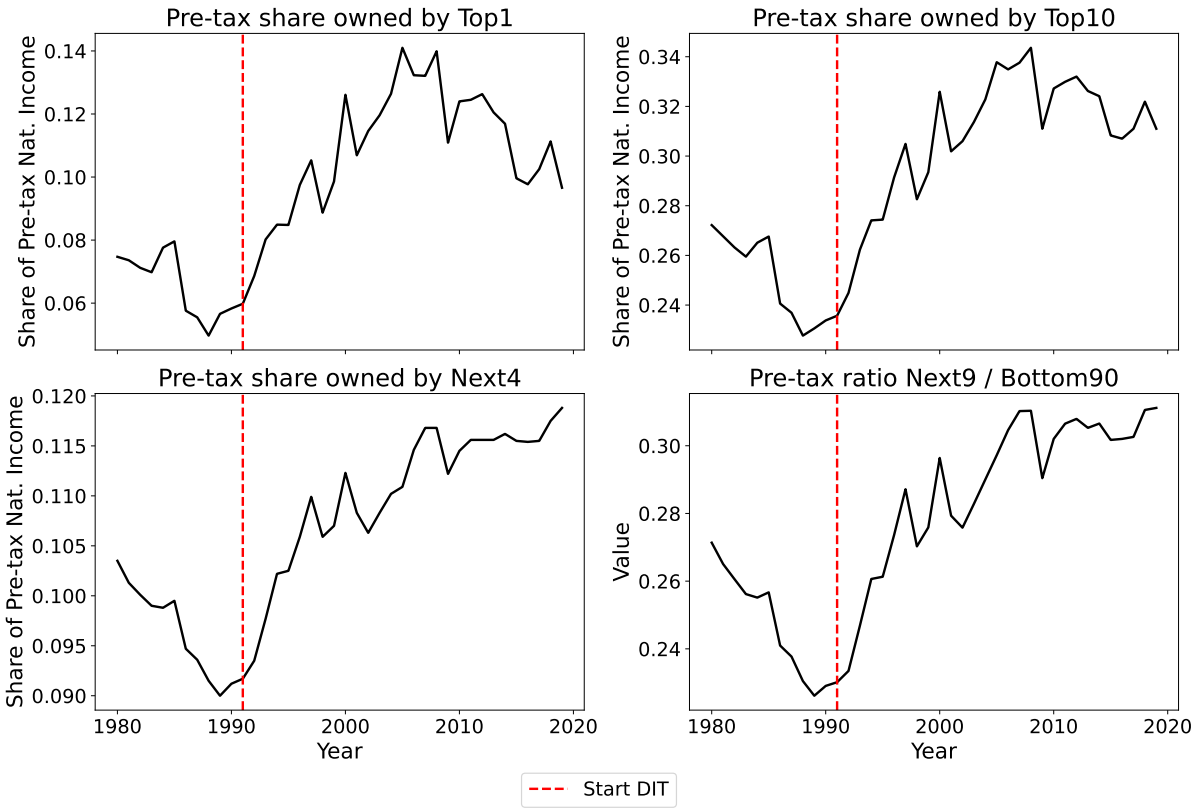
ihelä and Sullström 2008, OECD 2020a).

The Finnish Tax System in 2019

By 2019, Finland's tax system retained the core features of the dual income tax model introduced in 1993, while incorporating several refinements made over the previous two decades. Labour income was taxed under a progressive rate schedule, combining state and municipal taxes, with top marginal tax rates exceeding 50% when including social contributions (Ministry of Finance Finland 2020). Capital income, in contrast, was taxed separately at a mildly progressive flat rate: 30% on annual capital income up to €30,000, and 34% on the portion exceeding that threshold (OECD 2017, 2020).

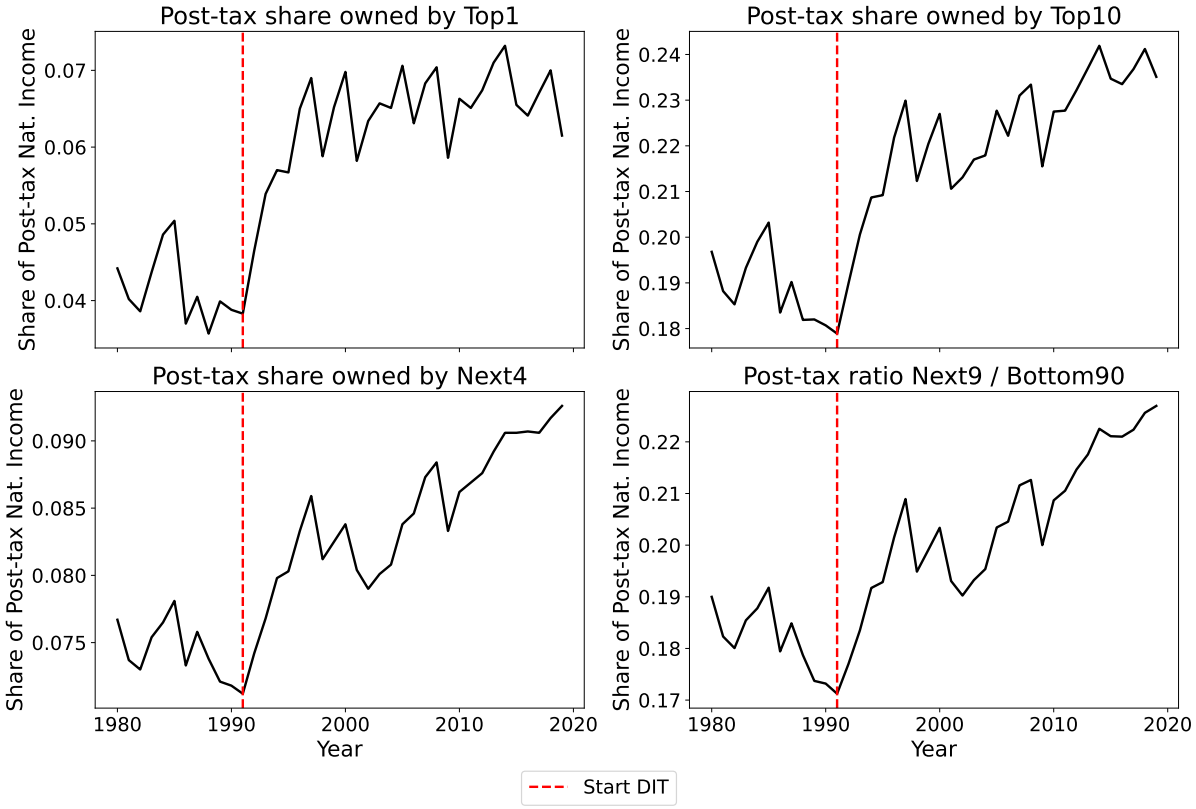
Norway

Figure 1.3: Evolution of some relevant pre-tax income concentration metrics for Norway



Source: own elaboration on WID data.

Figure 1.4: Evolution of some relevant post-tax income concentration metrics for Norway



Source: own elaboration on WID data.

Norway as well has a straightforward application of the theoretical framework of DIT; therefore, it is among our treated countries in both our frameworks from 1992 onward.

The Comprehensive Income Tax System of the 1980s

In the 1980s, Norway had a tax system following the SHS model with very high marginal rates. However, this system had several special cases; for example, interest expenses were fully deductible, while the returns from some investments, especially in housing, were taxed lightly or not at all. This created incentives to borrow heavily and to invest in tax-favoured assets rather than in more productive sectors and it at the end of the decade was stated to be considered too distorting (Sørensen 1997).

The 1992 Tax Reform and the Introduction of the DIT

A government-appointed committee, led by Professor Aarbakke, prepared a report proposing a complete redesign of the income tax system. The committee's proposals led to the idea of separating the taxation of capital and labour income (OECD 1991).

The DIT reform started to be put in effect the 1st of January 1992. The new system had a flat 28% tax rate on all types of capital income (interest, dividends, capital gains,

and income from rental property), while labour income continued to be taxed under a progressive schedule (Sørensen 1994). The same 28% rate applied to corporate income, which helped align the taxation of capital at both the company and individual level.

A key element of the reform was the effort to avoid double taxation of corporate income. An imputation system allowed shareholders to subtract the corporate tax already paid from their personal income tax liability on dividends (Sørensen 1994).

The reform also introduced rules to separate capital and labour income for the tricky case of self-employment. A normal return on invested capital was calculated and taxed at 28%, while any excess profit was taxed as labour income under the progressive schedule. This method helped prevent the reclassification of labour income as capital income for tax advantage (OECD 1991).

The 2006 Shareholder Income Tax Reform

After a few years, weaknesses in the system began to emerge. Because capital income was taxed at a lower rate than labor income, business owners and professionals increasingly shifted income from labour to capital forms, by paying themselves in dividends rather than wages or by retaining profits in companies (Sørensen 1997). Although rules on income splitting existed, enforcement was difficult.

To address this, a government-appointed committee led by Skauge[2] published a report recommending changes to the DIT to reduce income shifting and restore fairness (Sørensen 2003).

A shareholder income tax model was introduced in 2006. In this system, individual shareholders receive a rate-of-return allowance (RRA), a deduction based on the risk-free return on the purchase price of their shares. Dividends and capital gains above this allowance are taxed at the capital income rate (Sørensen 2005). This means only "excess" returns, often seen as disguised labour income or rents, are subject to personal taxation. Shareholders and business owners, including partners and self-employed, now faced personal taxation on income exceeding a normal return (Sørensen 2005).

To complement this, the top marginal tax rate on labour income was lowered slightly to reduce the incentive for income shifting.

The Norwegian Tax System in 2019

By 2019, Norway operated a mature and refined dual income tax system. Capital income, including interest, dividends, and capital gains, was taxed at a flat rate of 22%, which also applied to corporate income. Labour income, on the other hand, was taxed under a progressive marginal rate schedule, with four income brackets. The marginal tax rate on

[2]Former Norwegian Conservative Minister of Finance.

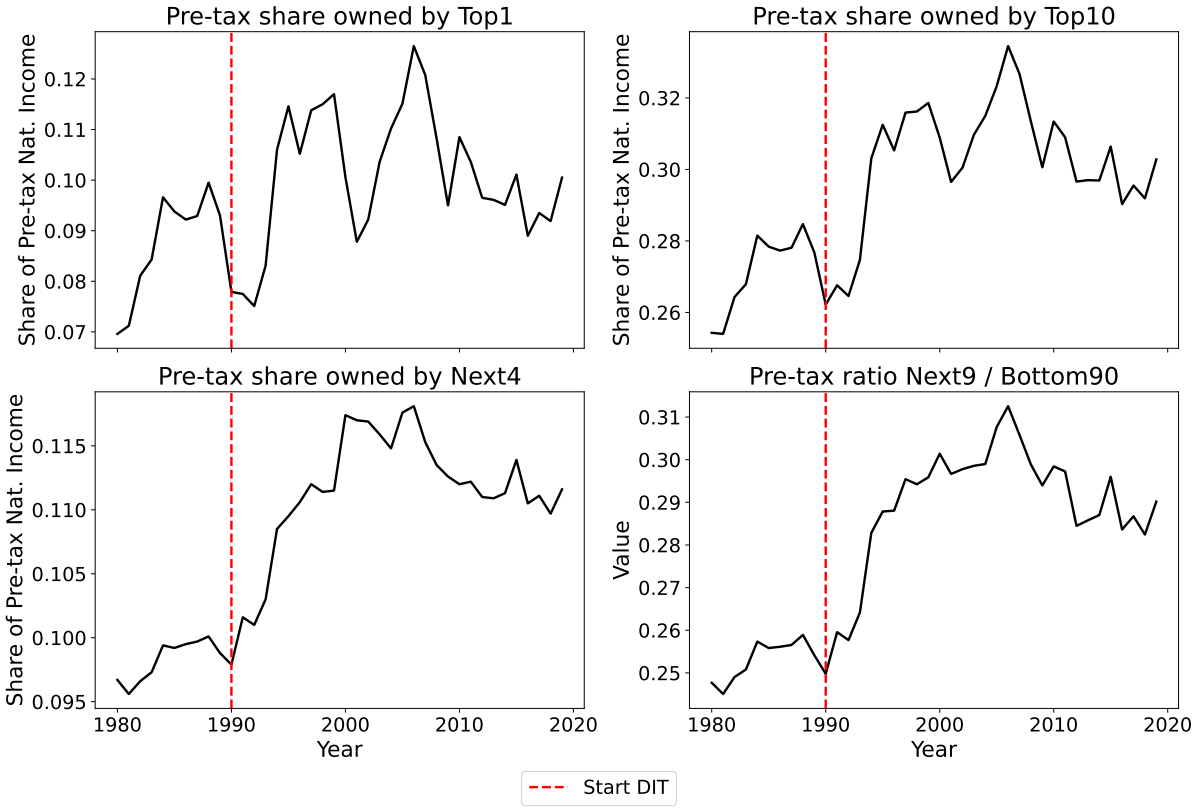
labour income (excluding employer social contributions but including employee contributions) started at approximately 25.9% for incomes above NOK 55,000 (reflecting the combination of the 22% base rate and the lowest bracket and social contributions) and rose in steps. Middle-income earners faced marginal rates of around 34.4% and 43.4%, depending on their income level. The top marginal rate on labour income reached 46.4% for annual earnings above NOK 964,800 (roughly €100,000), combining all applicable income taxes and the employee's share of national insurance contributions (OECD 2012).

The rate-of-return allowance (RRA) continued to apply to shareholder income. Under this rule, each shareholder was given an annual deduction equal to a risk-free return on the cost basis of their shares. Only dividends and capital gains exceeding this allowance were subject to tax, ensuring that normal returns on savings and investment were not penalized (Sørensen 2005).

Business income earned by sole proprietors and partners was taxed under aligned models that split total income into a capital portion (taxed at 22%) and a labour portion (taxed under the progressive labour income schedule). Wealth taxation also remained in place, applying to the net value of assets above a threshold. Altogether, the Norwegian system in 2019 maintained the principles of the dual income tax: capital income faced a low, flat rate with protections for normal returns, while labour income was taxed progressively, ensuring both efficiency and equity.

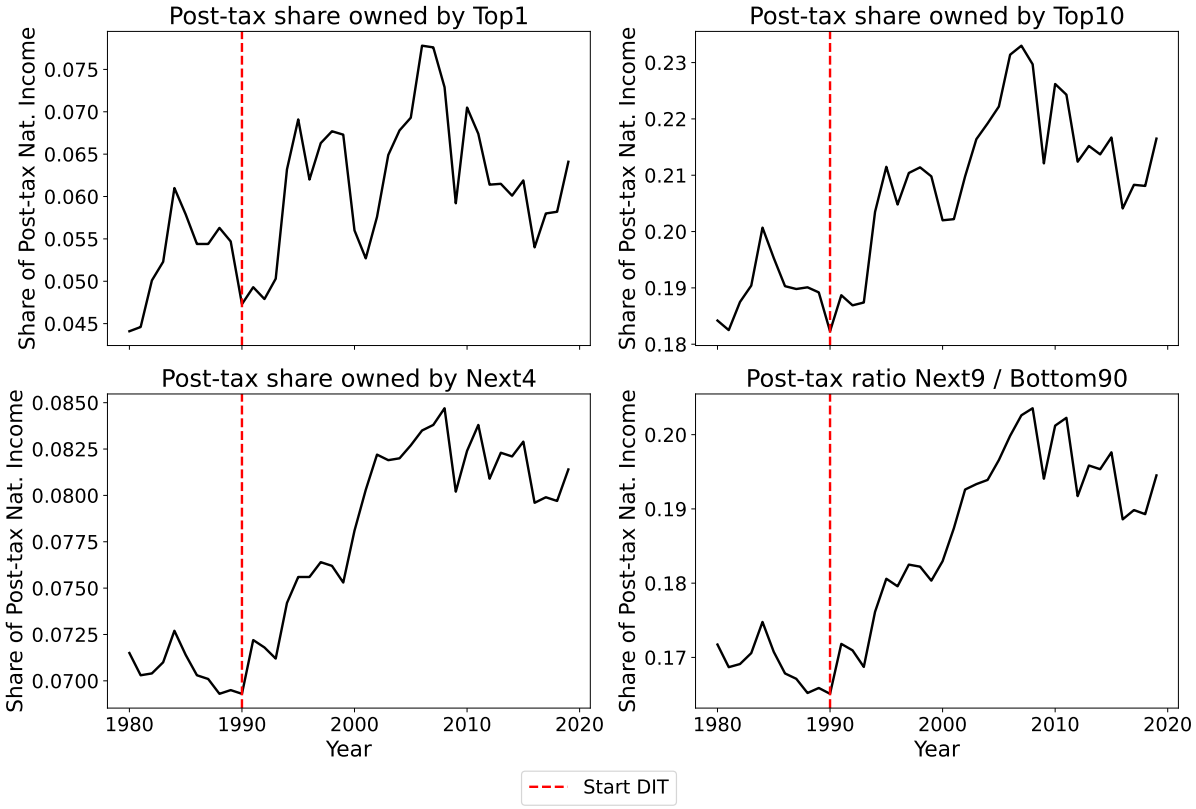
Sweden

Figure 1.5: Evolution of some relevant pre-tax income concentration metrics for Sweden



Source: own elaboration on WID data.

Figure 1.6: Evolution of some relevant post-tax income concentration metrics for Sweden



Source: own elaboration on WID data.

Like Finland and Norway, also Sweden has a straightforward application of the theoretical framework of DIT; therefore, it is among our treated countries in both our frameworks from 1991 onward.

The Comprehensive Income Tax System of the 1980

In the 1980s, Sweden operated a comprehensive income tax system in which labour and capital income were aggregated and taxed under a single progressive rate schedule. The system combined a central government income tax with a flat municipal income tax levied by local authorities. In the late 1980s, the top marginal tax rate on income (summing central and municipal income tax rates) became around 72% (Sørensen 1994). Capital income was similarly taxed under the same progressive schedule, but nominal interest income was not adjusted for inflation, resulting in over-taxation of real returns during periods of high inflation. Furthermore, the system suffered from extensive tax base erosion, with numerous exemptions and deductions, creating both horizontal inequities and efficiency losses (Agell et al. 1998).

Århundradets skattereform, namely the "Tax Reform of the Century"

The Swedish tax reform of 1990–1991 represented one of the most comprehensive and ambitious overhauls of an income tax system in the OECD world. Known in Sweden as *århundradets skattereform* ("the tax reform of the century"), it was a response to mounting concerns about inefficiencies and distortions of the comprehensive income tax system. The reform was the product of a broad political consensus and was implemented in two major legislative stages over consecutive years: in 1990, initial base-broadening measures were introduced; while 1991 marked the full implementation of the new system (Agell et al. 1998).

Labour income continued to be taxed under a progressive schedule, consisting of a proportional local tax (averaging around 30%) and a central government surcharge on higher incomes, resulting in a top marginal rate of about 50%. In contrast, all capital income (interest, dividends, capital gains, and rental income) was taxed at a flat rate of 30% (Sørensen 1994). This flat rate was aligned with the reformed corporate income tax, which was also lowered to 30%, reinforcing integration between personal and corporate taxation.

To prevent income shifting from labour to capital income, the 3:12 rules (3:12-reglerna) were put in place. These provisions aimed to restrict the amount of dividend income that could be taxed at the flat capital income rate of 30%, and to reclassify any excess as labour income, subject to progressive marginal tax rates (Agell et al. 1998; Sørensen 1994). the dividends eligible for capital income treatment were limited to a given return on invested equity, set at a fixed rate (originally 9%). Dividends above this threshold were taxed as labour income. This tight constraint reflected a cautious approach to protecting the dual income tax structure from erosion through income shifting.

Sweden became the very first country to fully apply the dual income tax model.

The liberalization of the 3:12 rule

In the 2000s, the 3:12 rules were significantly liberalised, partly in response to demands for greater support to entrepreneurship and small business owners. The most important change came in 2006, when a wage-based rule was introduced. Under this rule, the allowable amount of dividends taxed as capital income was expanded to 50% of the total wage bill of the firm, including the owner's own salary. This meant that owner-managers could increase their capital income allowance simply by paying out higher wages (Alstadsæter and Jacob 2012, 2016).

Additionally, the capital income tax rate on qualifying dividends was reduced to 20%, enhancing the tax benefit of classifying business income as dividends rather than wages (Alstadsæter and Jacob 2012, 2016).

These changes substantially weakened the original anti-avoidance purpose of the rules.

Empirical evidence confirms that many business owners responded by shifting income from labour to capital form, thereby reducing their total tax burden (Alstadsæter and Jacob 2012, 2016). The reforms created sharp differences in effective marginal tax rates between wage earners and self-employed entrepreneurs who could organise their income flexibly.

The Tax System in 2019

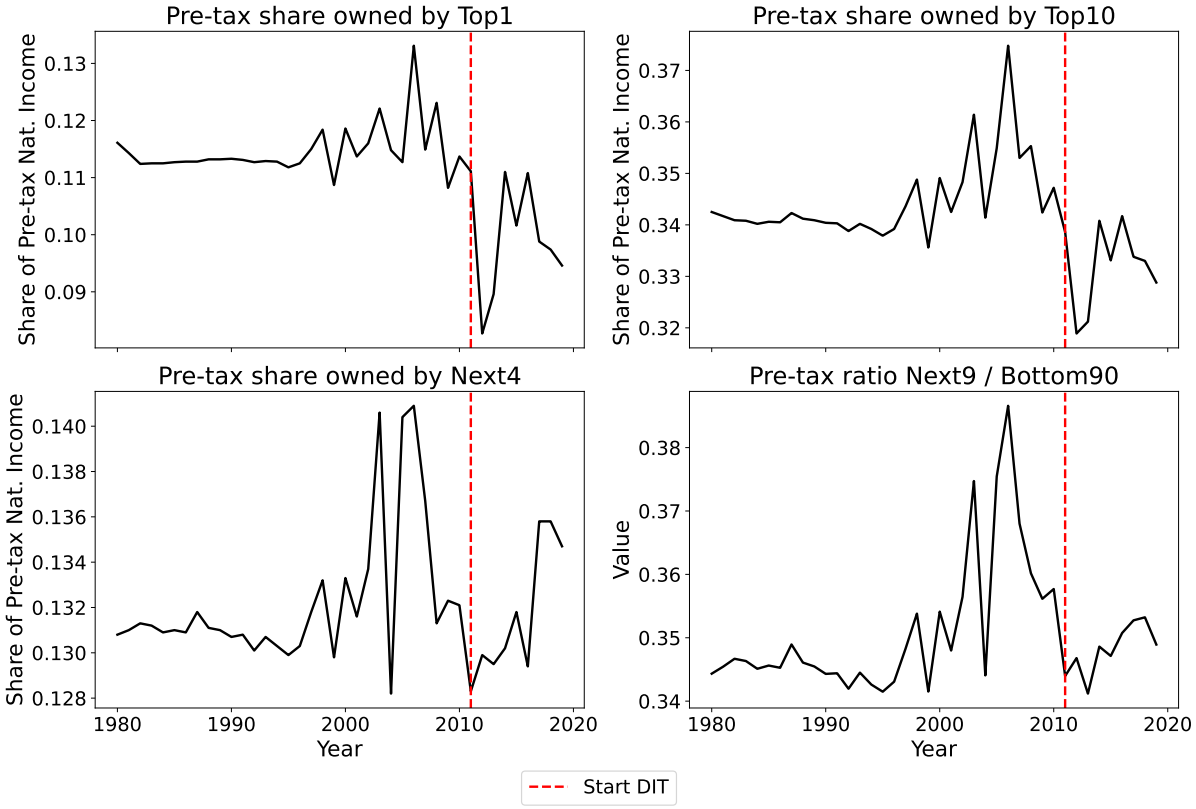
By 2019, the core structure of the dual income tax system remained intact. Labour income was taxed according to a progressive rate schedule, combining a municipal income tax, which was flat and averaged around 32%, with a central government surtax of 20% applied to annual income exceeding 703,000 SEK (approximately €66,000). This resulted in a top statutory marginal tax rate on labour income of approximately 52% (OECD 2020a).

All the kinds of capital income, on the other hand, continued to be taxed separately at a flat rate of 30%; however, because of the 3:12 rules (previously described), active owners of closely held companies were often taxed at a reduced rate of 20% on a portion of distributed dividends. Dividends above the threshold defined by these rules were either taxed at 30% or, in some cases, reclassified as labour income and taxed progressively. In addition, the corporate income tax rate was reduced to 21.4% in 2019, further lowering the total tax burden on retained and distributed profits (OECD 2020a).

1.4.2 Other countries that introduced the DIT

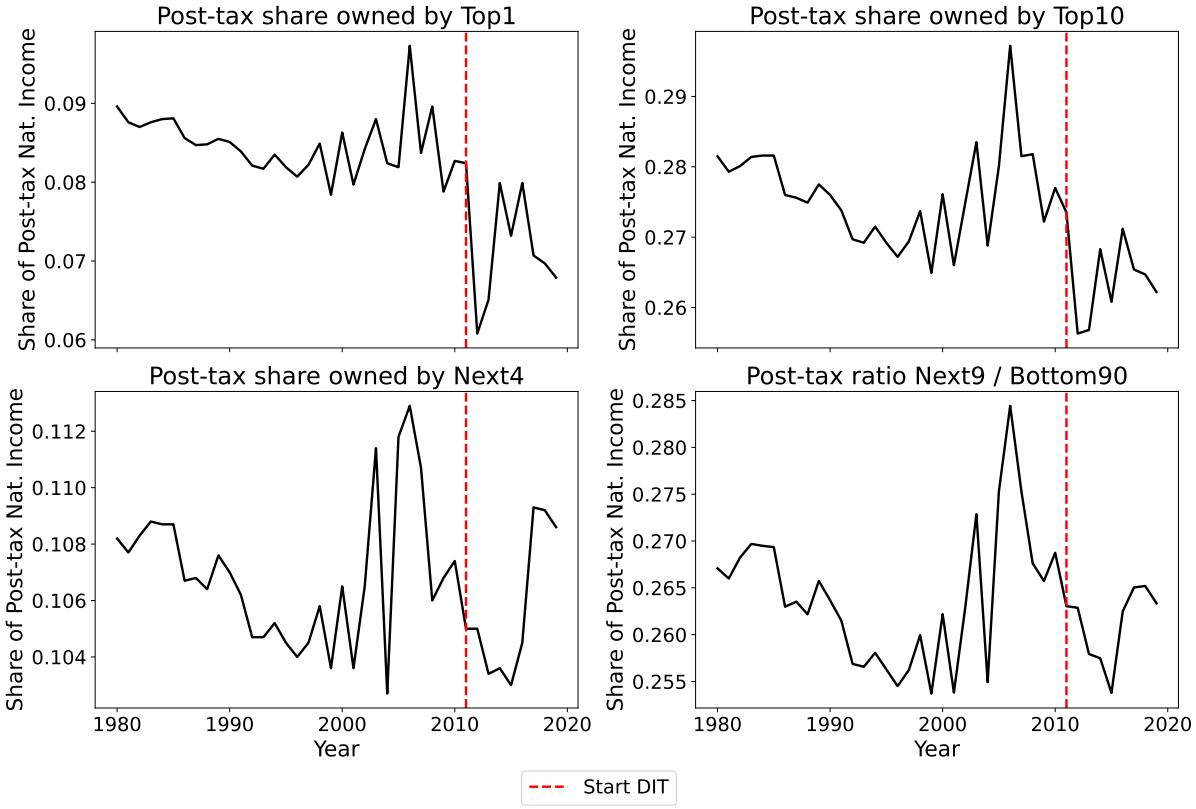
Austria

Figure 1.7: Evolution of some relevant pre-tax income concentration metrics for Austria



Source: own elaboration on WID data.

Figure 1.8: Evolution of some relevant post-tax income concentration metrics for Austria



Source: own elaboration on WID data.

Austria introduced elements of the DIT system very gradually, so to establish a clear-cut starting point of its DIT system it is not easy. Austria starts to have a flat tax on interests and dividends in 1994 (while capital gains remain tax exempt) and then in 2012 the flat tax is extended also on capital gains. However, the pre-reform system was far from being a proper comprehensive income tax system: for this reason we did not include Austria in our strict framework while it is a treated country in the relaxed framework from 2012 onwards.

Taxation in the 1980s and 1990s: Fragmented Treatment of Capital Income

During the 1980s and 1990s, Austria's personal income tax system was quite convoluted. On paper, labour and capital income were subject to the same progressive personal income tax (*Einkommensteuer*) schedule; however, in practice, the treatment of capital income was highly fragmented and favourable.

Capital income, particularly capital gains on financial assets, had a specific income formation system. The tax code distinguished between short-term and long-term capital gains: gains obtained from a within a year of acquisition (this was called "speculation period") were taxed under progressive income tax rates, after such a time threshold gains were fully exempt (Schratzenstaller and Wagener 2009, Genser 2006).

In addition to capital gains, other forms of capital income (such as interest and dividends) were typically subject to final withholding taxes at preferential rates: these were ranging from 20% to 25% (Schratzenstaller and Wagener 2009).

At the corporate level, Austria applied a corporate income tax (*Körperschaftsteuer*) rate of 30% in the 1980s, reduced to 34% in the 1994 reform, partly to harmonize with EU standards (Fink 2019). Profits distributed as dividends were subject to double taxation, but relief was provided via a partial imputation system.

The 1994 Reform: First Institutional Steps Toward DIT

The 1994 tax reform marked a critical juncture. Though it did not establish a proper dual system, but it introduced elements that institutionally separated capital income from labour income within the tax system (Sørensen 1994)

Most notably, the reform institutionalized final[3] withholding taxation (*Endbesteuerung*) on certain forms of interest income at a flat rate of 22%, which would later rise to 25%. This marked the beginning of a schedular approach to taxing capital income (Fink 2002).

On the corporate side, the 1994 reform reduced the CIT rate to 34%, while keeping the partial imputation system to alleviate the double taxation of dividends.

This reform was partly motivated by Austria's preparations for EU accession and a desire to modernize its tax system in line with developments in other small, open European economies (Schratzenstaller and Wagener 2009).

The 2000s: Progressive Fragmentation and Expansion of Schedular Elements

Throughout the 2000s, Austria continued to expand the schedular treatment of capital income. Various reforms extended withholding taxation to dividends and broadened the scope of flat-rate taxation for financial income. By the mid-2000s, most[4] interest and dividend income was taxed at 25%, with minimal integration into the progressive tax base (Schratzenstaller and Wagener 2009).

Capital gains, however, remained partially outside the schedular framework. The speculation period was still in place, allowing investors to avoid taxation on capital gains from securities held longer than one year. Thus, while Austria had moved far from the comprehensive model, it had not yet achieved full dualization.

The corporate income tax rate was reduced from 34% to 25% in 2005, eliminating the imputation system.

[3] "Final" means that such income was excluded from the annual tax return and thus not subject to progressive income taxation.

[4] important exceptions remained: capital gains on securities were still tax-exempt if held for more than one year, and certain foreign dividends or complex financial products were not uniformly covered by withholding. As a result, the schedular treatment of capital income was predominant but not yet universally applied.

The 2012 Reform: De Facto Introduction of a Dual Income Tax

The turning point came in 2012, when Austria abolished the speculation period for capital gains and extended the flat withholding tax regime to nearly all forms of capital income, including capital gains on financial assets. From this point on, dividends, interest, and capital gains were taxed uniformly at a flat rate of 25%. Even Austria's corporate tax rate was taxed at 25%, creating a pure DIT structure.

The System in 2019: A Consolidated Dual Framework

By 2019, Austria's dual system had become fully consolidated. Capital income was subject to a 27.5% flat withholding tax, following a rate increase in 2016, while labour income continued to be taxed under a progressive system with marginal rates ranging from 25% to 55% (BMF 2019). Real estate capital gains were taxed at a slightly lower flat rate of 25%, with continued exemptions for primary residences and long-term holdings (European Commission 2019). The corporate income tax rate remained at 25%.

Belgium

Belgium is often listed as one of the countries that in recent years have been getting close to achieve a Dual Income tax system. In our opinion this is a flawed assessment; indeed Belgium is one of the few countries that has tax exempt capital gains for the whole time frame of our study. For this reason Belgium is excluded from our causal inference study in both frameworks.

Pseudo comprehensive Taxation in the 1980s

In the 1980s, Belgium operated a pseudo comprehensive income tax system that, on paper, combined labour and capital income within a unified progressive personal income tax schedule but it had actually a number of special rules for different types of capital income. Marginal tax rates on labour income reached up to 72% in the early part of the decade (Cnossen 2000).

Capital income was treated less uniformly. Interest from regulated savings accounts, for instance, benefited from partial exemptions. Dividends were included in taxable income but taxed without a credit for underlying corporate taxes, resulting in economic double taxation (Cnossen 2000).

According to the general principle of the 'normal management of private wealth' (Article 90 of the Belgian Income Tax Code), capital gains on shares were generally not

taxed for individual investors; however, if they are classified as 'speculative', [5] they could be taxed at a flat rate of up to 33% (Cnossen 2000). These criteria introduced legal ambiguity and administrative discretion, creating inconsistencies in tax enforcing.

During this period, corporate income tax (CIT) was levied at relatively high rates ranging from 45% to 48%, depending on the level of profit and the characteristics of the firm. There was no systematic integration between corporate and personal capital income taxation, and dividends were taxed both at the corporate level and again at the personal level.

The 1993 Reform and after

The 1993 tax reform in Belgium is frequently cited in academic literature as a move toward a Dual Income Tax (DIT) system (Cnossen 2000).

In our opinion, this characterization may be an overstatement because this policy did not alter the taxation of capital gains for private individuals that remained mainly[6] tax free. This selective approach to capital gains taxation indicates that the 1993 reform failed to establish a comprehensive DIT system.

The reform's primary motivations appeared to be administrative efficiency and improved tax compliance, rather than a systematic shift toward dual income taxation. By implementing withholding taxes on interest and dividends,[7] the government aimed to simplify tax collection and reduce evasion, especially in the context of increasing international capital mobility (OECD 2003). labour income continued to be taxed under progressive rate schedule, with marginal rates ranging from 25% to 55%.

From 1993 till 2019 this system remained basically unchanged with the exception of the corporate income tax.

Belgium maintained a relatively high and separate CIT in the 1990s and by 2019 the rate had been reduced to 29% without an imputation mechanism (OECD 2019).

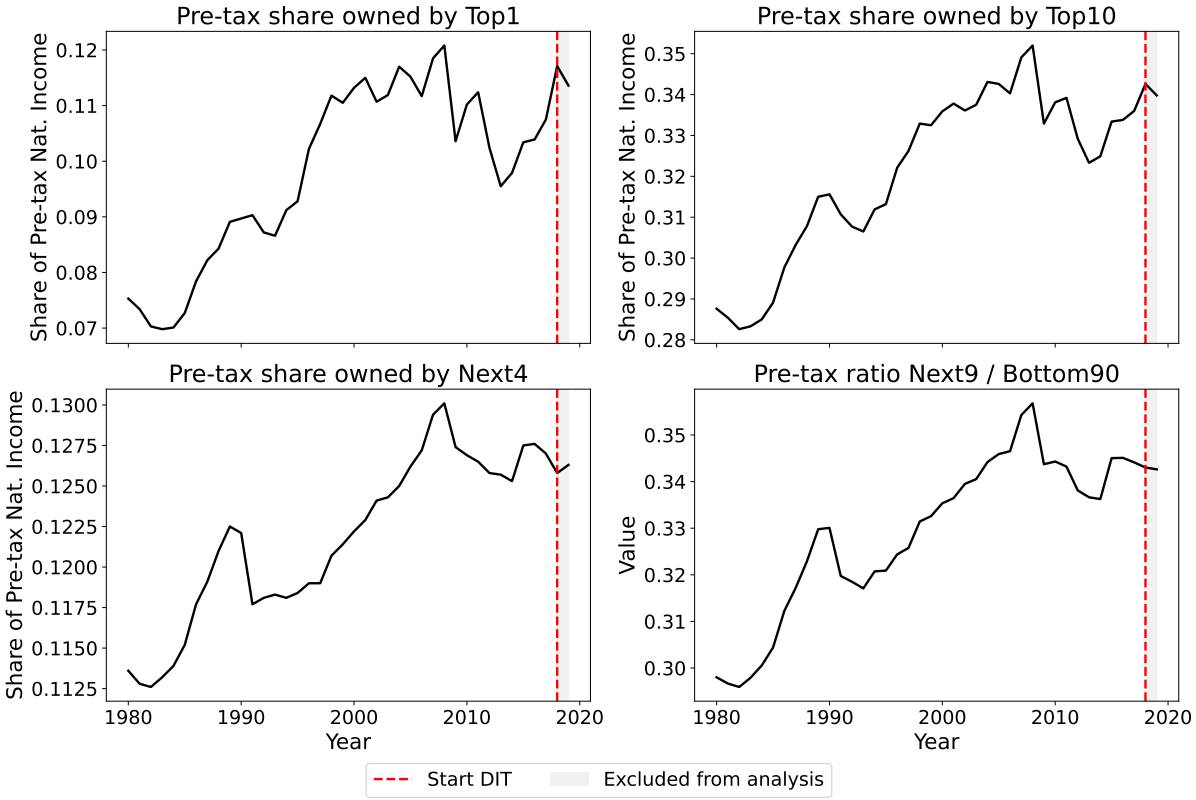
[5]While Austria had a specific time threshold, Belgian tax law does not define a precise holding period to determine speculation, but looks at a group of characteristics: whether the gain is realised on from the sale of movable goods (e.g., shares); whether the sale is not part of normal wealth management but is deemed speculative in intent; whether the asset is resold shortly after acquisition (the assessment is based on facts and circumstances like frequency, pattern, volume of transactions).

[6]In addition to the "speculative transactions" and "professional trading" case, we found out that in some very rare case capital gains are taxed as "diverse " or "Miscellaneous " income. In such cases, the capital gain is taxed at a flat rate of 33%, plus communal surcharges (typically bringing the effective rate closer to 34–35%).

[7]There still were exceptions; for example, interests from regulated savings accounts were partially exempt, government bonds and other specific securities were subject to lower rates.

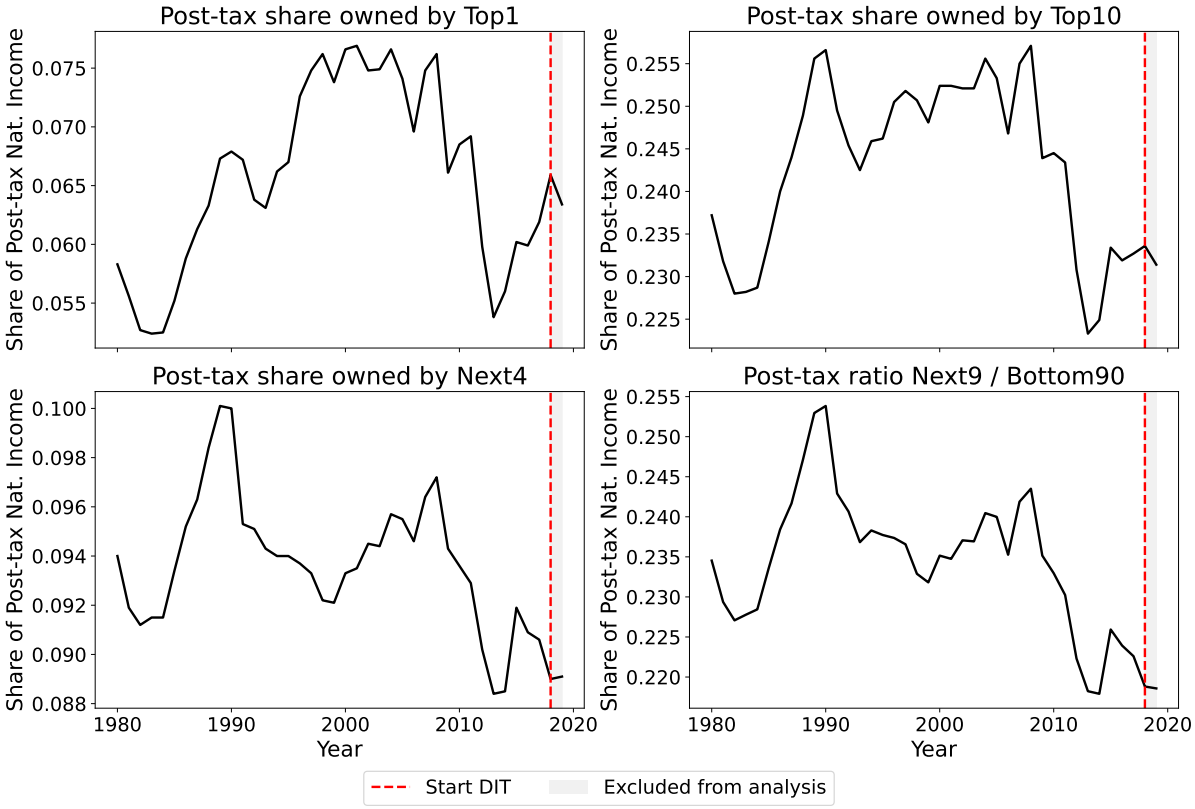
France

Figure 1.9: Evolution of some relevant pre-tax income concentration metrics for France



Source: own elaboration on WID data.
We do not include the post-DIT years since having just 1 year of treatment would add only noise.

Figure 1.10: Evolution of some relevant post-tax income concentration metrics for France



Source: own elaboration on WID data.

The evolution of the French individual tax system is quite convoluted and it is strange to see a country in which a comprehensive income tax that is with less exceptions during the 2010s than the 1980s. It is not easy to categorise this country for our study; however, even if capital gains received a favourable treatment by the tax system they have been taxed progressively till 2018. Therefore we consider France a control country till 2018 and, since having France among the treated countries just for one year would only add noise, in 2019 we did not include France neither among the treated nor among controls of our causal inference study. This is true for both our frameworks.

A fragmented comprehensive tax system

Until the early 1980s, France maintained a formally comprehensive income tax system in which labour and capital income were, in principle, subject to the same progressive schedule under the *Impôt sur le Revenu* (IR). However, in practice, capital income was subject to lighter taxation due to a range of exemptions, alternative tax treatments, and exclusions that created a de facto dualism within the unified framework.

One of the most notable cases was that of capital gains on the sale of securities. Before 1976, such gains were entirely exempt from income taxation if the annual gross

proceeds from sales remained below 25,000 francs[8] (indexed annually) and the securities had been held for more than two years. The 1976 reform (Loi n° 75-1278 du 30 décembre 1975) formally brought these gains into the IR base despite the time passed from the acquisition; however, the tax-free threshold of 25,000 francs for capital gains made by non-professional investors remained (Maillard 1993).

At the corporate level, the *Impôt sur les Sociétés* (IS) was levied at a standard marginal rate of 50% in the early 1980s, with reductions applied to retained earnings under certain reinvestment conditions.

Dividends, for their part, benefited from the *avoir fiscal* system, a partial imputation credit that offset corporate tax previously paid on distributed profits, thereby reducing the marginal personal tax burden on dividend income. Interest income was often subject to withholding but could be declared under the IR. Labour income, by contrast, was fully taxed under the progressive scale, which had a top marginal rate of 60% in the early 1980s (Malabouche 1991).

The situation evolved substantially with the introduction of flat-rate withholding taxes (*prélèvements libératoires*), which enabled capital income to bypass the progressive income tax. The Finance Law for 1983 first introduced this mechanism for interest income, allowing it to be taxed at a flat rate of 15%, withheld at source. Subsequent Finance Laws raised the rate incrementally, reaching 24% by the early 2000s. Dividends were brought into the scope of optional flat-rate taxation through the Finance Law for 1996, with the rate initially set at 16%, later rising to 21% depending on the year (OECD 2006). These *prélèvements* were final taxes: if chosen, the income was excluded from the IR base. This system, while optional, became increasingly attractive to high-income taxpayers seeking to avoid higher marginal rates under the IR.

During this period, the corporate income tax (*Impôt sur les Sociétés*, IS) was levied at a marginal rate of 50% in the early 1980s, gradually reduced to 33.3% by the late 1990s, in line with European trends.

Several modifications regarding the capital income taxation (2000s–2010s)

A significant change occurred in 2000, when the Finance Law for 2000 (Loi n° 99-1172, 30/12/1999) abolished the 25,000 franc exemption threshold. From the 1st January 2000, all net capital gains on disposals of securities became taxable in full under the IR professional traders continued to be taxed under business income rules, ordinary investors were now fully liable for capital gains tax, eliminating the prior de facto exemption for small disposals.

From 2006, the taxation of capital gains was further modified to include holding-

[8] 25,000 francs in 1976 are equivalent to about €5,500 in 2025.

period-based tax base reductions, granting a 50% deduction for gains on securities held for more than two years and 65% for those held for over eight years. These reliefs aimed to incentivize long-term investment but did not reinstate any exemption thresholds. The remaining portion of the gain was taxed under the progressive IR rates and subjected to full social charges.

Under President Nicolas Sarkozy (2007–2012), additional incentives were introduced for entrepreneurs and small investors. The 2007 TEPA (*Loi en faveur du travail, de l'emploi et du pouvoir d'achat*) Law provided full or partial exemptions on capital gains from the sale of shares in SMEs, conditional on holding periods and reinvestment.

However, in 2004, the avoir fiscal was abolished, following pressure from the European Commission and in anticipation of EU case law on cross-border dividend taxation. It was replaced by a 40% personal income tax allowance on qualifying dividends. This new system applied equally to French and foreign-sourced dividends but reintroduced double taxation, as it no longer linked the personal tax treatment of dividends to the corporate tax already paid (OECD 2006).

The corporate tax rate remained stable at 33.3%.

The Hollande Reform: Return to Comprehensive Taxation

In 2013, President François Hollande reversed much of the de facto dualization by reintegrating capital income into the progressive IR schedule. Dividends, interest, and capital gains were once again taxed according to the general income tax brackets, with a top marginal rate of 45%. Additionally, capital income became fully liable for social charges totaling 15.5%, comprising the CSG, CRDS, and other levies (Lehmann, Sicsic, et al. 2019).

This reform abolished most of the deductions for holding periods and reintroduced a comprehensive approach to personal taxation.

The PFU Reform: De Facto Dualisation in 2018

A fundamental shift occurred in 2018 under President Emmanuel Macron with the introduction of the *Prélèvement Forfaitaire Unique* (PFU): a unified flat tax of 30% on capital income (12.8% income tax plus 17.2% for social levies). The PFU applied to dividends, interest, and capital gains, and became the default regime. Taxpayers retained the option to opt into the progressive schedule if advantageous (Lehmann, Sicsic, et al. 2019).

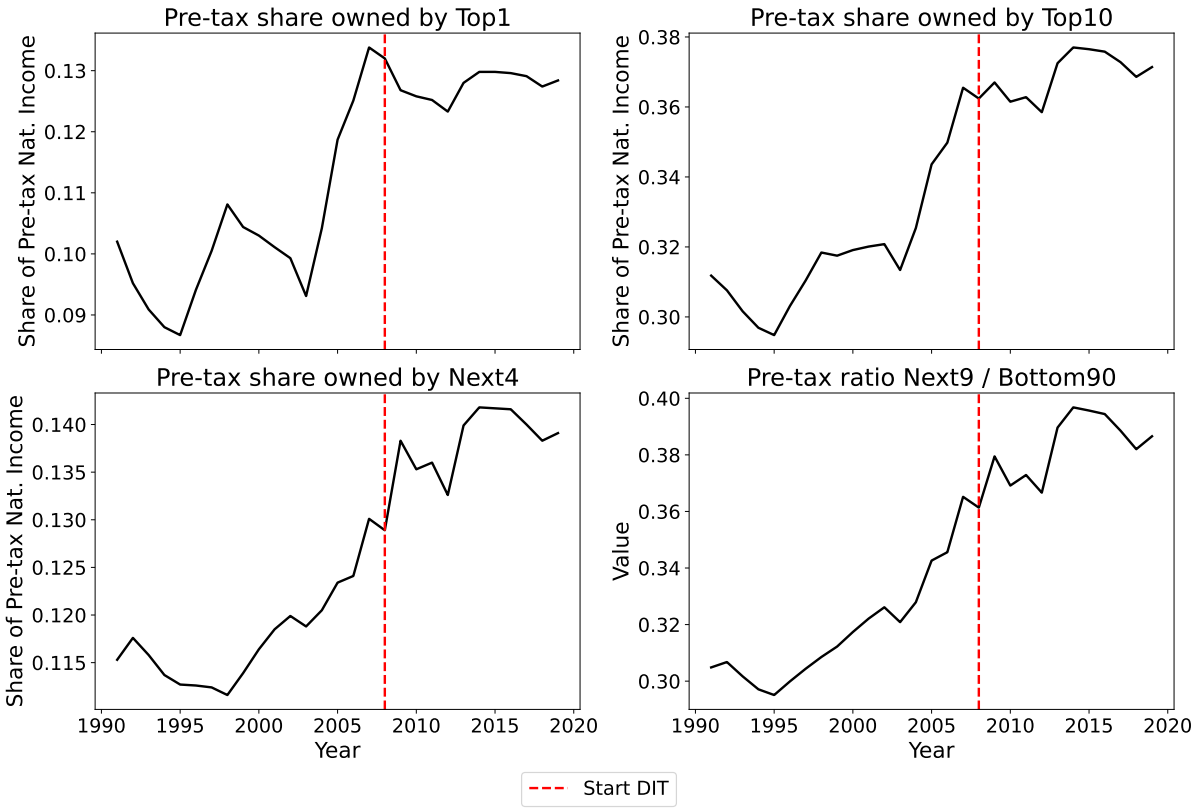
This reform constituted a de facto Dual Income Tax, separating capital and labour income into distinct tax regimes. Labour income continued to be taxed progressively, with marginal IR rates up to 45% plus social contributions.

In 2019, the corporate tax rate remained at 33.3% and an imputation system was not reintroduced. As a result, distributed profits remained subject to double taxation, albeit

at lower marginal rates (OECD 2020b).

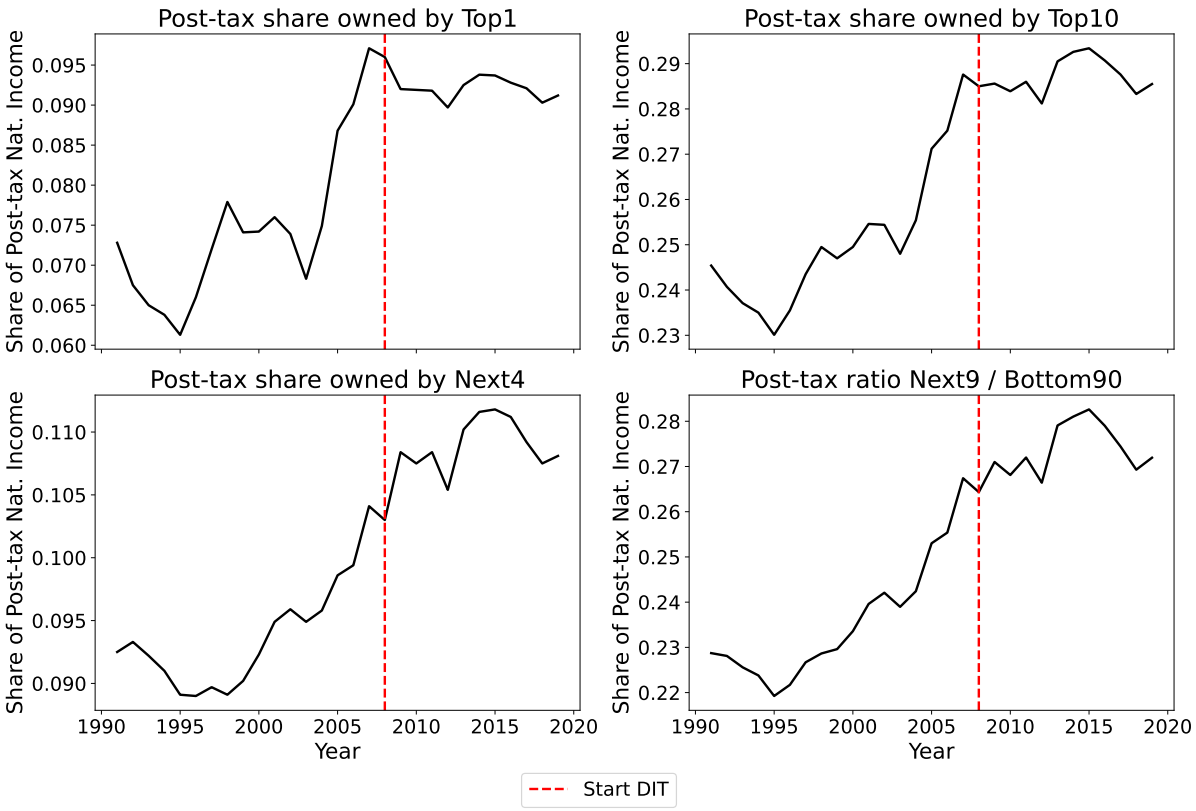
Germany

Figure 1.11: Evolution of some relevant pre-tax income concentration metrics for Germany



Source: own elaboration on WID data. We consider Germany only from 1991 onwards because we wanted to consider the country only from January of the first year after the unification post WWII.

Figure 1.12: Evolution of some relevant post-tax income concentration metrics for Germany



Source: own elaboration on WID data.

The German case is a very complex case to study. The first obstacle is, of course, the deep and complex process of reunification; however, there are also difficulties that are specific to the fiscal studies. Modern Germany started with an incomplete comprehensive tax system and then substituted it with a long transitional phase; this transitional phase ended with another peculiar choice. Germany is one of the few countries that after the dualization of the tax system still applied different tax rates between retail and professional investors. Such convoluted evolution of the tax system forced us to exclude Germany from the strict framework of our causal inference study; however, since from 2009 there is a flat tax on capital income, we could include Germany in the flexible framework study.

From Division to Reunification: A Fragmented Starting Point

In the decades prior to reunification in 1990, West Germany (Federal Republic of Germany) and East Germany (German Democratic Republic) operated under fundamentally different tax systems. We did not consider East Germany for our study. West Germany had a market-oriented and progressive income tax regime based on the 1955 Income Tax Act, where both labour and capital income were taxed jointly at marginal rates reaching up to 56% in the late 1980s. The system aimed to be comprehensive; however, capital

income, particularly dividends and capital gains, benefited from various exemptions and imputation credits, resulting in differential effective taxation compared to labour income (Bach et al. 2013).

To help finance the extraordinary costs of reunification, the solidarity surcharge (Solidaritätszuschlag)[9] was introduced in 1991. Initially conceived as a temporary measure, it levied an additional 7.5% on personal income tax, corporate tax, and capital income tax (Bach et al. 2013).

The corporate tax system during this period followed a split-rate model, taxing retained and distributed profits at different rates. Retained earnings were taxed at 45%, while distributed profits were taxed at 30%.

The Unified Comprehensive System in the 1990s

In the years following reunification, Germany maintained a comprehensive income tax system; however, while labour income was fully subject to progressive taxation, capital income benefited from a patchwork of exemptions and favourable treatments.

Long-term capital gains from share sales, for instance, were tax-exempt if the holding period exceeded one year. Dividends were subject to double taxation, once at the corporate level and again at the shareholder level, until an imputation system was introduced (Bach et al. 2013). This system aimed to formally equalize the treatment of capital and labour income, but in practice, the many relief mechanisms created asymmetries that eroded tax neutrality.

Transitional Period (2001–2009): *Halbeinkünfteverfahren* and *Teileinkünfteverfahren*

The period between 2001 and 2009 is often described in the literature as the beginning of a shift toward a Dual Income Tax (DIT) model. However, we did not concur. Although some elements of capital income were treated separately or given preferential treatment, the overall structure remained progressive, and the treatment of capital gains, in particular, was inconsistent with a DIT framework.

In 2001, the Tax Reform Act 2000 introduced the half-income system (*Halbeinkünfteverfahren*), replacing the imputation system. Under this rule, 50% of dividend income and capital gains from "substantial"[10] shareholdings became taxable under the personal progressive income tax, while the other half remained exempt.

[9]The solidarity surcharge is not a flat tax in the strict sense even if it is levied at a flat rate (5.5%). Indeed, it is an additional tax payment computed upon the individual tax income (which is progressive).

[10]The initial threshold to be categorised as a "substantial" shareholder was more than 10% of company's shares

In 2002, the threshold regarding the "substantial shareholdings" decreased to 1% marking a significant departure from earlier rules. For smaller, "non-material" shareholdings, the exemption for gains on shares held more than one year still applied (Bach, Corneo et al. 2006).

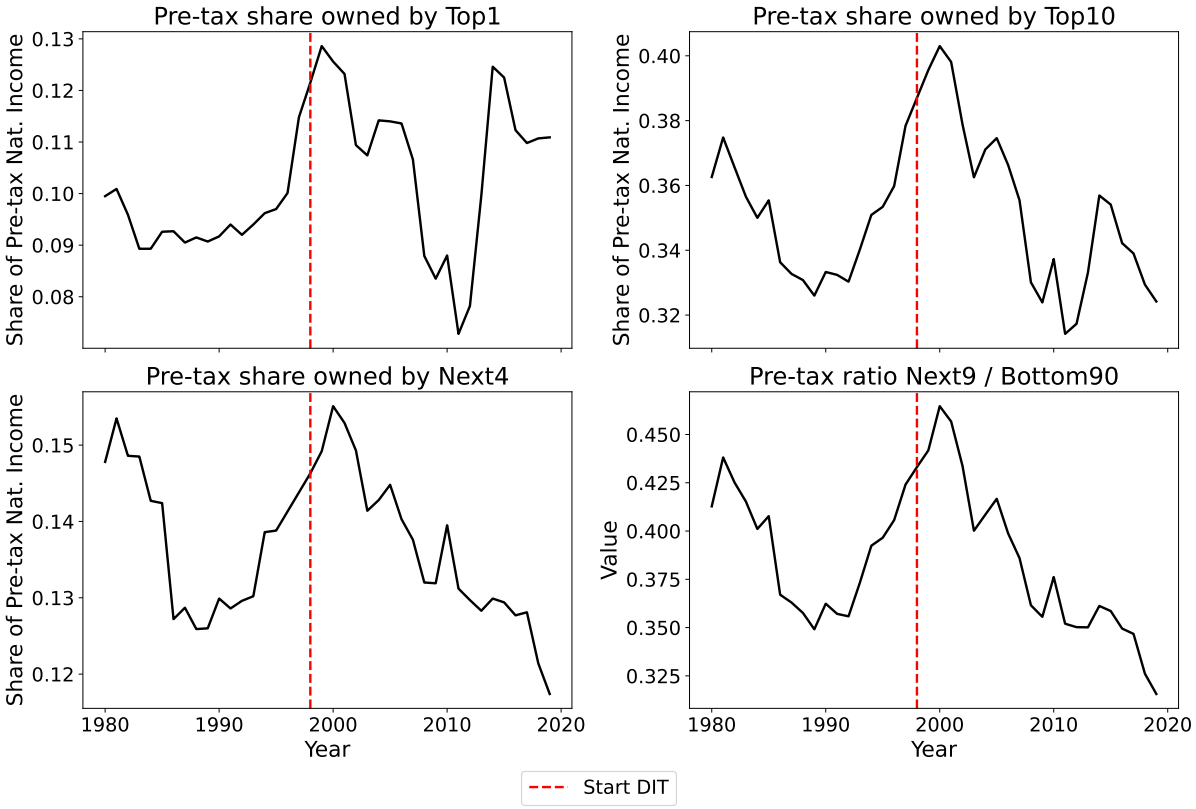
In 2008, a further reform introduced the *Teileinkünfteverfahren* (partial income procedure), effective January 1, 2009, replacing the half-income system. Under this rule, 60% of business-related dividends and capital gains became taxable under the progressive personal tax schedule, and only 60% of related expenses were deductible. It is important to notice the this system applies only to substantial shareholdings and business-related investments. Capital income remained partly integrated into the comprehensive tax system, and only select elements began to resemble the features of a Dual Income Tax (Jenderny 2022).

The Introduction of Dual Income Taxation with the *Abgeltungsteuer* in 2009

In 2009, Germany introduced the *Abgeltungsteuer*, a final flat withholding tax of 25% on all kinds of capital income. While Teileinkünfteverfahren applies to professional investors, Abgeltungsteuer changed the tax rates of the common taxpayer; for this reason we consider this reform marked the starting point of a Dual Income tax system in Germany (Jenderny 2022).

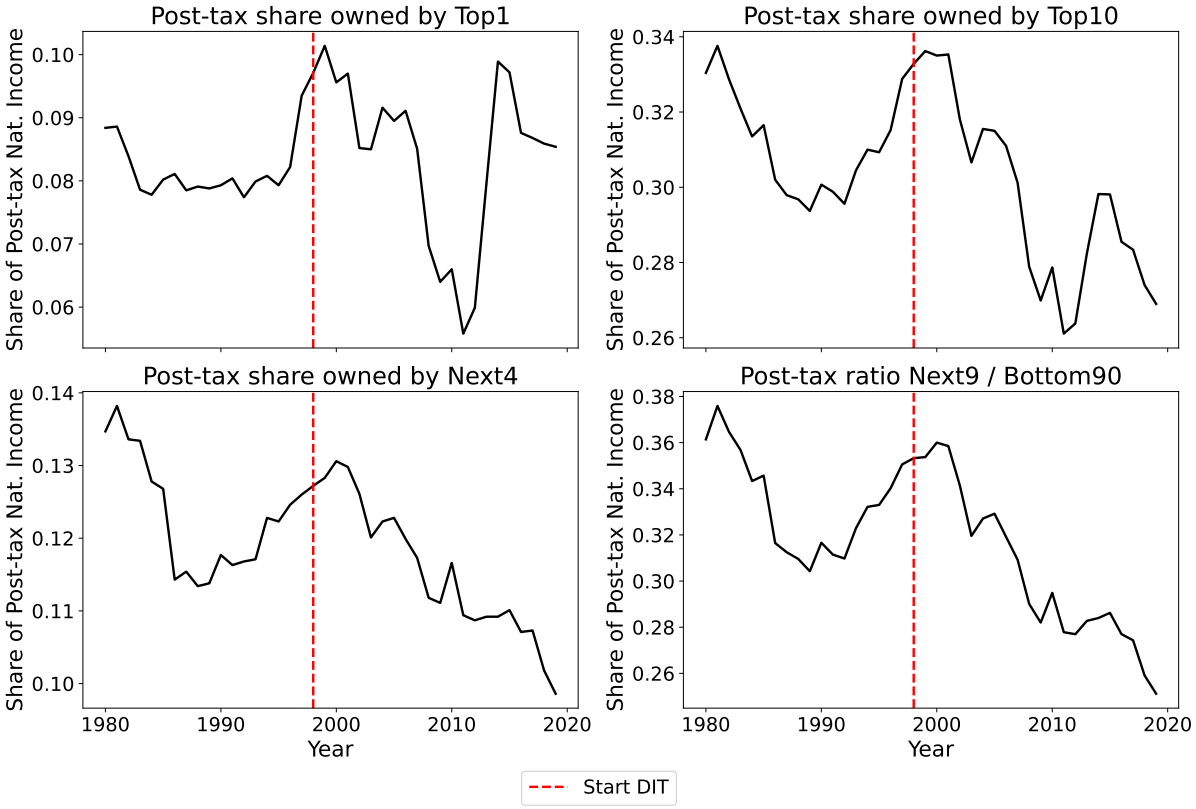
Greece

Figure 1.13: Evolution of some relevant pre-tax income concentration metrics for Greece



Source: own elaboration on WID data.

Figure 1.14: Evolution of some relevant post-tax income concentration metrics for Greece



Source: own elaboration on WID data.

Greece is another country that never fully implemented the comprehensive tax system; indeed, the Greek tax system pre-DIT did not have a clear tax treatment of capital income. However, in 1999 Greece introduces a flat tax on capital gains. For these reasons, we include Greece only in the relaxed framework of our causal inference study as a treated country after 1999.

The Tax System in the 1980s and 1990s: Progressive Labour Taxation and Fragmented Capital Taxation

During the 1980s and early 1990s, capital income, however, was treated unevenly: capital gains from the sale of stocks were exempt from taxation in Greece, while capital income like interest and dividends were instead taxed as part of total personal income and thus subject to progressive tax rates (OECD 1998, 2000).

The corporate income tax (CIT) during this period was also levied at progressive or high flat rates, commonly ranging from 35% to 40%, and separate from the PIT. There was no integration between corporate and individual taxation: profits could be taxed first at the corporate level and again when distributed, resulting in potential double taxation (OECD 2001).

In 1987, Greece introduced a 15% withholding tax on interest and dividend income. This was not a final tax: it acted as a prepayment against the taxpayer's ultimate liability under the progressive personal income tax system. This reform improved tax administration and collection, but did not change the fundamental integration of capital and labor income under a unified system (Asimakopoulos 2024).

The 1993 Reform: Structural Separation of Capital and Labour Income

A turning point occurred in 1993, when Greece undertook a reform that introduced final withholding taxes on certain types of capital income, particularly interest and dividends (Asimakopoulos 2024, Genser 2006). Unlike the 1987 prepayments, these taxes were no longer integrated into the progressive income tax schedule. The reform was undertaken to align the corporate income tax with the new final withholding taxes. The CIT remained at around 35%. Part of the literature pinpoint 1993 as the beginning of the DIT in Greece, however we do not concur since capital gains remained untaxed.

1999 Reform: Capital Gains Enter the Tax Base

In 1999, Greece extended the schedular system by introducing a 10% flat tax on capital gains from the sale of listed shares. This reform marked the first time such gains were formally included in the personal tax base. It was part of a broader effort to modernize the tax system and align with international standards, particularly in light of Greece's preparations for joining the Eurozone (Bank of Greece 1999, OECD 2001).

This development was, however, partially reversed in the mid-2000s, when capital gains taxation was temporarily suspended to stimulate stock market activity (Asimakopoulos 2024). The exemption was short-lived, as fiscal pressures soon forced its reinstatement.

Greece did not accompany the 1999 reform with changes to the corporate income tax. The CIT remained substantially higher than the personal capital income tax rates, with a statutory rate near 35% (OECD 2001).

Post-Crisis Consolidation and the Emergence of a impure DIT System

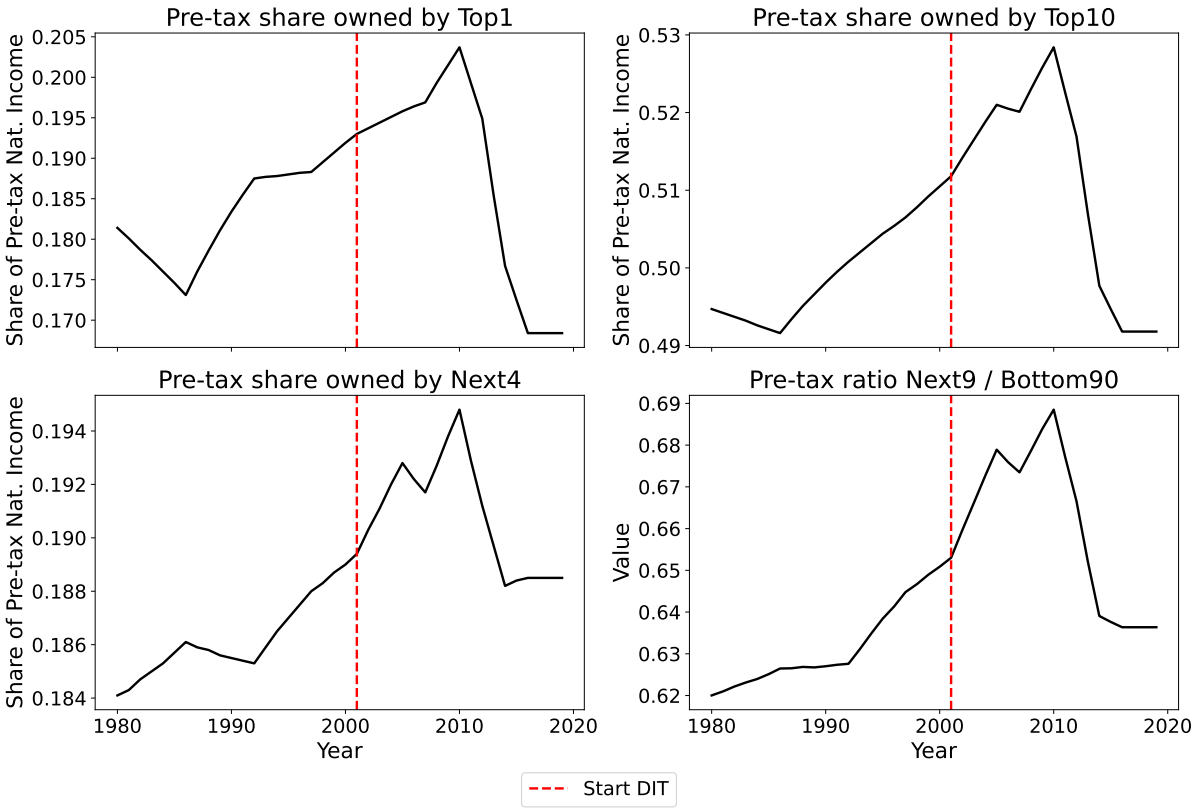
In the period subsequent to the debt crisis, under the fiscal consolidation programmes supervised by the EU and IMF, Greece undertook comprehensive tax reforms. From 2011, capital income was explicitly taxed at flat, final rates, while labour income continued under a progressive marginal tax structure (IMF 2011). By 2019, the Greek tax system had fully embraced the DIT framework. Labour income was taxed progressively with marginal rates ranging from 22% to 45%, capital income was taxed separately, with 5% on dividends, 15% on interest, and 15% on capital gains. These rates were flat, final, and

withheld at source, applying equally to all taxpayers regardless of income level (OECD 2020b).

The corporate income tax is still not formally integrated into this system making Greece a country with an impure dual tax system.

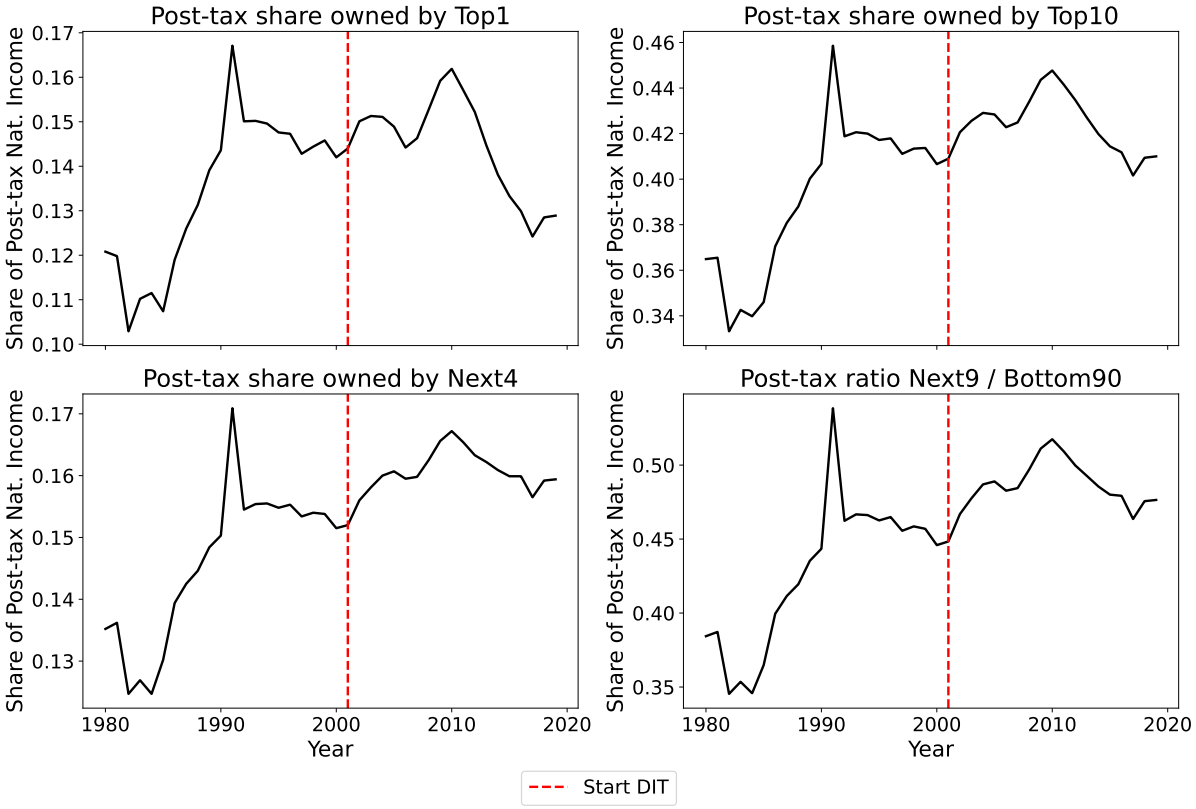
Israel

Figure 1.15: Evolution of some relevant pre-tax income concentration metrics for Israel



Source: own elaboration on WID data.

Figure 1.16: Evolution of some relevant post-tax income concentration metrics for Israel



Source: own elaboration on WID data.

Israel is considered by the literature as one of countries that moved from a comprehensive income tax system to a DIT; however, in our opinion the former cannot be considered a proper comprehensive tax system due to the tax exemption of capital gains. Therefore, we cannot include Israel in our strict framework causal inference study, while Israel can be inserted into the flexible framework as a control country until 2002 and as a treated country after that.

The fragmented system in the 80s and 90s

In the 1980s and 1990s, Israel's tax system on paper applied a comprehensive and progressive income tax schedule to all types of income, including both labour and capital income; however, in practice, there were significant differences in the treatment of labour and capital income.

Labour income was taxed at according to the progressive personal income schedule; in contrast, capital gains on publicly traded securities were exempt for individual non

professional investors.[11]

Interest and dividends were, instead, taxed at lower marginal rates through separate regimes or subject to reliefs, although their treatment was more heterogeneous (OECD 2006).

The 2002 Rabinovich Reform and the Introduction of Dual Income Tax (DIT)

In response to the increasing disparity in effective taxation between labour and capital income, Israel initiated a fundamental reform in 2002, following the recommendations of the Rabinovich Committee.

The 2002 reform introduced a flat tax rate of 25% on dividends and real capital gains realized from the sale of securities acquired on or after January 1, 2003. For substantial shareholders[12] the rate was set at 30%. Interest income was generally taxed at a flat rate of 25%. However, preferential rates applied under specific conditions.

The corporate tax rate was 36% in 2002 and was gradually reduced over subsequent years. It fell to 35% in 2003, 34% in 2004 and continued to decrease until it reached 25% in 2010 (OECD 2010; IMF 2005).

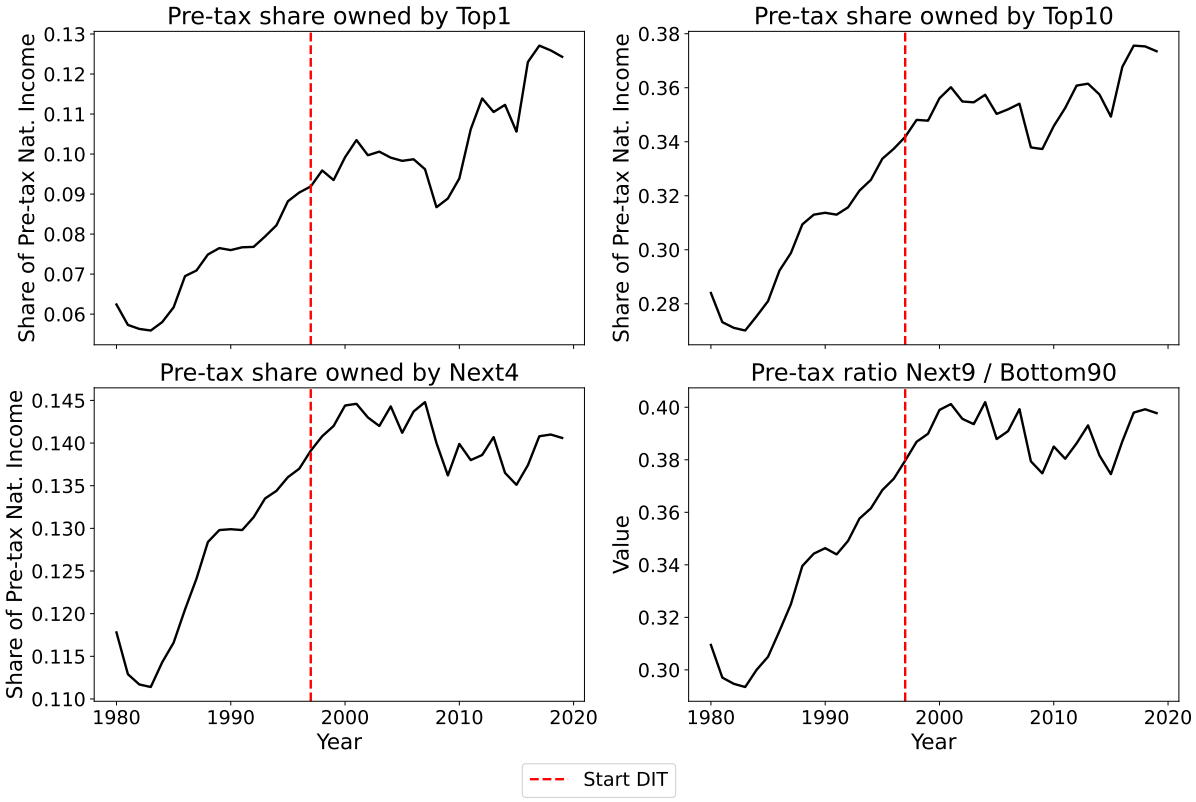
This reform marked the formal transition to a Dual Income Tax (DIT).

[11]The distinction between individual investors and professional traders was based on the nature and frequency of transactions. Individuals engaged in occasional investment activities were eligible for the exemption, while those conducting frequent or substantial trading activities were classified as conducting a business and therefore subject to taxation on their gains (Tzarfati 2022).

[12]those holding 10% or more of a company's shares

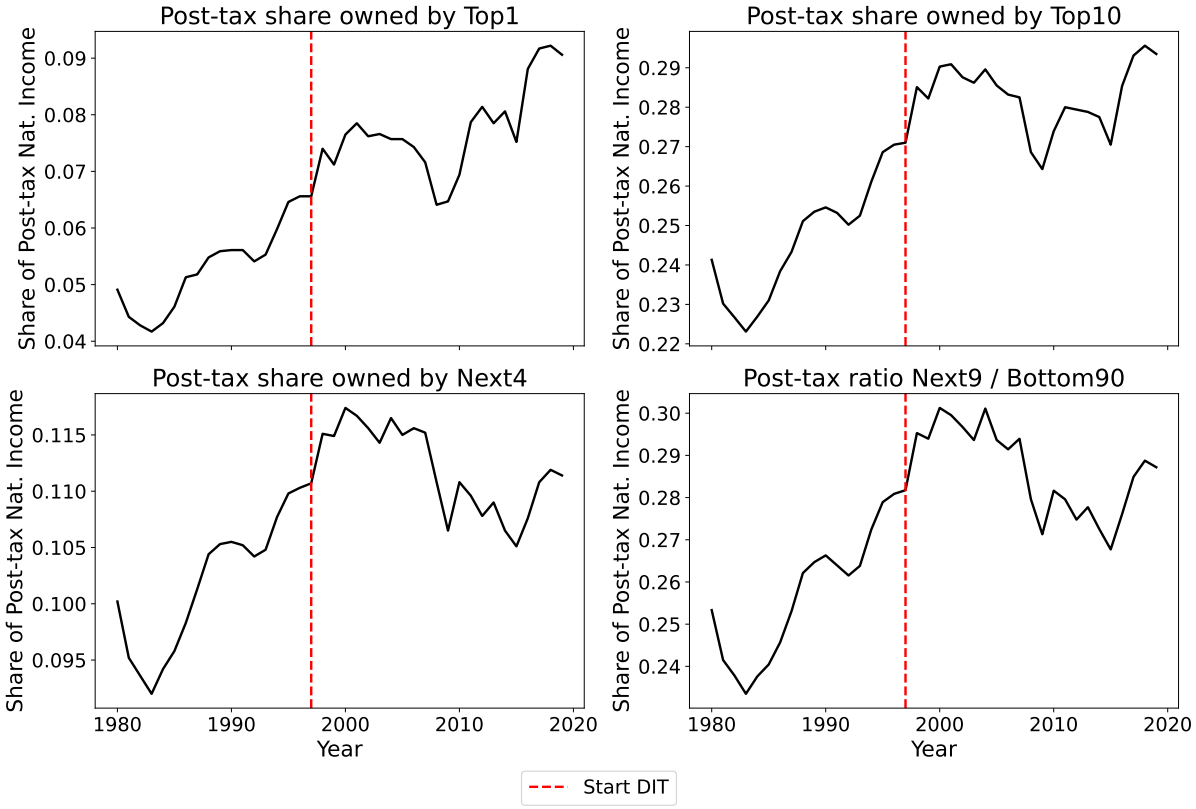
Italy

Figure 1.17: Evolution of some relevant pre-tax income concentration metrics for Italy



Source: own elaboration on WID data.

Figure 1.18: Evolution of some relevant post-tax income concentration metrics for Italy



Source: own elaboration on WID data.

Italy is among the countries considered by the literature as transitioned from a comprehensive tax system to a dual one; however the evolution of the Italian tax system has two peculiarities: the progressive tax on income had already lost its comprehensiveness at the end of the 80s, and an amount of modification of tax laws way more frequent than other developed countries. Since capital gains are mostly tax exempt already in the 1980s, we cannot include Italy in our strict framework causal inference study; however, we include Italy in the relaxed framework as a treated country from 1998 onwards.

The dismantle of the comprehensive tax system

Italy's tax system in the 1980s and early 1990s was based on a global, progressive personal income tax (*Imposta sulle persone fisiche* - IRPEF) introduced with Law No. 825/1971. By the mid-1990s, the IRPEF marginal rates ranged from 18% to 51%, having declined from a top marginal rate of 72% in the early 1980s (Gastaldi and Liberati 2005, Pellegrino and Panteghini 2020).

However, the IRPEF has seen multiple modifications that have slowly eroded the original nature of the comprehensive tax. To give some hints:

- Interest income was the first to be removed from the IRPEF base. Law No. 29/1983

introduced a 30% final withholding tax on bank deposit interest. This was reduced to 25% by Law No. 74/1986, which became the standard marginal rate for bank interest and corporate bonds in the late 1980s. Meanwhile, government bonds received preferential treatment: Law No. 482/1985 set a flat 12.5% rate.

- Regarding dividends, Law No. 72/1986 introduced a partial exclusion regime, in which 40% of dividend income was exempted and the remaining 60% was taxed progressively. This system remained in place until the 1998 reform.
- Capital gains taxation was even more fragmented. Prior to 1987, capital gains on listed shares were generally tax-exempt if held longer than 18 months. Law No. 227/1987 introduced a limited regime for professional traders, but widespread taxation of capital gains was only established with Legislative Decree No. 461/1997, effective from 1 July 1998. It introduced three regimes:
  - *Risparmio amministrato* (12.5% tax withheld by intermediaries),
  - *Risparmio gestito* (12.5% on net managed portfolio returns),
  - *Dichiarativo* (taxpayer-declared under IRPEF).

By the mid-1990s, most forms of capital income were taxed outside the IRPEF system, under differentiated marginal rates ranging from 12.5% to 30% (Alworth et al. 2002; OECD 2000a).

During these decades, corporate income was taxed separately under IRPEG (*Imposta sul Reddito delle Persone Giuridiche*) tax at a flat marginal rate of 36% to 37% and the integration of corporate-personal income was limited. Dividends distributed to shareholders faced a second layer of taxation, with partial relief only introduced in 1986 (Pellegrino and Panteghini 2020).

The Introduction of a Dual Income Tax (1998)

To reconcile all these modifications under a new framework and under pressure from capital mobility and European integration, Italy introduced a Dual Income Tax (DIT) in 1998 through Legislative Decree No. 466/1997. The reform targeted non-corporate businesses, such as sole proprietorships and partnerships, by splitting business income into two components: a notional return on equity, taxed at a flat rate of 19%, and a residual profit, taxed under the progressive IRPEF schedule (Bordignon et al. 1999; Gastaldi and Liberati 2005).

For corporations, a related provision allowed a deduction from the IRPEG base corresponding to a notional return (7%) on the increase in equity relative to its 1996 level. However, the DIT did not apply to portfolio income such as interest, dividends and capital gains, which continued to be taxed through substitute or final withholding taxes at flat marginal rates ranging from 12.5% to 27%, depending on the asset class (Alworth et

al. 2002). At that time, IRPEG (Imposta sul Reddito delle Persone Giuridiche) imposed a flat marginal tax rate of 37%.

The Consolidation of Flat Taxation on Capital Income (2012–2019)

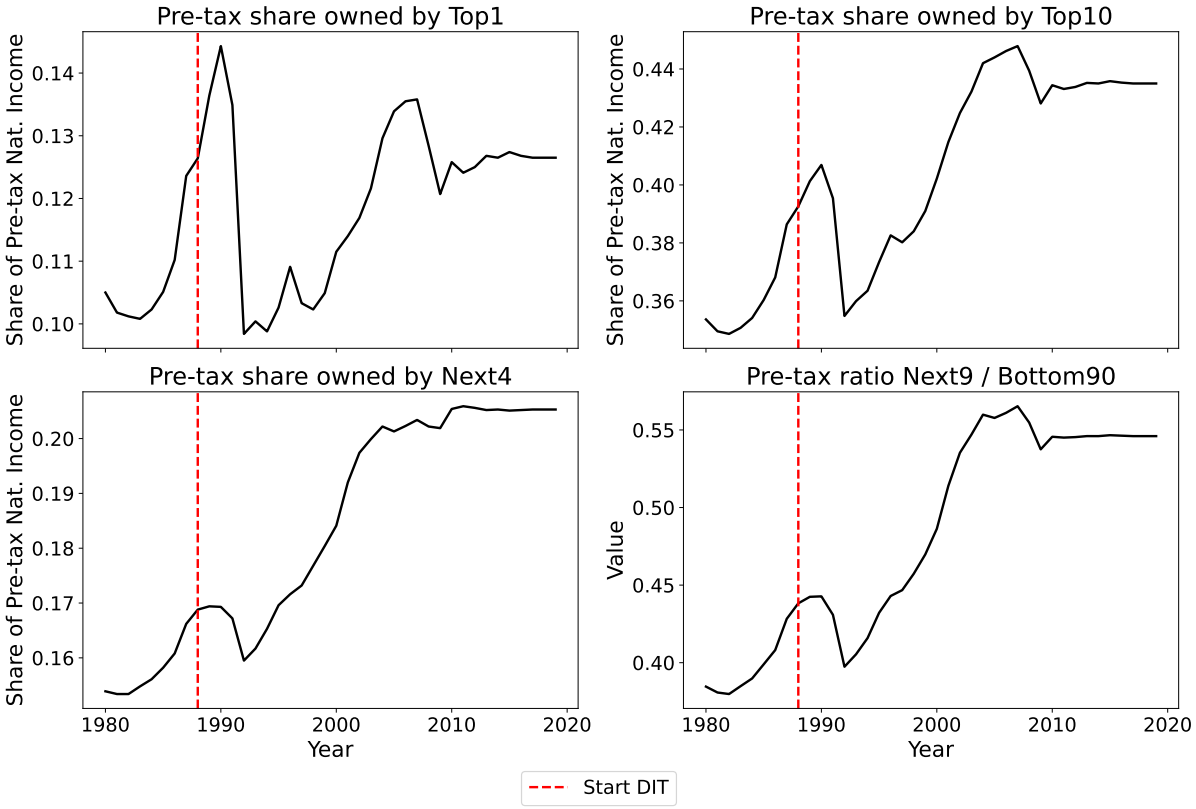
In the following years, Italy tried to simplify the schedular regime for capital income. A major reform in 2012 replaced the existing substitute taxes with a uniform flat tax of 20% on most financial income, including interest, dividends, and capital gains. This flat tax, applied through final withholding, marked a shift toward a simplified capital income tax regime, separate from IRPEF (MEF 2012).

In 2014, the flat tax was increased to 26% under Decree-Law No. 66/2014. The change applied broadly to financial capital income—interest from bank accounts and bonds, dividends from non-qualified holdings, and capital gains on listed shares. Government bond interest, however, retained a preferential marginal tax rate of 12.5%, justified by the need to sustain public debt demand (Pellegrino and Panteghini 2020).

At the corporate level, important reforms were also implemented. In 2004, the IRPEG was replaced by IRES (Imposta sul Reddito delle Società), which maintained a flat marginal rate of 33%, later reduced to 27.5% in 2008, and again to 24% in 2017 (Legislative Decree No. 147/2015; Budget Law 2016). No full imputation or exemption system was introduced for dividends, meaning that double taxation persisted, albeit partially mitigated through reduced taxation of distributed profits at the shareholder level.

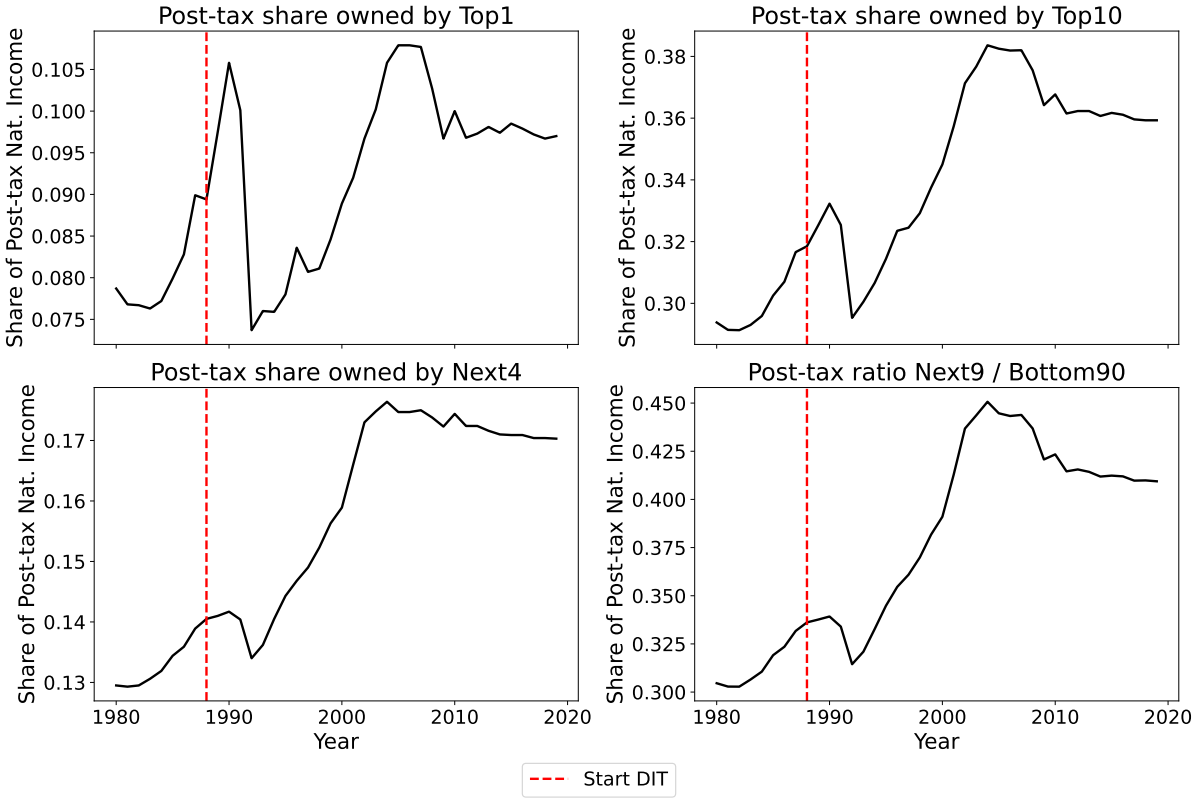
Japan

Figure 1.19: Evolution of some relevant pre-tax income concentration metrics for Japan



Source: own elaboration on WID data.

Figure 1.20: Evolution of some relevant post-tax income concentration metrics for Japan



Source: own elaboration on WID data.

While literature describe Japan as having shifted from a comprehensive to a dual income tax (DIT) system, this narrative overlooks the fact that Japan never fully implemented a comprehensive income tax in practice. For this reason we cannot include Japan in the strict framework of our causal inference study; however, thanks to the 1989 capital gains start to be taxed with a flat rate, therefore we can include Japan in our relaxed framework and consider it a treated country from the aforementioned reform onwards.

Capital Gains Before Reform: A Symbol of Fragmentation

Before 1989, capital gains from listed securities were effectively untaxed for most individual investors. Only frequent, large-volume traders were required to declare them under global taxation. The vast majority of gains were exempt or passed through a securities transaction tax (STT) levied on gross proceeds, not actual gains (Shoven 1989, Ishi 2001, 2006). This meant that capital gains income—especially among high-wealth individuals—escaped progressive taxation entirely.

The 1988–89 Reform: Formalizing Schedular Taxation

The 1988–89 reforms marked a structural turning point. In 1988, tax-exempt savings regimes like the "Maruyu" system were abolished, and a 20% withholding tax on interest was introduced. In 1989, capital gains from listed shares were finally brought into the tax net, but not under the global schedule. Instead, two schedular options were introduced (Ishi 2001, 2006):

- self-declaration method: Taxpayers could declare their actual capital gains and pay a flat 26% tax (including local tax) on them;
- withholding method on deemed gains: instead of calculating actual gains, taxpayers could pay a 20% tax on a deemed gain, which was assumed to be 5% of the sale price (not the actual gain).

2003 Reform: Preferential Flat Rates for Capital Gains

The 2003 reform entrenched the separation of labour and capital taxation by introducing a temporary flat 10% marginal tax rate on capital gains from listed shares and dividends. The reform was intended to stimulate financial markets and was not integrated into the global income schedule. Initially due to expire in 2007, the preferential rate was extended several times reflecting persistent political reluctance to increase capital income tax.

In 2014, the preferential 10% rate was allowed to expire, and the standard 20% marginal rate was reinstated. Capital gains from listed shares continued to be taxed separately through either withholding or declaration.

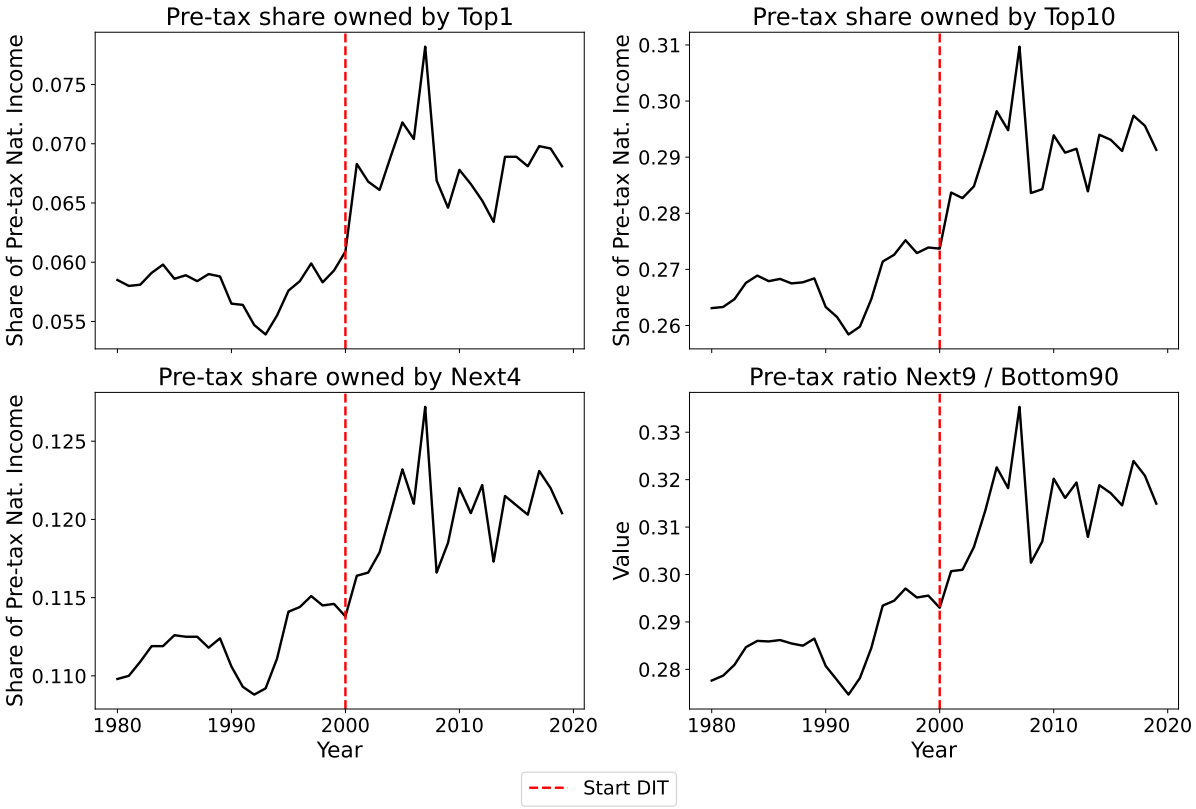
In parallel, the Nippon Individual Savings Account (NISA) was introduced in 2014 to encourage household investment in financial assets by offering tax exemption on capital gains and dividends from investments made within the account. Under the standard NISA scheme, individuals could invest up to 1.2 million yen per year (later increased to 1.44 million yen)[13], with tax-free treatment on income from eligible stocks, ETFs, and mutual funds for up to five years.

By 2019, Japan had solidified a dual income tax system. Labour income was taxed progressively, with a top marginal rate of 45%, while most capital income was taxed schedularly at flat rates. The marginal corporate income tax, however, remained around 30% and dividends were taxed again at the personal level.

[13] 1.44 million yen in 2014 are approximately €8,470 in 2025

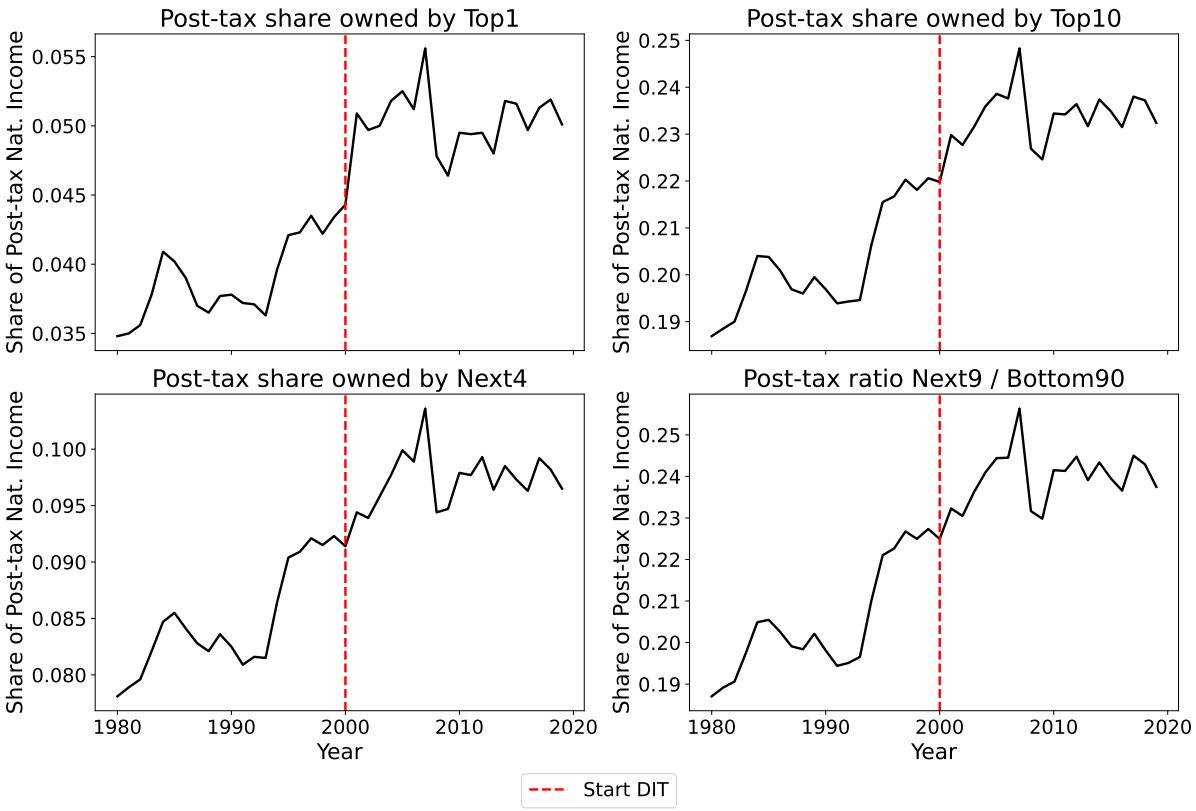
Netherlands

Figure 1.21: Evolution of some relevant pre-tax income concentration metrics for Netherlands



Source: own elaboration on WID data.

Figure 1.22: Evolution of some relevant post-tax income concentration metrics for Netherlands



Source: own elaboration on WID data.

The tax system of the Netherlands is an interesting case: in 2001 they structured a tax system very similar to a DIT but with a quite unique system of categorization of income. Unfortunately, since the pre 2001 tax system did not tax capital gains, we can include the Netherlands only in the relaxed framework of our causal inference study.

Comprehensive Income Taxation in the 1980s and 1990s

In the 1980s and 1990s, the Dutch tax system was characterised by the application of a comprehensive income tax with the addition of a favourable treatment of the capital gains. The personal income (including dividends and interests) was taxed according a progressive scale; instead, capital gains were generally exempt from taxation for private individuals unless the taxpayer was deemed to be conducting a business or engaging in speculative trading.

The CIT was levied at a flat rate—34.5% in the early 1990s—on corporate profits, and the dividend withholding tax (generally 25%) was intended to integrate corporate and personal taxation by providing a credit at the shareholder level (Cnossen and Bovenberg 2001).

The 2001 Reform and the Move Toward a Dual Income Tax

A major overhaul of the Dutch income tax system occurred in 2001: the reform introduced the "box" system, explicitly separating different income sources into three compartments with distinct tax treatments. This marked a decisive shift toward the logic of the Dual Income Tax model (Cnossen and Bovenberg 2001).

- Box 1 included labour income and imputed rental value of owner-occupied housing, taxed under a progressive rate schedule with a top marginal rate of 52%.
- Box 2 applied to income from substantial business interests (defined as shareholdings of 5% or more), taxed at a flat rate of 25%.
- Box 3 encompassed income from savings and portfolio investments, which was no longer taxed based on actual returns. Instead, a return of 4% on net assets was assumed and taxed at a flat rate of 30%.[14]

To mitigate the burden on small savers and ensure progressivity within Box 3, the reform introduced a tax-free threshold (heffingvrij vermogen) of €17,600 per person in 2001, or €35,200 for tax partners.[15]

The Tax System in 2019: Continued Separation of Capital and Labour

By 2019, the basic structure of the post-2001 tax system remained intact, though several minor adjustments at the tax rates had been made.

Box 3 remained the most controversial. Although the flat 4% notional return was challenged in court and subject to criticism for not reflecting actual returns it was still in force in 2019 and taxed at 30% above the threshold.

Although not labelled a Dual Income Tax system, the 2019 Dutch income tax regime embodied its essential features.

Portugal

Portugal is a unique case because the literature often remarks that one of the core characteristics of its tax system was not enforced: during the 1980s Portuguese tax taxation had a proper comprehensive tax system but taxation on capital was not enforced after the 1989 reform the literature says label the Portuguese system as close to DIT even if capital gains could still be taxed progressively because this procedure was not commonly used by taxpayers. For these peculiar situation we prefer not to include Portugal in both framework of our causal inference study.

[14]Instead of looking at what you actually earned, the post 2001 Dutch tax system assumes that you earn a fixed return on your total net assets (assets minus debts). From 2001 to 2016, this assumed return was set at a flat 4% per year. This 4% is called a notional (or fictitious) return — a government estimate of what your investments "should" earn, on average.

[15]The thresholds were indexed to inflation.

Taxation in the 1980s: A Comprehensive and Fragmented System

In the early 1980s, Portugal operated under a comprehensive income tax system with Top marginal tax rates for personal income reached 80% (OECD 2001). At the same time, the corporate income tax (CIT) stood at 36.5%, but was not coordinated with the personal tax system and this created the potential for double taxation of capital income (Bronchi and Gomes-Santos 2001).

Capital income, such as dividends, interest, and capital gains, was taxed at the same marginal rates as labour income. However, enforcement was weak, and high-income taxpayers frequently used exemptions and planning tools to reduce their tax liabilities and, in contrast to labour income, which was generally subject to withholding at the source, capital income was often underreported (Lopes 2008).

The 1989 Reform: Institutional Modernization and Functional Duality

The 1989 personal income tax reform represented a major modernization of the Portuguese tax system, coinciding with the country's recent accession to the European Economic Community (Neves 1993). The reform replaced the previous system with the *Imposto sobre o Rendimento das Pessoas Singulares* (IRS).

Crucial was the introduction of final withholding taxes at a 25% flat rate on all kinds of capital income, marking a departure from the uniform comprehensive approach (Bronchi and Gomes-Santos 2001). However, Taxpayers retained the option to include capital income in their general taxable income (*opção pelo englobamento*).

The literature consider the 1989 as the starting point of the DIT system in Portugal, in our opinion is actually the opposite. Thanks to this reform capital income taxations is actually enforced but, at the same time, the flat tax on capital income is just a lower tax cap: since taxpayers had the option to include capital income in their general taxable income, the progressivity in the lower brackets is maintained.

The Incomplete Dual Income Tax Model

Portugal's system met some, but not all, of these criteria. While the formal split in tax treatment emerged, and capital income was taxed at a flat rate, there was no full corporate–personal integration. Dividends continued to be taxed both at the corporate and personal level without relief mechanisms like imputation credits or exemptions. This lack of integration meant that marginal tax rates on distributed profits could be high, violating the neutrality goal of the DIT model (Bronchi and Gomes-Santos 2001).

Developments by 2019: Stability of the Dual Structure

By 2019, the essential structure of Portugal's income tax system had remained intact since the 1989 reform. labour income continued to be taxed under a progressive marginal rate schedule, with brackets ranging from 14.5% to 48% (OECD 2019). Capital income, including interest and dividends, was subject to a flat final withholding tax of 28%, unless voluntarily aggregated into total income. This stable arrangement reinforced the functional duality of the system, even in the absence of formal DIT legislation (OECD 2019).

On the corporate side, CIT rates had been reduced to 21% by 2019. While this reduction narrowed the gap between corporate and capital income tax rates, integration between CIT and PIT was still lacking. Distributed profits faced tax first at the corporate level, then again as dividends at the personal level, leading to potential marginal tax burdens on capital exceeding those typical of "pure" DIT systems.

Portugal's system thus remained a hybrid: a partial DIT, with clear differentiation in the treatment of labour and capital income and moderate alignment of marginal rates, but without full structural integration or strict separation of tax bases. While administratively efficient and relatively compliant with EU standards, it remained vulnerable to criticism on grounds of fairness and consistency.

South Korea

South Korea has a tumultuous recent political history that makes this country quite different from other developed countries; however, the evolution of its income tax system followed a path similar to the ones we have already seen: a theoretical comprehensive tax system that materialize in progressive taxation on labour income and a series of ad hoc law regarding capital income. Together with Belgium and New Zealand, Korea is the only country which still has, in 2019, tax exempt capital gains. Due to these characteristics we cannot include this country neither as a control nor as a treated unit in both frameworks of our causal inference study.

Pseudo comprehensive taxation in the 1980s

In the 1980s, South Korea's tax system was primarily designed to support rapid industrialization and economic growth. The tax structure was characterized by a relatively low reliance on personal income taxes and the focus was on indirect taxes, such as consumption taxes, which were easier to administer and provided stable revenue streams (Jun, 2009).

Labour income was taxed under a progressive schedule; while, most capital income was subject to lower flat-rate final withholding taxes. Interest and dividends were taxed

separately at rates generally around 15–20%, and capital gains from financial assets were effectively untaxed for individual investors (Yun 1992).

Reforms in the 1990s

The 1990s marked a critical turning point as South Korea undertook substantial tax reforms to address income inequality and prepare its tax system for globalization. A cornerstone of this effort was the introduction of the Global Income Tax System (GITS) in 1996, which aimed to consolidate labour income and certain forms of capital income into a single progressive tax base (Yoo, 2000). Interest and dividends were included in the global income base, but only when annual income exceeded a certain threshold. Below this threshold, they remained subject to separate withholding taxes—typically around 15.4%—to ease compliance for small investors (Yun 1992, Yoo 2000).

Capital gains taxation, however, remained fragmented and limited: individual investors were largely exempt from capital gains taxation unless they were classified as "major shareholders"[16]; these major shareholders faced progressive marginal tax rates aligned with the GITS structure, but the majority of investors realized untaxed gains. By contrast, capital gains from real estate were taxed under a separate and progressive regime, with marginal tax rates ranging from 20% to 60%, depending on both the size of the gain and the holding period (Jun 2009). Properties held for less than two years were taxed at the top rate of 60%, while long-term holdings (more than 3 years) benefitted from substantial deductions—up to 30% for holding periods exceeding 10 years. Gains from principal residences held for at least three years were exempt altogether.

In terms of business taxation, South Korea's corporate income tax (CIT) during the 1990s followed a moderate progressive structure, with marginal rates of 16% on taxable income up to KRW 200 million and 30% above that threshold (Jun 2009). While the system did not formally adopt dividend imputation (i.e., crediting taxes paid at the corporate level to personal income tax liabilities), a partial dividend deduction was introduced to reduce double taxation.

Recent Reforms and Current Structure

From 2001 onward, most interest and dividend income was taxed at a flat 14% final withholding rate, decoupling it from the progressive schedule applied to labour income (OECD 2004).

Nonetheless, the system continued to exclude most financial capital gains. Only major shareholders were taxed on gains from listed shares, and even then, under the personal

[16]Major shareholders was defined as owning more than 1% of a company's shares or holdings exceeding KRW 1 billion

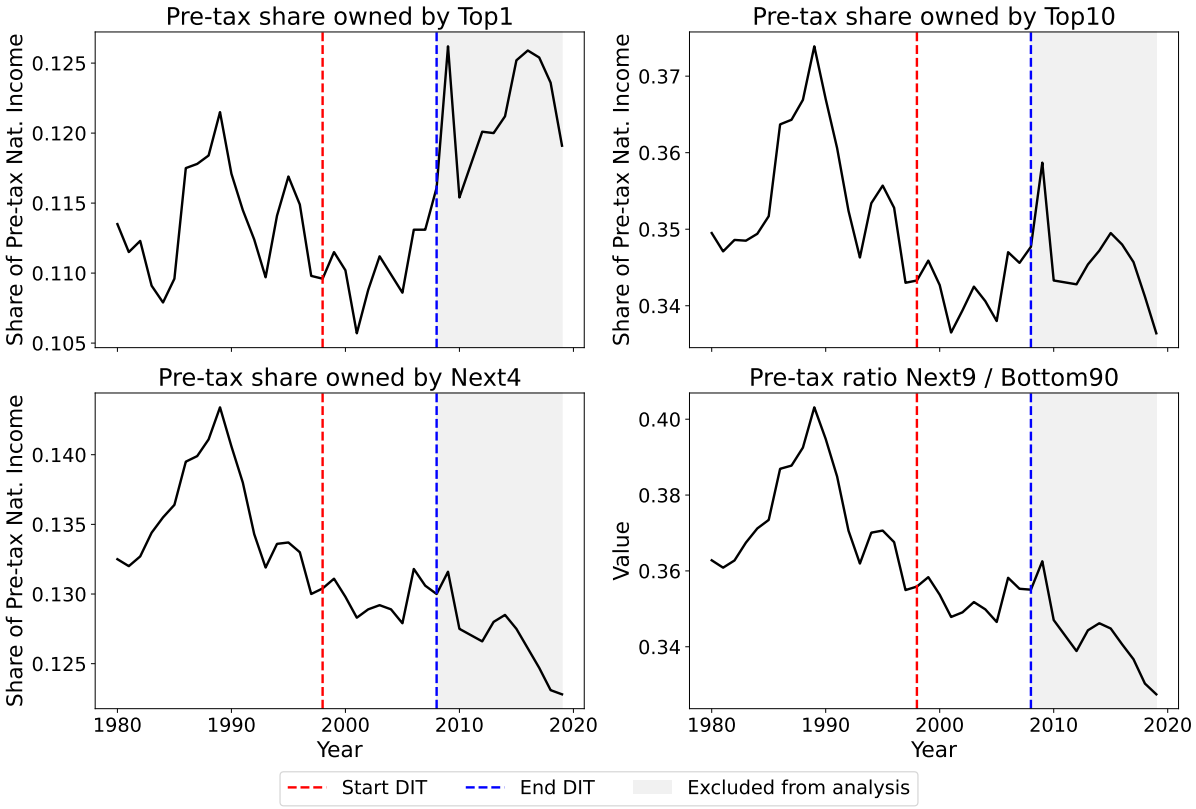
progressive schedule rather than a flat capital income tax. Minor shareholders remained entirely exempt, enabling high-income individuals to legally avoid taxation on substantial investment income (Jun 2009). In contrast, real estate capital gains remained subject to a distinct progressive regime. Strangely, corporate income tax remained progressive.

This is the system still in place in 2019.

1.4.3 Countries going back and forth between SHS and DIT

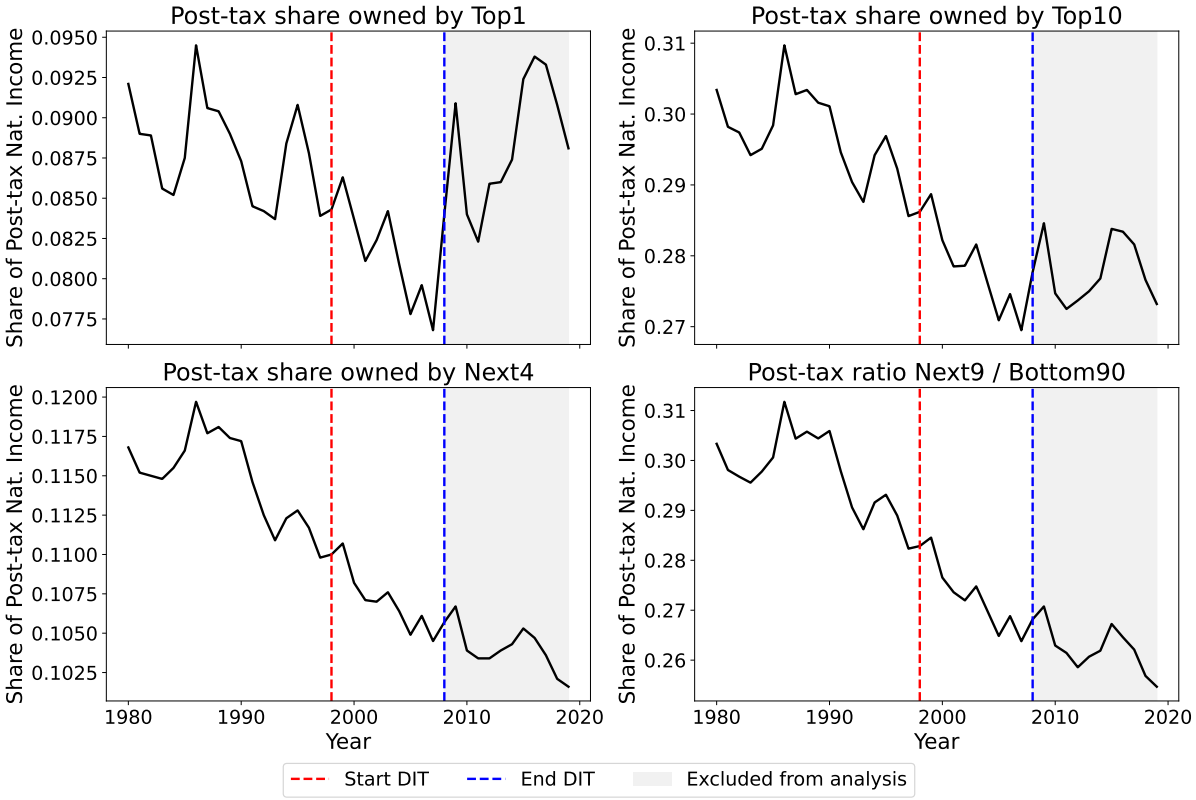
Spain

Figure 1.23: Evolution of some relevant pre-tax income concentration metrics for Spain



Source: own elaboration on WID data.
Spain is excluded from our causal analysis after 2008 because a treated country cannot become again untreated in our econometric methods.

Figure 1.24: Evolution of some relevant post-tax income concentration metrics for Spain



Source: own elaboration on WID data.

Spain is one of the few countries that abandoned a proper comprehensive income tax system for a fully fledged DIT and then went back again reintroducing progressivity into the capital income tax. Due to this peculiar path, we consider Spain as control country till 1999, as treated country from 1999 till 2008 and, after 2008, we eliminate the country from both treated and controls. This is applied in both the strict and relaxed framework.

A Unified Progressive Tax System in the 1980s and Early 1990s

In the 1980s and early 1990s, Spain's personal income tax (*Impuesto sobre la Renta de las Personas Físicas* - IRPF) operated under a comprehensive system in which all income was aggregated and taxed under a single, progressive schedule. Labour income, capital gains, dividends, and interest were all included in the general taxable base and subjected to the same marginal tax rates, which ranged from 25% to 56% in the mid-1980s (OECD, 2006).

During this period, corporate income was taxed separately under the corporate income tax (*Impuesto sobre Sociedades*), with marginal rates typically above 35%. Spain did not yet implement a coordinated mechanism between corporate and personal income tax on capital returns so the system was suffering of double taxation of corporate profits.

First Steps Toward Dualism

To address the issue of double taxation of corporate profits, Spain also began introducing partial relief mechanisms for inter-corporate dividends. Specifically, corporate shareholders receiving dividends from affiliated companies could benefit from exemptions or deductions that partially alleviated the economic double taxation arising from taxing profits at both the corporate and shareholder levels (Torregrosa-Hetland 2021, Lagares-Calvo, Herrera-Molina et al. 2014). However, these mechanisms remained limited in scope and did not extend to individual shareholders, who continued to face full double taxation on distributed profits.

On the corporate side, the general statutory corporate income tax rate was gradually reduced from 35% in the early 1990s to 32.5% in 1996, and eventually to 30% by 1999, in a bid to enhance Spain's attractiveness to foreign investors and improve alignment with the evolving tax policies of other EU member states (OECD, 2006; Torregrosa-Hetland 2021).

An ambitious reform arrived with the Law 40/1998: this reform represented a turning point in the architecture of Spanish personal income taxation and marked the first explicit legal articulation of a dualistic logic within the IRPF. From the 1st of January 1999, capital gains from assets held for more than one year, instead of being taxed jointly with other sources of income, were subject to a distinct flat marginal rate of 18% (OECD 2006, Torregrosa-Hetland 2021).

In addition to the separation of capital gains, Law 40/1998 simplified the tax brackets, reduced the number of deductions, and revised the treatment of imputed income and fringe benefits, aiming to broaden the base while lowering marginal rates.

The 2006 Reform: Formalising the Separation

A decisive step toward a more structured dual income tax model occurred with the 2006 reform, enacted through Law 35/2006: the reform eliminated the distinction between short- and long-term capital gains and introduced a flat tax rate of 18% on all forms of capital income, including dividends, interest and capital gains, separately from labour income, which continued to be taxed under a progressive marginal rate schedule with rates ranging from 24% to 43% (OECD, 2006).

Back to progressive capital income tax

The 2008 global financial crisis led to increasing budget deficits and political pressure to enhance fiscal equity. In response, the Spanish government passed the Law 2/2008, which increased the flat rate on capital income from 18% to 21% in 2010. While this change was still uniform, it set the stage for reintroducing progressiveness: with the Law 39/2010, *de*

Presupuestos Generales del Estado para 2011, the flat tax rate on capital income with a progressive schedule (*renta del ahorro*) starting in 2011:

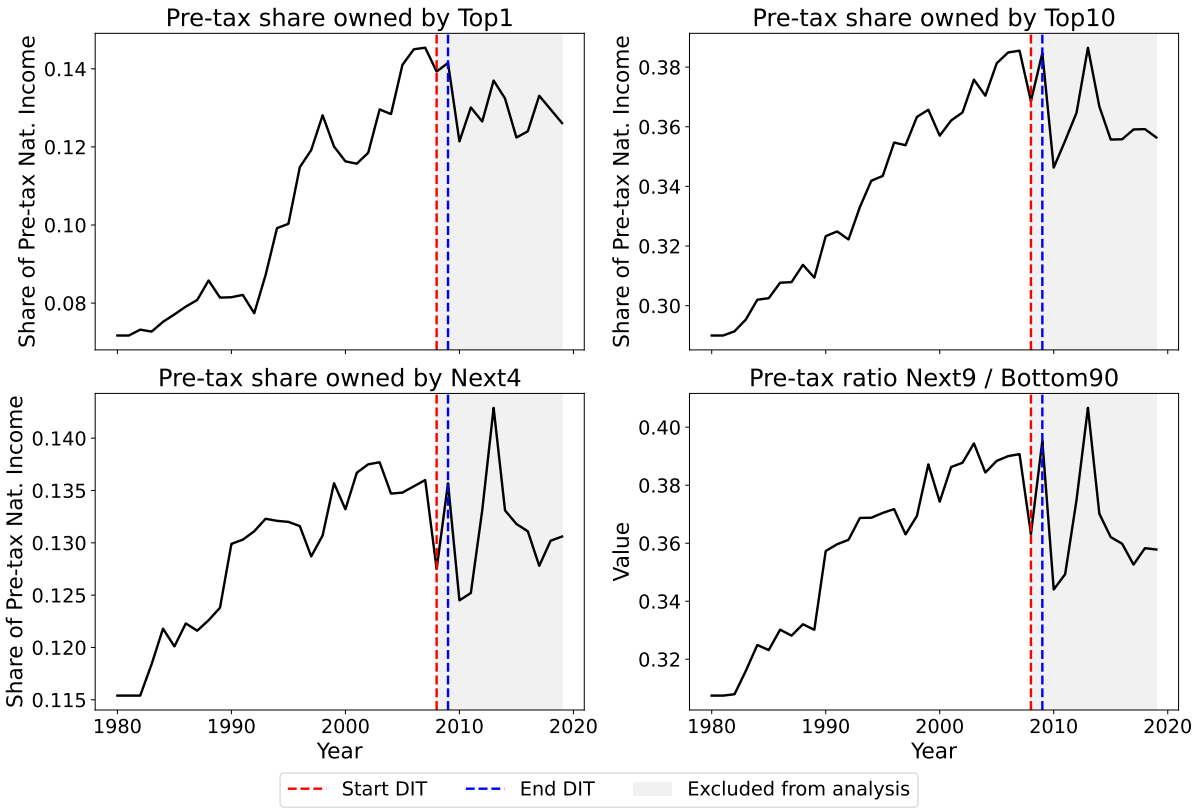
- 19% for the first €6,000,
- 21% for income between €6,000 and €24,000,
- 23% for income above €24,000.

This schedule applied to interest, dividends, and capital gains. The reform was justified as a way to increase tax revenue and introduce more fairness into the tax system, as capital income was heavily concentrated among top earners (Lagares-Calvo et al. 2014).

This schedule remained in force until 2019 with only some minor changes.

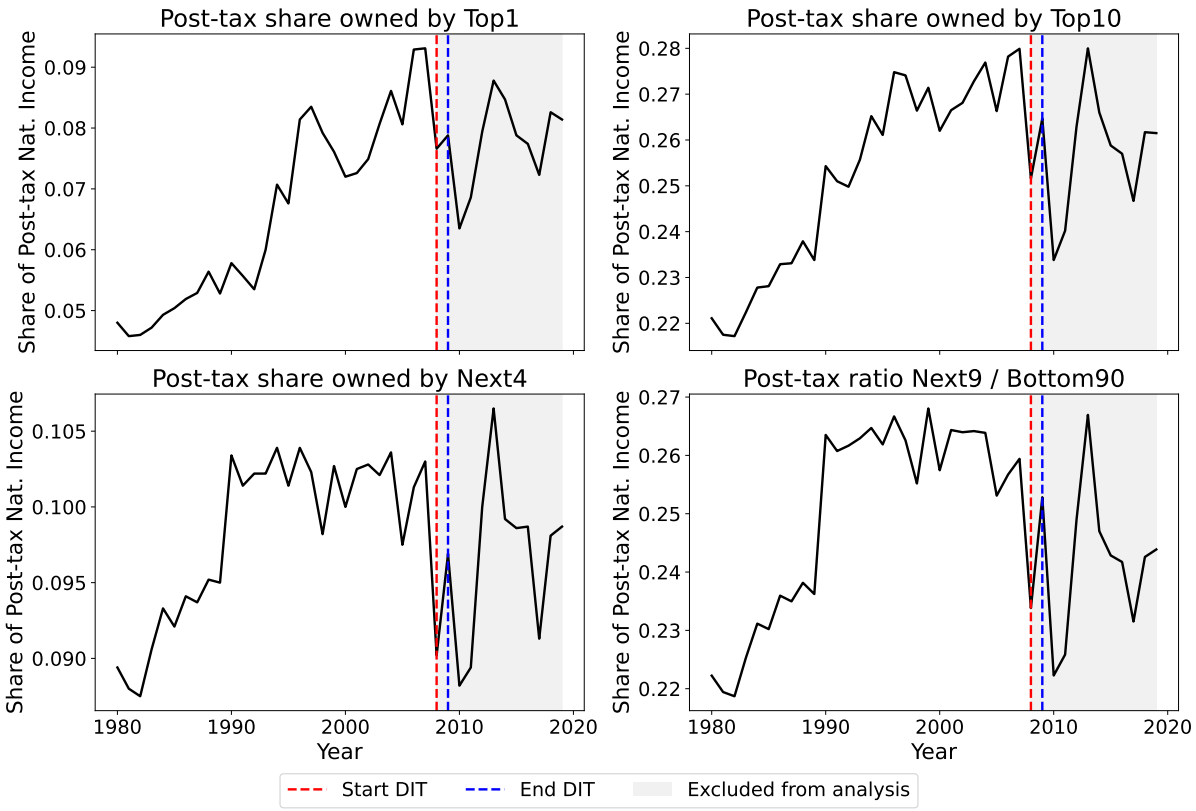
The UK

Figure 1.25: Evolution of some relevant pre-tax income concentration metrics for UK



Source: own elaboration on WID data.
UK is excluded from our causal analysis after 2008 because having just 1 year of treatment would add only noise and after that, the UK reversed the treatment.

Figure 1.26: Evolution of some relevant post-tax income concentration metrics for the UK



Source: own elaboration on WID data.

The UK, similar to Spain, started with a comprehensive income tax system and, even if embraced the DIT, it added back progressivity into capital income tax. In our causal inference study, the UK is a control unit until 2008; since the flat tax on capital income was in place for only two years, we just drop the country after 2008.

The 1980s: High Marginal Rates and Partial Relief for Capital Income

In the 1980s, the United Kingdom maintained a comprehensive income tax system under which labour and capital income were taxed jointly according to a progressive marginal rate schedule. Labour income faced a top marginal income tax rate of 60%, while capital income was subject to similar nominal rates but with specific relief mechanisms. Dividends were taxed under an imputation system: corporations paid Advance Corporation Tax (ACT) upon distribution, and shareholders received a tax credit against personal income tax. This credit fully covered the liability for basic rate taxpayers (at 30% in the early 1980s), but higher rate taxpayers (taxed at 60%) paid an additional tax on dividends (Leape 1993). Capital gains, meanwhile, were taxed as part of personal income and therefore subject to the same marginal rates, with indexation relief introduced in 1982 to adjust gains for inflation (Daunton 2002, Leape 1993).

The corporate income tax rate went from 52% in 1982 to 35% by 1986.

The reduction of progressivity during the 1990s

In the 1990s, tax reforms under Conservative governments simplified the tax structure. The top marginal rate on labour income was reduced to 40% in 1988 and remained at that level through the 1990s. The tax treatment of capital income maintained the imputation system: basic rate taxpayers (facing a 25% marginal tax rate) owed no further tax because the imputed tax credit fully covered their liability, whereas higher rate taxpayers (facing a 40% marginal tax rate) were required to pay an additional 15% tax on the grossed-up dividend amount.

Capital Gains Tax (CGT) also remained aligned with income tax rates, but indexation relief continued to protect gains from inflation-induced taxation. The corporate income tax rate was reduced further to 33% by 1994.

A significant innovation came in 1998, when Chancellor Gordon Brown introduced taper relief for Capital Gains Tax (CGT), replacing indexation for individuals. Taper relief reduced the taxable portion of a gain based on the length of time an asset was held, with preferential treatment for business assets. For business assets held for two years or more, only 25% of the gain was taxable, effectively applying a reduced marginal tax rate. This reform was intended to encourage long-term investment and distinguish between passive and entrepreneurial capital gains (Adam, Browne et al. 2010).

The 2000s: Partial Dualisation through Flat-Rate Capital Gains Tax

The trend toward separation of capital and labour taxation culminated in 2008 under Chancellor Alistair Darling, who abolished both taper relief and indexation relief and introduced a flat 18% marginal tax rate on capital gains. This reform removed the link between CGT and the income tax schedule, marking the first time since the introduction of CGT in 1965 that capital gains were taxed independently of the taxpayer's income bracket (Adam, Browne et al. 2010).

The corporation tax rate had by then fallen to 28% with no imputation system.

The 2010 and 2016 Reforms: Reintroducing Progressivity in CGT

The shift toward flat taxation of capital gains was partially reversed in 2010, when the coalition government reintroduced a progressive CGT schedule. Under the new rules, gains were taxed at 18% for basic rate taxpayers and 28% for higher and additional rate taxpayers.[17]

[17] "Basic rate taxpayers" are the taxpayers belonging to the first bracket of the income tax schedule, "higher rate taxpayers" are the ones belonging to the second bracket and "additional rate taxpayers" are the ones belonging to the third and highest bracket.

Further changes followed in 2016, when the standard CGT rates were reduced to 10% for basic rate taxpayers and 20% for higher and additional rate taxpayers (even though residential property gains remained subject to the previous 18% and 28% rates). These reforms retained progressivity while reinforcing preferential treatment for capital income relative to labour. Dividends also became subject to a new, formally separate schedule, with a tax-free dividend allowance[18] and marginal rates of 7.5%, 32.5%, and 38.1%, fully replacing the earlier imputation-based model (Adam and Miller 2021).

The corporation tax rate, reduced to 19%.

This is the system that was in place until 2019.

The USA

The Regan presidency is often seen as the end of idea that a strongly progressive tax system is a necessity in modern welfare states. Even if it is actually true that during such presidency capital gains started to be taxed with a singular flat tax rate, it is also true that the framework of comprehensive income taxation already had a quite favourable tax treatment of long-term capital gains. The tax system designed under president Regan could be considered (with some caveats due to the incredibly low progressivity of the labour income tax schedule) an ante-litteram DIT application; however, we cannot use include the US in our causal study due to the large tax diversity occurring across the different US states: to the federal income tax each taxpayer has to add also the state income tax. Since income taxation at the state level has an enormous degree of variability,[19] including the US would only add noise to our study. We still decided to present the evolution of the federal income tax due to the political influence that the US has on developed countries.

Before Reagan: somehow comprehensive and progressive tax system

Prior to the reforms of the 1980s, the United States operated a comprehensive income tax system with progressive schedule. The top federal marginal tax rate on ordinary income[20] stood at 70% for high-income earners.[21]

Long-term capital gains, however, were taxed under a distinct and more favourable regime.[22] The taxation of long-term capital gains followed a separate but still progressive

[18] The allowance started as £5,000 in 2016 and was reduced to £2,000 in 2018.

[19] In the US, income taxation at state ranges from no individual income taxation in Alaska, to a tax schedule with a top tax rate higher than 10% in California, New York or New Jersey.

[20] "Ordinary income" meant wages, interest, dividends, and short-term capital gains.

[21] One of the highest top income tax rates among advanced economies (Auerbach and Slemrod 1997).

[22] To qualify as long-term, an asset needed to be held for: more than 6 months before 1977; more than 9 months between 1977 and 1981; more than 12 months after Regan's 1981 Economic Recovery Tax Act (ERTA) reform.

schedule: a 60% exclusion rule applied, in which only 40% of a long-term capital gain was added to taxable income and taxed at ordinary marginal rates. In addition, the tax liability on net capital gains was capped at a maximum marginal rate of 28%, ensuring that even high-income taxpayers did not pay more than this rate on their gains (Auten and Carroll 1999).

In the early 1980s, the top federal CIT rate was 46%, creating a classical system of double taxation: once at the corporate level, and again when profits were distributed as dividends or realized as capital gains.

Reagan's Tax Agenda

The election of President Ronald Reagan marked a major shift in tax policy. The centerpiece of this shift was the Economic Recovery Tax Act of 1981 (ERTA), which not only lowered the top marginal rate on ordinary income from 70% to 50%, but also reduced the top rate on long-term capital gains from 28% to 20% (Auerbach and Slemrod 1997).

This trajectory was reinforced by the Tax Reform Act of 1986 (TRA), one of the most comprehensive overhauls of the U.S. tax system. TRA eliminated many tax shelters, reduced the number of tax brackets, and lowered the top marginal rate on ordinary income further to 28%. At the same time, it repealed the 60% exclusion for long-term capital gains and instead taxed them at a flat rate of 28%, aligning the top rate on capital gains with the top rate on labour income (Auten and Carroll 1999). While this reform temporarily restored formal parity between capital and labour income taxation at the federal level, it also marked the end of the progressive treatment of long-term gains. Capital gains were no longer subject to graduated rates or included proportionally in taxable income—they were now taxed under a separate, flat-rate regime.

The TRA also reduced the top corporate tax rate from 46% to 34%, while maintaining a classical double taxation structure.

Tax Treatment During the 1990s

The Omnibus Budget Reconciliation Act of 1993 increased the top marginal rate on ordinary reversing part of the compression achieved under Reagan. In 1997 an unusual tax policy was approved: the Taxpayer Relief Act of 1997 lowered the top marginal tax rate on long-term capital gains from 28% to 20% for assets held longer than 18 months; but, at the same time, reintroduced some progressivity in the capital gains taxation. Taxpayers in the lowest bracket of ordinary income faced just a 10% tax rate on long-term capital gains (Gale et al. 2019).

Throughout the 1990s, the federal corporate income tax remained fixed at 35%, well above the marginal rates applied to capital gains.

The Bush Reforms: Expansion of Preferential Capital Income Treatment

The early 2000s marked a substantial broadening of preferential treatment for capital income. Under the Jobs and Growth Tax Relief Reconciliation Act of 2003 (JGTRRA), the top marginal rate on long-term capital gains was reduced further from 20% to 15%. More significantly, the reform extended this preferential rate to qualified dividends, which had previously been taxed at ordinary income rates. As a result, both forms of investment income were now taxed under a flat, reduced rate, while labour income remained subject to the progressive rate structure, which reached 35% at the top bracket (Auerbach and Hassett 2007).

A further development came in 2008, when the Tax Increase Prevention and Reconciliation Act of 2005 (TIPRA) introduced a 0% tax rate on long-term capital gains and qualified dividends for taxpayers in the 10% or 15% ordinary income tax brackets (the 2 lowest of the ordinary income tax schedule). In 2008, this applied to individuals with taxable income up to 32 550$ (single filers) or 65 100$ (married couples filing jointly). This addition created a two-bracket structure for capital income, formalizing a progressive schedule: 0% for low-income earners and 15% for all others. It marked the first time since the mid-1990s that long-term capital gains and dividends were taxed at different rates based on income.

During this period, the corporate tax rate remained at 35%, continuing to diverge from the lower personal tax rates on capital gains and dividends.

Obama-Era Adjustments: Reintroducing Progressivity at the Top

Under President Barack Obama, capital income taxation became more progressive for high-income earners. The American Taxpayer Relief Act of 2012, effective from 2013, created a new top marginal rate on long-term capital gains and qualified dividends of 20% for individuals with taxable income above 400,000$ (or 450,000$ for married couples filing jointly) (Ren and Xiao 2014).

In the same year, the Affordable Care Act introduced the Net Investment Income Tax (NIIT), which imposed a 3.8 percentage point surtax on net investment income[23] for individuals with modified adjusted gross income (MAGI) above 200,000$ (or 250,000$ for married couples filing jointly). This surtax was levied in addition to existing statutory rates. The corporate tax rate remained at 35%, continuing to exceed the highest marginal rate on capital income and reinforcing a lack of coordination.

[23]Investment income collects interest, dividends, capital gains, rental income, and passive business income.

The Tax System in 2019: Marginal Adjustments, Not a Dual Tax

The Tax Cuts and Jobs Act (TCJA) of 2017 made the most significant corporate tax reform in decades by permanently lowering the federal corporate income tax rate from 35% to 21%. This brought the CIT much closer to the top personal capital income rate of 20%, reducing the tax gap between retained and distributed profits and improving overall neutrality (Gale et al. 2019).

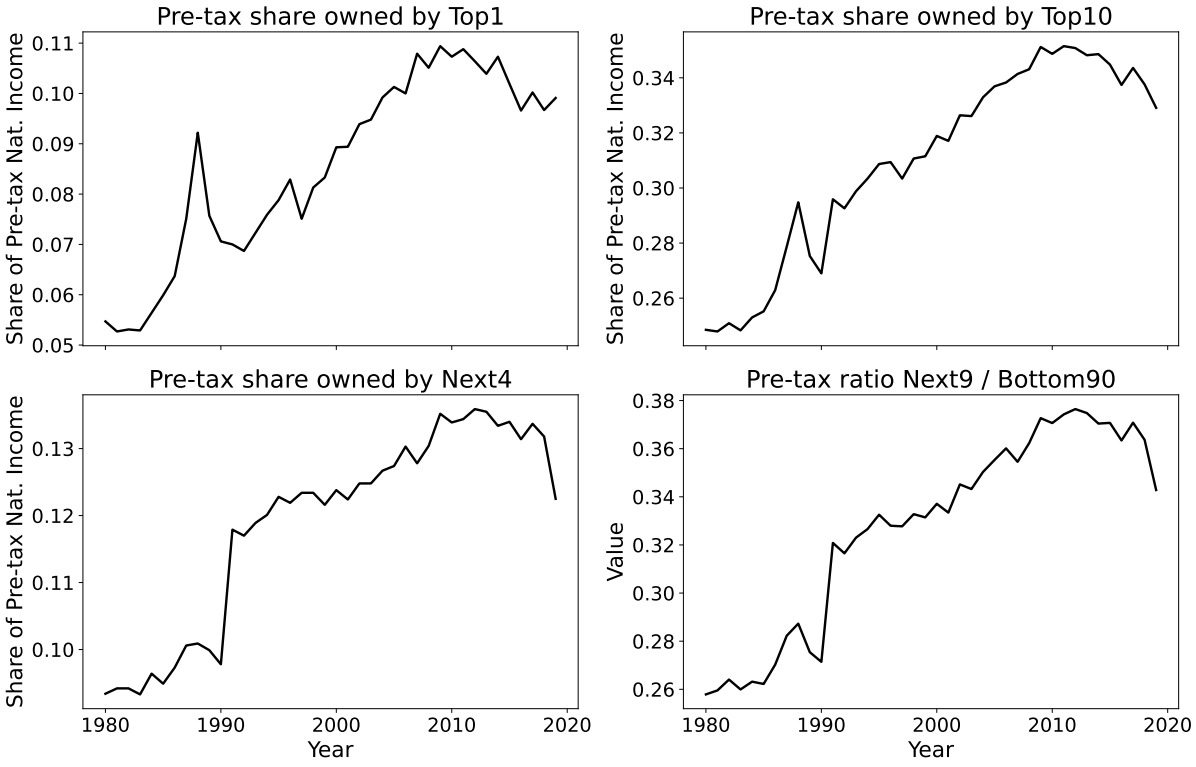
At the personal level, long-term capital gains and qualified dividends continued to be taxed under a tiered structure: 0%, 15%, or 20%, depending on income. Labour income remained subject to a progressive rate schedule, ranging from 10% to 37%. Interest income and non-qualified dividends continued to be taxed at ordinary rates.

Strangely, even if US was the first developed country to dismantle the comprehensive tax system, this process went back and forth ending with a tax system characterised by very low tax rate but with some degree of progressivity also in the capital income taxation.

1.4.4 Countries that never introduced DIT

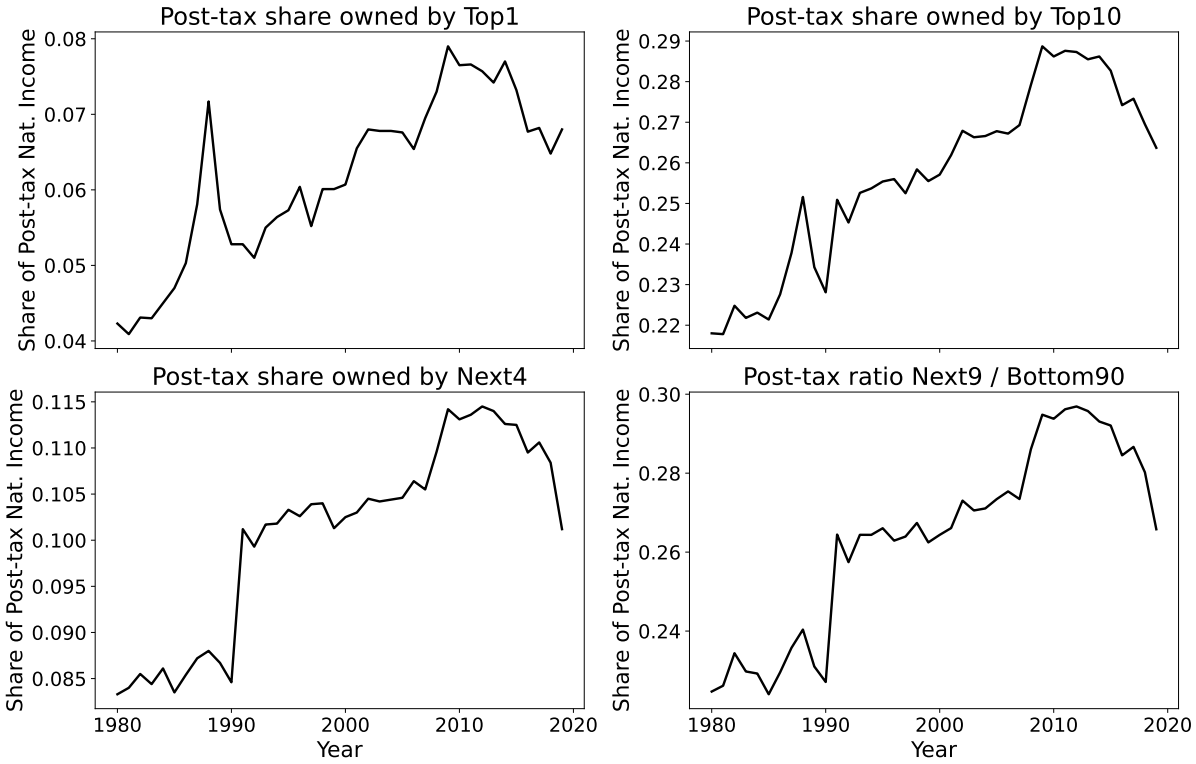
Australia

Figure 1.27: Evolution of some relevant pre-tax income concentration metrics for Australia



Source: own elaboration on WID data.

Figure 1.28: Evolution of some relevant post-tax income concentration metrics for Australia



Source: own elaboration on WID data.

Australia represents an interesting case. Although many developed countries entered the 1980s with a comprehensive tax system and then abandoned it, Australia strengthened its system. Even if it is not a fully fledged SHS income tax system, the progressivity in taxing capital income is still there; therefore, Australia is among our control countries in the causal inference study.

The usual pseudo comprehensive tax system of the 1980s

In the early 1980s, Australia had a comprehensive income tax system in which substantial portions of capital income were exempt: most notably, capital gains were untaxed, unless they were originating from short-term property speculation (Reinhardt and Steel 2006, Fenna 2007)

A turning point came in 1985, when the Australian government implemented a major reform package that included the introduction of a Capital Gains Tax (CGT) and a dividend imputation system. Under the new regime, capital gains on assets acquired after 20 September 1985 became taxable upon realisation, and were integrated into the personal income tax base, taxed at the same marginal rates as labour income. Additionally, the corporate income tax rate was set at 46%, and the newly introduced imputation credit system allowed shareholders to claim credits for corporate tax already paid, effectively

eliminating double taxation of dividends (Reinhardt and Steel 2006, Fenna 2007). These changes broadened the income tax base and aimed to neutralise the tax treatment of different income types.

Adding some leniency in capital income taxation

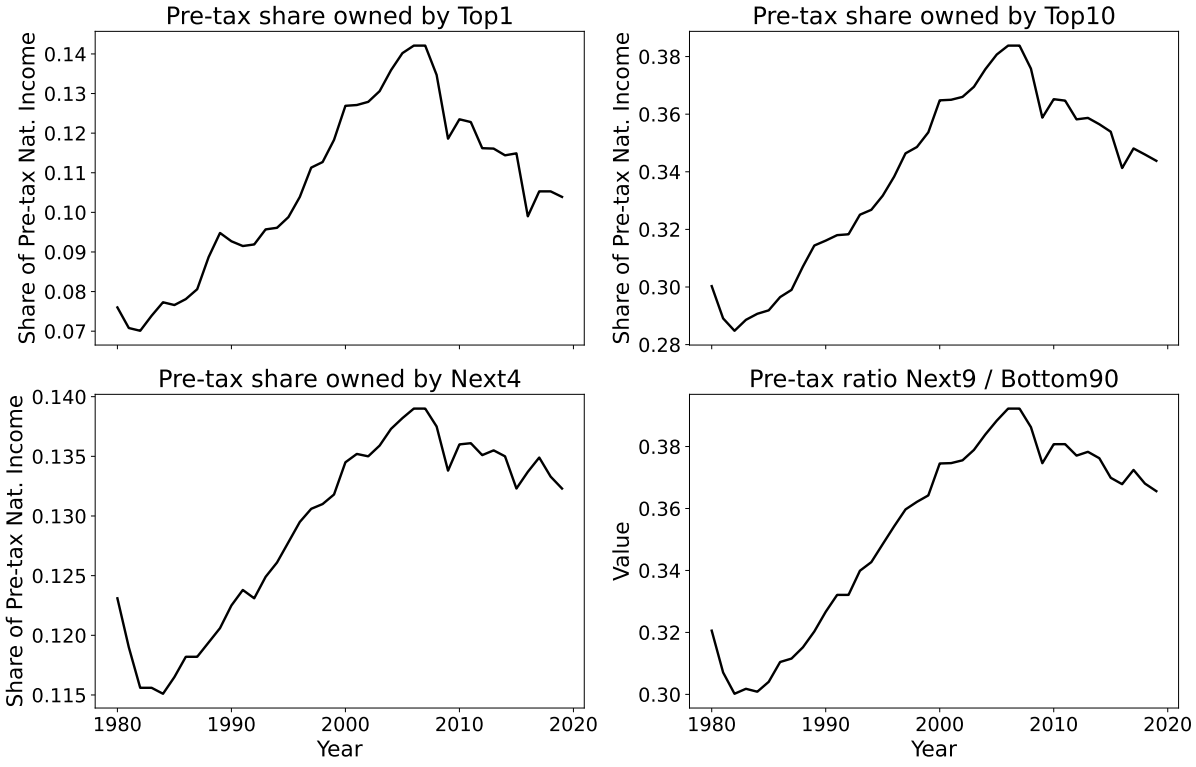
During the 1990s, capital income began to benefit from concessions. The 1999 "Review of business taxation", chaired by John Ralph, proposed to replace the CGT indexation method (which adjusted asset cost bases for inflation) with a 50% discount on nominal capital gains for individuals who held assets for more than 12 months. This reform, legislated that same year, maintained capital gains within the progressive tax schedule but effectively reduced the portion subject to marginal rates (Reinhardt and Steel 2006, Fenna 2007). Labour income remained taxed at progressive marginal rates, with top rates gradually reduced.

The corporate income tax rate was reduced progressively over time, from 46% in the mid-1980s to 36% by 1993, and finally to 30% by 2001.

This SHS tax system with some reliefs towards capital gains was still in place in 2019.

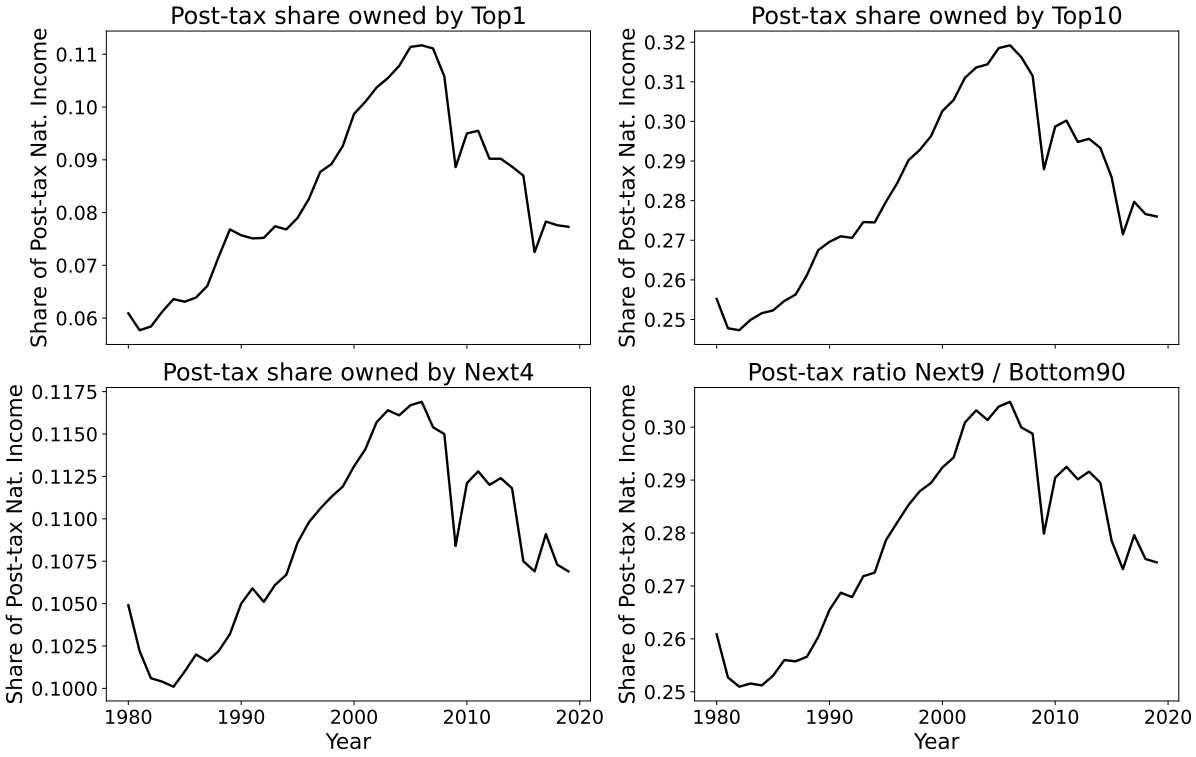
Canada

Figure 1.29: Evolution of some relevant pre-tax income concentration metrics for Canada



Source: own elaboration on WID data.

Figure 1.30: Evolution of some relevant post-tax income concentration metrics for Canada



Source: own elaboration on WID data.

Canada is a bright example of tax policy research: the works of Royal Commission on Taxation are a cornerstone of the study of taxation with a global relevance. Like Australia, Canada is one of the few countries that made a minor modification to its comprehensive tax system trying to protect the core of the tax framework without ignoring the deep changes that the capital market experienced in the globalization era.

Foundations of Capital Income Taxation (1972 Reform)

The foundations of Canada's modern income tax system were laid by the sweeping reforms of 1972, which implemented many of the recommendations of the Royal Commission on Taxation, commonly known as the Carter Commission. Carter Commission represented a landmark effort to modernize Canadian tax policy in light of evolving economic and social conditions. Its work is widely regarded as a milestone in the international study of taxation, not only for its scope and methodological rigour but also for its lasting influence on equity-based approaches to tax design.

Guided by the principle that 'a buck is a buck', the Commission advocated horizontal equity (equal treatment of equal income) and vertical equity (greater contributions from those with higher ability to pay). It proposed a comprehensive income tax base, treating all forms of income as equivalent for tax purposes.

Although not all of its recommendations were adopted, the Commission laid the intellectual groundwork for the Income Tax Reform of 1972, which introduced the taxation of capital gains, modernized the treatment of dividends through a gross-up and tax credit system, and reinforced the progressivity of personal income taxation (Brazer 1967).

It is important to note that, since the reform of 1972, capital gains were never fully taxed: only 50% of realized capital gains were included in personal taxable income and taxed at progressive marginal rates.

The federal corporate income tax (CIT) rate in Canada was initially set at 40% on taxable corporate profits. This rate was applied in addition to provincial corporate income taxes, which varied by province, typically ranging from 10% to 13%, resulting in combined statutory CIT rates around 50%–53% in the early to mid-1970s (Boadway and Kitchen 1999).

The 1972 reform also established a system to reduce the double taxation of dividends: a gross-up and dividend tax credit (DTC) mechanism was introduced. Under this system, dividends received by individuals were grossed up to approximate the underlying corporate pre-tax earnings, and a non-refundable tax credit was provided to represent the corporate tax already paid. This constituted a partial imputation system: while it integrated corporate and personal taxes on distributed profits, it did not fully eliminate double taxation, nor did it refund corporate taxes in cases where the shareholder's personal tax liability was lower than the credit.

Minor changes regarding the capital income taxation

Capital gains, initially taxed on 50% of their value, saw their inclusion rate raised to two-thirds in 1988 and then to 75% in 1990. Then two distinct policy announcements were made, both in 2000: capital gains realized between February 28 and October 17, 2000, were taxed on 66.67% inclusion; gains realized on or after October 18, 2000, were taxed on 50% inclusion. At the end of the 2000 the treatment of capital gains went back to the original rate from the 1972 reform (Department of Finance Canada 2000a, 2000b).

During the year some minor changes to the imputation system and the tax rates were made without changing the core tax system; hence we can say that a comprehensive tax system was still in place in 2019.

New Zealand

New Zealand is often listed among the developed countries that never abandoned its comprehensive income tax system; however, its system never actually taxed capital gains, therefore, we cannot use New Zealand neither as a control nor as a treated unit in both frameworks of our causal inference study.

The Tax System in the 1980s: A Unified and Progressive Structure

During the early 1980s, New Zealand operated a comprehensive and unified income tax system with a strong leniency towards capital gains. Labour income together with dividends and interest were aggregated and taxed under a progressive tax schedule, which ranged from 15% to over 60% in the late 1970s and early 1980s (OECD 1990). Capital gains were generally untaxed, except in narrowly defined situations where they could be classified as income under the so-called intention test, which applied to assets acquired with the clear purpose of resale (Sadiq and Sawyer 2018).

A major turning point came in the 1986–1989 period, when the Fourth Labour Government implemented a sweeping set of tax reforms designed to simplify the tax system and broaden the base. These reforms lowered the top marginal income tax rate from 66% to 33% and reduced the number of income tax brackets, so flattening the progressive rate structure (McLeod et al. 2001). At the same time, the corporate income tax rate was aligned with the top marginal personal income tax rate at 33% (OECD 1996, Sadiq and Sawyer 2018).

The 2007 Reform of the Foreign Investment Fund Regime

A significant development in the taxation of capital income occurred in 2007 with the comprehensive reform of the Foreign Investment Fund (FIF) regime, which governs how New Zealand residents are taxed on portfolio investments in overseas companies. The reform introduced the Fair Dividend Rate (FDR) method as the default taxation rule for most foreign equity investments, excluding shares in certain Australian-listed companies under the trans-Tasman mutual recognition framework. Under the FDR method, taxpayers are deemed to earn an annual return of 5% on the opening market value of their foreign shares, regardless of the actual dividends received or capital gains realized during the tax year (Sadiq and Sawyer 2018).

The FDR regime represented a major shift in both the conceptual and administrative approach to taxing offshore portfolio income. It replaced a previously complex and often burdensome set of rules that required tracking actual income flows, unrealised gains, and changes in valuation across different accounting periods.

Importantly, the FDR method does not apply to domestic investments, which continue to be taxed based on actual dividends and are subject to the imputation credit system.

The Tax System in 2019: Still Largely Comprehensive, but with Dual Features

As of 2019, New Zealand continued to operate a progressive personal income tax system, with capital gains still generally untaxed, unless caught by the intention test. Despite discussions around the introduction of a comprehensive capital gains tax, particularly

following the recommendations of the Tax Working Group (2019), the government chose not to proceed with the reform, citing concerns about complexity and political feasibility.

1.5 Causal inference study

1.5.1 Empirical approach

Our interest lies on the identification of the causal effect that the implementation of a Dual Income Taxation regime has on income concentration. Specifically, we focus on analyzing the effects on the concentration of income, measured as the share of income held by the top 1, 5 and 10% of the population. To identify this impact, we exploit the timing heterogeneity in the implementation of this policy across countries.

To exploit this variation, we consider the estimation of a generalized TWFE Difference-in-Difference model, as well as using an event-study design. The generalized TWFE would potentially identify the average impact that the policy has on income concentration, whereas the event-study design may allow us to identify the short- and long-term effects of this policy. Empirically, these two specifications would be written as follows:

$$\Omega_{i,t} = a_0 + a_1 * DIT_{i,t} + \delta_i + \tau_t + \gamma X + \varepsilon_{i,t} \quad \text{(Generalized TWFE)}$$

$$\Omega_{i,t} = a_0 + \sum_{j=2}^{T_0} a_j DIT_{i,t-j} + \sum_{j=0}^{T_1} b_j DIT_{i,t+j} + \gamma X + \delta_i + \tau_t + \varepsilon_{i,t} \quad \text{(Event-study design)}$$

where $\Omega_{i,t}$ is the income share among the richest 1%, 5%, and 10% of the population. $DIT_{i,t}$ is a dummy that assumes the value of 1 if the country i has implemented the tax regime in year t or earlier. $DIT_{i,t-j}$ and $DIT_{i,t+j}$ represent the leads and lags of the dummy variable, where T_0 and T_1 represent the maximum number of periods a country is observed in the sample before and after the policy is implemented.

Finally, $X's$ are a set of exogenous control variables at the country level that are related to taxation regimes but are not affected by the treatment itself, with δ_i and τ_t representing the country and period fixed effects.

While this empirical approach has been used heavily in the applied econometrics literature, recent developments on the literature of Difference-in-Difference models have raised the problem that neither of these two approaches would properly identify Average treatment effects on treated (ATTs), in presence of heterogeneous effects, with staggered treatment timing (see Sun and Abraham, 2021; Callaway and Sant'Anna, 2021; Goodman-Bacon, 2021; among others).

In principle, the TWFE-DID approach fails to identify ATTs because the way linear regression identifies the impact of the treatment effect ends up using early treated units as part of the controls for later treated units. This can potentially violate the parallel

trends assumption, which is crucial for the identification of the treatment effects. Only when treatment effects are homogeneous would TWFE-DID identify average treatment effects Goodman-Bacon (2021).

Although dynamic specifications that include leads and lags of the treatment of interest have better properties for identifying treatment effects based on the relative timing, research by Sun and Abraham (2021) has also found that such specification may also be subject to contamination, similar to the TWFE-DID approach. To avoid this problem, Sun and Abraham (2021) and Wooldridge (2021) suggest using a specification that fully interacts cohort and timing indicators.

To avoid the problems raised by the literature regarding the weaknesses of the traditional TWFE-DID specification and event-study design, we opt to apply two of the novel approaches introduced in the literature. This is the estimation strategy proposed in Callaway and Sant'Anna (2021), as well as the two-step imputation approach proposed by Gardner (2022) and Borusyak et al. (2024).

1.5.2 Assumptions and Estimation

For the identification of treatment effects, both estimation approaches rely on two important assumptions.

- The first one is the *Stable Unit Treatment Value Assumption* or SUTVA. This assumption implies that the potential outcomes of individuals are not affected by the treatment status of other units in the sample. In other words, there are no spillover effects that would propagate across countries.
- Second, we require the *Parallel Trends Assumption* or PTA. This assumption implies that in the absence of treatment, the outcomes of both treated and control units would have followed the same path. Thus, observed changes among control units could be used to impute potential outcomes in the absence of treatment among treated units. In turn, this is used to identify average treatment effects.

Although both estimation strategies rely on the same assumptions for the identification of ATTs, empirically, they use different versions of the PTA. The estimator proposed by Callaway and Sant'Anna (2021) breaks down the estimation process by focusing on identifying all valid $2x2$ DID designs that identify the treatment effects for cohort G (countries treated in year G) at time t.

$$ATT(G,T) = E(Y_t - Y_{g-1}|g = G) - E(Y_t - Y_{g-1}|g = 0) \tag{1.2}$$

This uses a weaker PTA assumption that only requires parallel trends to be observed after treatment takes place. After all relevant ATT(G,T)'s are estimated, average treatment effects, as well as dynamic effects can be obtained using weighted averages.

While this approach is robust to PTA violations that could have occurred before treatment takes place, the added flexibility that comes from treating each $2x2$ design separately demands more data if one needs to control for covariates in the model specification. Essentially, the number of controls that can be used in the estimation should be less than the minimum number of observations across all cohort and periods in the data. Because of this, we cannot control for any variables when implementing Callaway and Sant'Anna (2021)'s estimator.

The second estimator we implement, as a robustness to the findings based on Callaway and Sant'Anna (2021), is using the approach suggested by Gardner (2022) and Borusyak et al. (2024).

Similarly to Callaway and Sant'Anna (2021), this approach aims to avoid the problems associated with the TWFE-DID and event studies design by separating the identification problem in two steps. The first step aims to model potential outcomes in the absence of treatment using all units that were never treated or those that are not yet treated.

$$Y_{i,t} = X_{i,t} * \beta + \delta_i + \tau_t + e \qquad if\ trt_{i,t} = 0 \tag{1.3}$$

Under the assumption that the estimated model identifies the potential outcomes in absence of treatment for all eventually treated units, the ATT's for any post period and unit can be simply estimated as:

$$ATT_{i,t} = Y_{i,t} - \hat{Y}_{i,t}\ if\ trt_{i,t} = 1 \tag{1.4}$$

For statistical inference, this unit-period level ATT can be aggregated as needed, in a similar way as Callaway and Sant'Anna (2021) do with the ATT(G,T)s.

Because this approach uses more observations simultaneously in the first step, it provides some gains in efficiency compared to Callaway and Sant'Anna (2021). Furthermore, it allows us to add controls to the model specification, which would improve the identification of the treatment effects. However, it is important to understand that this estimator relies on the strong parallel trends assumption. In other words, because it uses information from all not-yet treated units across all periods to identify potential outcomes in absence of treatment, the estimator requires that PTA to hold across all pre and post treatment periods.

1.5.3 Data sources and descriptive statistics

Our dataset contains 15 countries for the period 1980-2019; 11 of which are *treated* (meaning that at some point in the time span considered they introduce DIT), and 4 are untreated. The *relaxed* framework includes the full dataset of 15 countries, whereas the *strict* one only includes a subset of it, containing 8 countries. The main variables in our

data set are: (1) different measures of pre-tax and post-tax income concentration; (2) several characteristics of the country to be used as controls and (3) labels of countries, for each year, following our newly introduced taxonomy in 1.3.3. The label assignment was made possible only thanks to the in-depth analysis conducted in Section 1.4.

Table 1.3: Summary Statistics of Economic Indicators

Indicator	**Mean**	**Median**	**Std. Dev.**
GDP per capita, curr. prices (IMF)	29,108.39	25,650.71	16,847.58
Real GDP growth (IMF)	2.27	2.40	2.23
Unemployment rate (IMF)	7.66	7.10	4.05
Current account balance, % of GDP (IMF)	0.50	−0.10	4.30
Labour share of GDP, curr. prices (PWT)	0.590	0.588	0.053
Capital services index, 2017=1 (PWT)	0.664	0.649	0.226
Total factor productivity index, 2017=1 (PWT)	0.983	0.982	0.092
Human capital index (PWT)	3.15	3.17	0.35
Average annual hours worked (PWT)	1,728.70	1,742.93	191.93
Real internal rate of return, % (PWT)	0.074	0.070	0.023
Depreciation rate of capital, % (PWT)	0.036	0.036	0.005
GDP price level (PPP, 2017=1) (PWT)	0.787	0.812	0.230
Population, millions (PWT)	34.56	16.96	34.58
Employment, millions (PWT)	16.03	8.68	17.34
GDP per capita, real USD (WDI)	34,908.23	33,011.13	12,313.28
Log real GDP per capita (WDI)	10.40	10.41	0.35
Inflation, consumer prices, annual % (WDI)	6.04	2.37	23.33
Exports, % of GDP (WDI)	31.14	28.80	13.72
Gross capital formation, % of GDP (WDI)	23.60	23.41	3.66
Total tax revenue, % of GDP (OECD)	36.80	38.55	6.54

Data sources and construction

The key sets of features we included in the data set can be grouped into 3 categories.

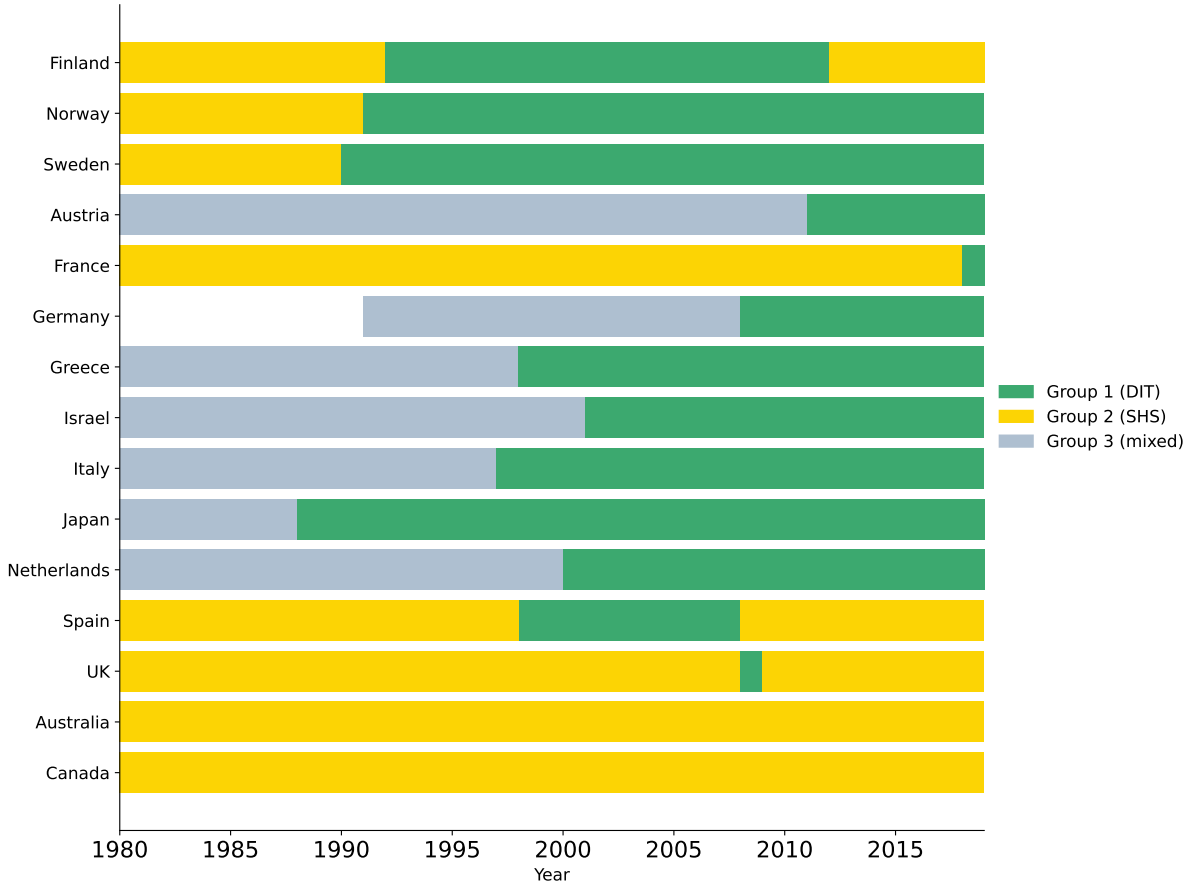
- **Income concentration** To measure the causal effect of DIT on income concentration, we include in our dataset measures of the share of total pretax national income [24] coming from the World Inequality Database (Alvaredo, Atkinson et al. 2024). For example, we include the share of total pre-tax national income captured by the top 1%, 5%, and 10% earners. This allows us to effectively measure the change in income concentration among the richest.
- **Country characteristics** As control, we include indicators of the countries (e.g. GDP, GPD growth, unemployment rate, inflation, population, etc.) retrieved from

[24]Pretax, post-replacement national income is the total income people receive from labor and capital before taxes and transfers, but after social insurance benefits, as defined in the World Inequality Database

the World Bank (World Development Indicators dataset), together with IMF (from the World Economic Outlook of April 2025), Penn World Table (Feenstra, Inklaar et al. 2015) and OECD (Revenue statistics). The inclusion of such variables is useful to control for potentially confounding factors that could bias our conclusions regarding the effect of the introduction of the DIT on capital concentration.

- **Assigned group** As described in-depth in 1.3.3, in this work, we introduce a taxonomy grouping tax systems in 3 categories: (1) tax systems with flat taxation of all capital income (DIT or variations of it); (2) fully fledged comprehensive income tax systems (SHS or variations of it); (3) Countries with mixed elements.

Figure 1.31: Classification of the countries of the dataset following our taxonomy defined in 1.3.3



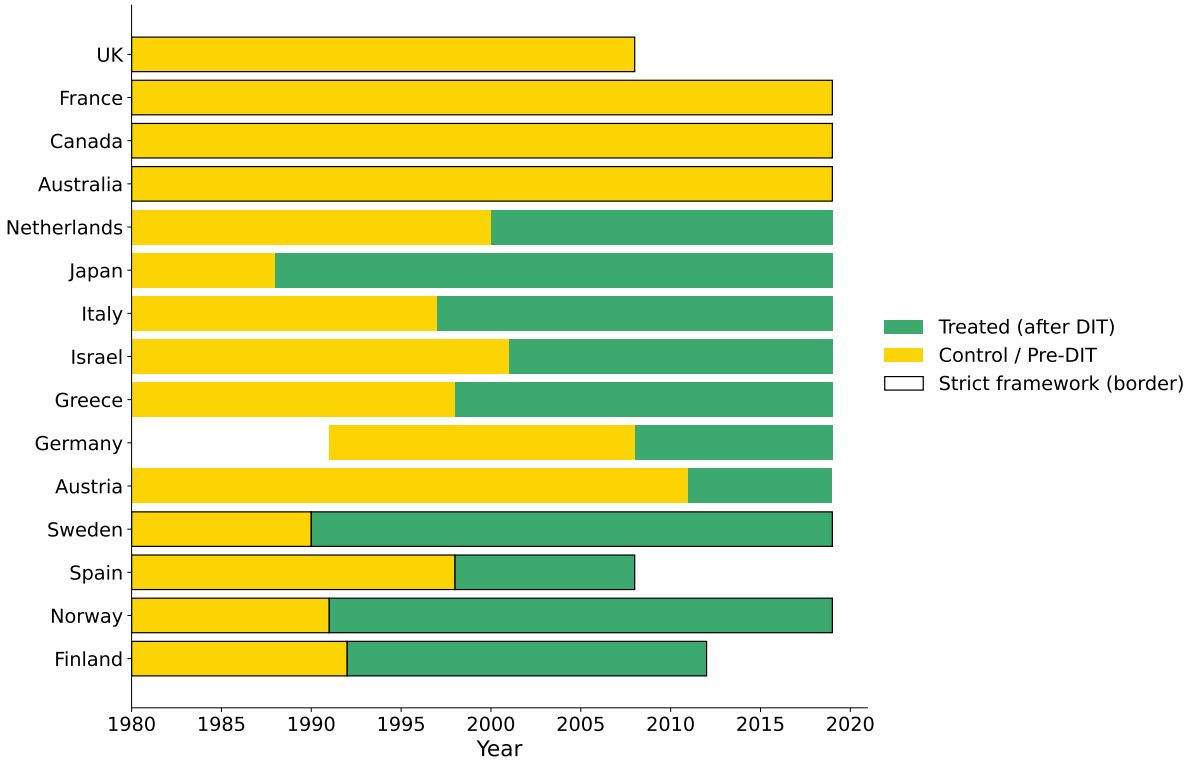
Denmark is not included, it is considered a special case given it is debated whether its system can be considered a DIT or not, as described in 1.4.1.

The figure 1.31 gives a clean visual of the wave of DIT implementation reforms:

- Early pioneers (late 80s - early 90s): Sweden, Finland, Norway, Japan
- Late 1990s cluster: Greece, Italy, Spain
- 2000s: Germany (2009), Netherlands, Israel, UK

- Late comers: Austria (2012) and France (2019).

Figure 1.32: Treated and control countries in both our frameworks.



Given the classification of the countries in the tax system groups, we choose treated and control countries for the relaxed and strict framework.

Fig. 1.32 shows the treated and control countries in both our frameworks. A country is considered *relaxedly treated* if they implement a flat tax on capital income, it does not matter which tax system they had in place before; instead, a country is considered *strictly treated* if they implement DIT and their previous tax system was a SHS. The cases of UK and France are peculiar in the sense that they do implement a flat tax on capital income but we do not consider the post-DIT years as explained in 1.4.

Since the number of units is very limited. we use the "not yet treated" countries as part of the control group.

Rationales for the controls

We report here the rationales for the inclusion of the control variables. Each group of variable was included because of a reasonable hypothesis for why the variable could potentially bias the effect of the DIT on income concentration.

- **H1: Business-cycle conditions**. Capital gains and asset prices rise more quickly than wages during robust expansions. Booms increase the wealthiest households'

Table 1.4: Overview of the dataset

Measure	Value
Number of country–years	557
Number of countries	15
Time span	1980–2019
Treated countries (relaxed framework)	11
Treated countries (strict framework)	4
Never treated countries	4
Median adoption year among adopters	1998
Number of candidate control vars.	20
Number of candidate dependent vars.	38

share of the national income as they already control the majority of marketable assets. Included controls: Real GDP growth %, Unemployment rate, Inflation rate, Real GDP per capita

- **H2: External balance and openness**. Open economies with large external imbalances give wealthy residents more possibilities to shift portfolios abroad or draw on foreign capital. These channels can dilute or amplify the effect of DIT on domestic asset accumulation at the top. Included controls: Current account balance, as a % of GDP, Exports of goods and services as a % of GDP
- **H3: Factor-input composition and productivity**. A low labour share and a production structure rich in capital services tilt income toward capital owners who are overwhelmingly in the top percentiles. Higher TFP or human capital gains can likewise raise the returns to capital (or super-skilled labour). Included controls: Share of labour compensation in GDP at current national prices, Capital services at constant 2017 national prices (2017=1), Total factor productivity at constant national prices (2017=1), Human capital index, based on years of schooling and returns to education, Average annual hours worked by persons engaged
- **H4: Investment climate and user cost of capital** Because the rich own most investable assets, a high internal rate of return (IRR) increases their capital income relative to wages. DIT taxes labour and capital differently, so its toll on top-end wealth will vary with the return environment. Included controls: Real internal rate of return on capital, in percent; Average depreciation rate of the capital stock; Gross capital formation (% of GDP); Price level of CGDPo (PPP/XR), price level of USA GDPo in 2017=1 (measures how expensive a country is relative to the U.S., based on its price level of output, not consumer goods)
- **H5: Scale and demographic structure** The size of the country and the average income shape both the tax policy design and the concentration of wealth itself. More populous economies could spread capital ownership across a broader population, reducing the concentration at the top, or create conditions that allow large fortunes

to expand even further. Included controls: Population, in millions; Number of persons employed, in millions; GDP per capita, current prices; total tax revenue as a percentage of GDP.

1.5.4 Relaxed Framework - The income concentration effect of introducing DIT

In the relaxed framework, we examine the impact of the introduction of a flat taxation on capital income across all 15 countries in our sample, regardless of their tax system design before the reform.

This approach aims at capturing the effect of introducing a dual income taxation, without a particular pre-reform context.[25]

Callaway Sant'Anna estimation

Table 1.5: Relaxed Framework - Effect of DIT Introduction on Post-Tax Income Concentration: Callaway Sant'Anna Estimator. Window (-5,5)

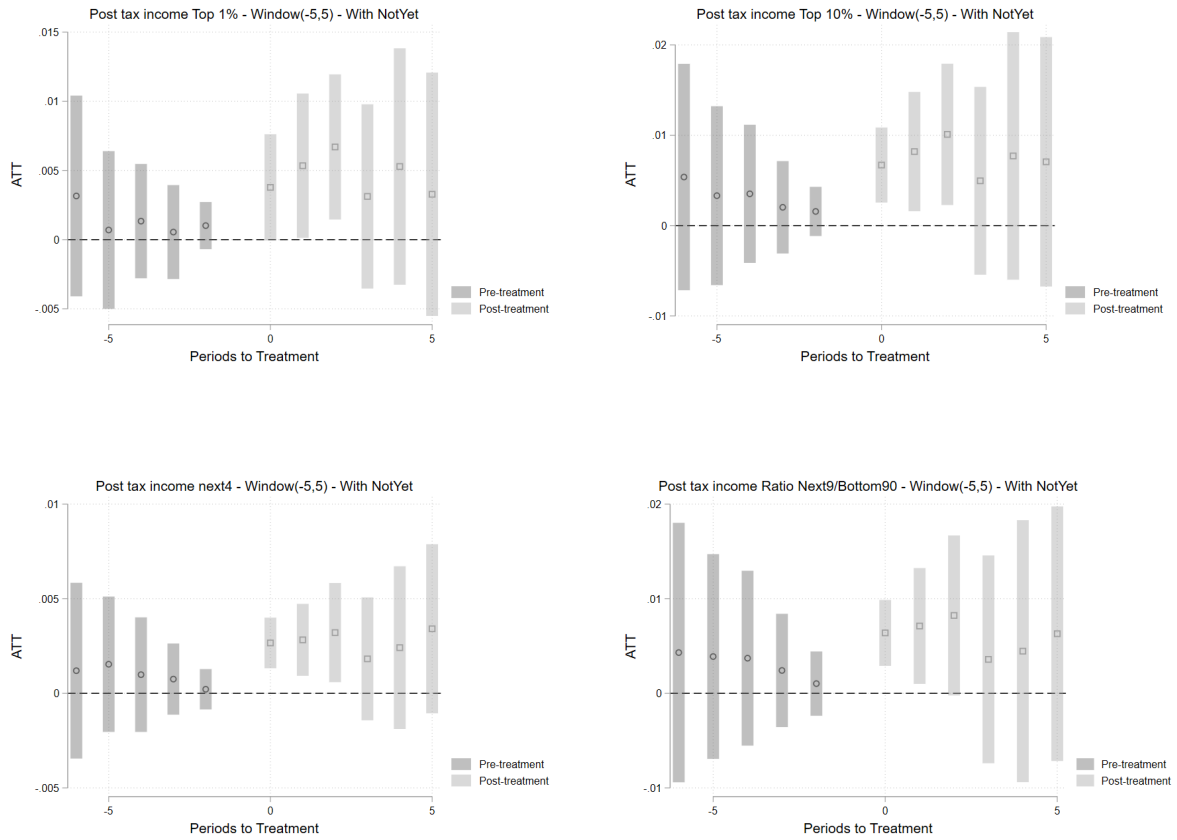
	Top 10%	Top 1%	Next 4%	Next9/Bottom90
Overall ATT	0.0067*	0.0050*	0.0015	0.0041
	(0.0050)	(0.0032)	(0.0024)	(0.0041)
	[-0.0031, 0.0165]	[-0.0013, 0.0113]	[-0.0032, 0.0062]	[-0.0039, 0.0121]
Short-term ATT (0-2 years)	0.0095**	0.0066**	0.0027	0.0024
	(0.0044)	(0.0027)	(0.0018)	(0.0025)
	[0.0009, 0.0181]	[0.0013, 0.0119]	[-0.0008, 0.0062]	[-0.0025, 0.0073]
Medium-term ATT (3-5 years)	0.0039	0.0034	0.0009	0.0015
	(0.0064)	(0.0045)	(0.0023)	(0.0029)
	[-0.0086, 0.0164]	[-0.0054, 0.0122]	[-0.0036, 0.0054]	[-0.0042, 0.0072]
Control Variables	No	No	No	No
Observations	557	557	557	557
Control Method	Not-yet-treated	Not-yet-treated	Not-yet-treated	Not-yet-treated

Source: Our own elaboration.
Robust standard errors in parentheses. 95% confidence intervals in brackets. * p<0.10, ** p<0.05, *** p<0.01. Sample covers 15 OECD countries, 1980-2019. Treatment is DIT introduction. Method uses not-yet-treated units as control.

The Callaway and Sant'Anna estimator shows an increase in income concentration following DIT introduction which is statistically significant but modest in size. As shown in Table 1.5, the overall average treatment effect indicates that the top 10% income share increases by 0.67 percentage points, while the top 1% share rises by 0.50 percentage points.

[25]However, it is also true that we considered for our analysis only developed countries.

Figure 1.33: Relaxed Framework - Callaway Sant'Anna event study plots for 4 relevant income concentration variables



Source: Our own elaboration.

Table 1.6: Relaxed Framework - Callaway Sant'Anna Dynamic Treatment Effects (Event Study Results). Window (-5,5)

Period	Top 10%	Top 1%	Next4%	Next9/Bot90
Pre-treatment Average	0.0132***	0.0089***	0.0009	0.0031
	(0.0043)	(0.0019)	(0.0013)	(0.0040)
t-5	0.0199***	0.0127***	0.0015	0.0039
	(0.0056)	(0.0027)	(0.0018)	(0.0055)
t-4	0.0149**	0.0100***	0.0010	0.0037
	(0.0062)	(0.0029)	(0.0015)	(0.0047)
t-3	0.0079***	0.0057***	0.0008	0.0024
	(0.0026)	(0.0014)	(0.0010)	(0.0031)
t-2	0.0013	0.0015	0.0002	0.0010
	(0.0027)	(0.0013)	(0.0005)	(0.0017)
Post-treatment Average	0.0144*	0.0031	0.0027	0.0060
	(0.0075)	(0.0037)	(0.0014)	(0.0044)
t+0	0.0085***	0.0231*	0.0027***	0.0064***
	(0.0024)	(0.0131)	(0.0007)	(0.0018)
t+1	0.0122**	0.0277	0.0028**	0.0071**
	(0.0058)	(0.0284)	(0.0010)	(0.0031)
t+2	0.0128	0.0304	0.0032*	0.0082*
	(0.0085)	(0.0394)	(0.0013)	(0.0043)
t+3	0.0122	0.0191	0.0018	0.0036
	(0.0076)	(0.0409)	(0.0016)	(0.0056)
t+4	0.0207**	0.0468	0.0024	0.0045
	(0.0093)	(0.0470)	(0.0022)	(0.0071)
t+5	0.0199	0.0383	0.0034	0.0063
	(0.0121)	(0.0595)	(0.0023)	(0.0069)

Source: Our own elaboration.
Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

In other words, if the top 10% initially held 30% of total income, this implies a rise to approximately 30.7%, which corresponds to a 2.2% relative increase in their share; while, for the top 1% we see a 0.50 percentage point rise from a baseline of 10% represents a 5% relative increase. These effects are small but not negligible, showing that the introduction of DIT has a causal effect on the income distribution.

We find particularly informative the temporal pattern of effects. In fact, the short-term impacts (0–2 years post-reform) are both larger and statistically stronger than the longer-term ones. The top 10% share increases by 0.95 percentage points and the top 1% share by 0.66 percentage points. This could imply that the effects of the tax reform arrive quickly and then stabilise, probably because of responses in behaviour from the citizens to the new fiscal structure, or that already after a couple of years our macrodata are influenced by factors that we do not control for, making our estimation too imprecise.

Medium-term effects (3 to 5 years after reform) become smaller and statistically insignificant.

Figure 1.33 shows these patterns through event study plots, which reveal increases right after the tax reform, and a flattening trend afterwards. It is important to note that the pre-treatment confidence intervals support the parallel trends assumption critical for causal identification in Difference-in-Differences designs.

Two-step DiD estimastion

The two-step Difference-in-Differences estimator, which allows the inclusion of control covariates, mainly confirms the findings of the Callaway and Sant'Anna approach. We report in Table 1.7 the overall effects, which are of similar magnitude: 0.67 percentage point increase for the top 10%, and 0.50 percentage points for the top 1%.

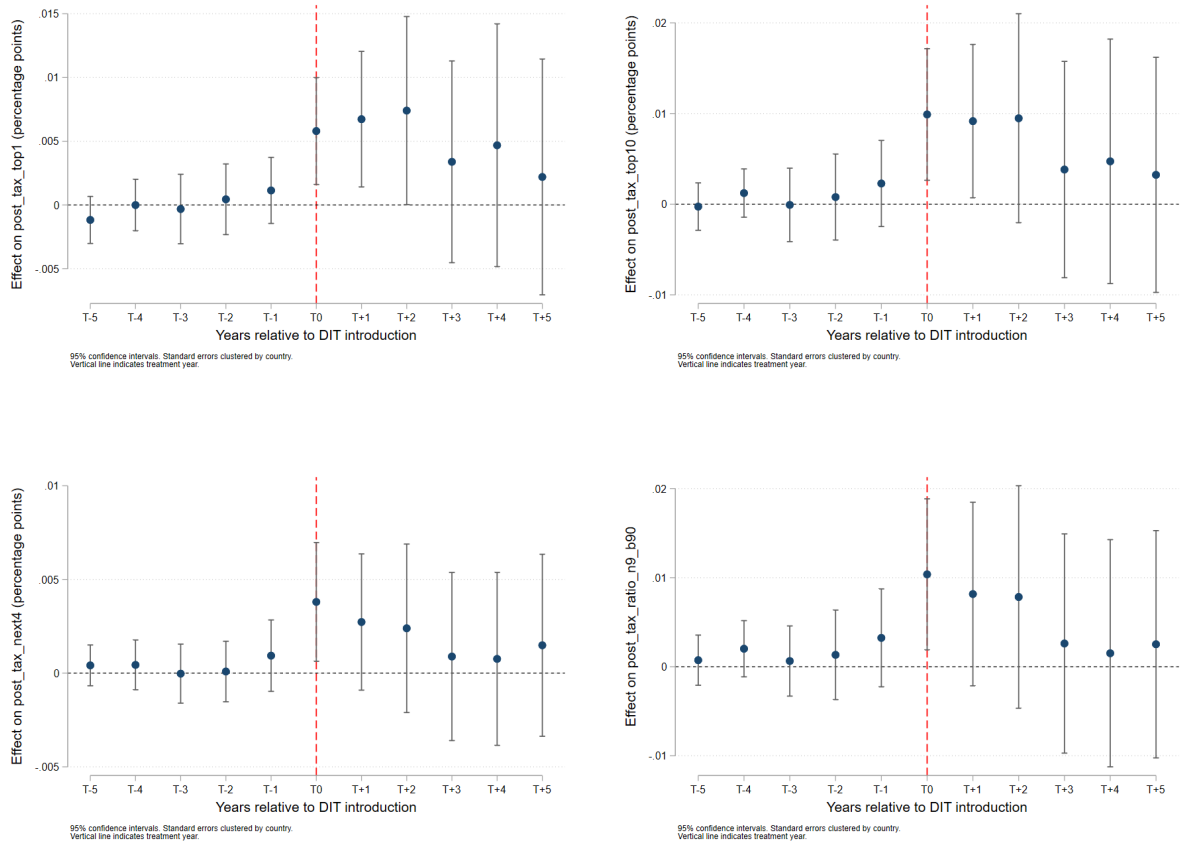
The inclusion of control variables such as economic factors, business cycle indicators, development measures, and production structure variables does not significantly alter the estimated causal effects. This supports our causal interpretation by reducing the risk that the omitted variable bias drives the estimated effects.

Figure 1.34 presents the coefficients from the event study, which confirm the previous findings: significant and rapid increases in top income shares, followed by a gradual decrease pattern. The stability of these patterns across two different estimators increases our confidence in the direction of the effect.

Robustness checks

To additionally confirm the stability of the results, we run robustness checks. Table 1.9 reports alternative specifications for the Callaway and Sant'Anna estimator. In all models, we see that the direction of the treatment effect is positive, but the magnitude and statistical significance vary.

Figure 1.34: Relaxed Framework - Two-Stage DID event study plots for 4 relevant income concentration variables



Source: Our own elaboration.

Table 1.7: Relaxed Framework - Effect of DIT Introduction on Post-Tax Income Concentration: Two-Stage DID Estimator. Window (-5,5)

	Top 10%	Top 1%	Next 4%	Next9/Bottom90
Overall ATT	0.0067*	0.0050*	0.0019	0.0041
	(0.0050)	(0.0032)	(0.0022)	(0.0038)
	[-0.0031, 0.0165]	[-0.0013, 0.0113]	[-0.0024, 0.0062]	[-0.0033, 0.0115]
Short-term ATT (0-2 years)	0.0095**	0.0066**	0.0028	0.0025
	(0.0044)	(0.0027)	(0.0019)	(0.0027)
	[0.0009, 0.0181]	[0.0013, 0.0119]	[-0.0009, 0.0065]	[-0.0028, 0.0078]
Medium-term ATT (3-5 years)	0.0039	0.0034	0.0012	0.0015
	(0.0064)	(0.0045)	(0.0025)	(0.0031)
	[-0.0086, 0.0164]	[-0.0054, 0.0122]	[-0.0037, 0.0061]	[-0.0046, 0.0076]
Control Variables	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	557	557	557	557

Source: Our own elaboration.
Standard errors clustered at country level in parentheses. 95% confidence intervals in brackets. * p<0.10, ** p<0.05, *** p<0.01. Sample covers 15 OECD countries, 1980-2019. Treatment is DIT introduction. Control variables include: business cycle (real GDP growth, unemployment rate, CPI inflation), development level (GDP per capita, human capital index, population), and production structure (labour share, TFP index, capital services index, average hours worked).

For example, the top 1% share shows a baseline increase of 1.10 percentage points, which is statistically significant. This means it's a relative increase of approximately 11

In Table 1.10, we show robustness checks for the two-stage DiD estimator in different model specifications. The treatment effects range from 0.13 to 0.85 percentage points for the top 10% share. The coefficient of variation (reported in Table 1.11) is between 0.45 to 0.67, telling us that the model is moderately sensitive to specification choices.

In conclusion, the results of the two indicators are consistent and statistically significant, but the exact size of the effect should be interpreted with caution, as it is sensitive to model assumptions.

1.5.5 Strict Framework - The income concentration effect of transitioning from SHS to DIT

The strict framework consists of a narrower but more targeted analysis. In fact, it focuses on countries that transitioned from a fully comprehensive (progressive) taxation of capital income to a flat taxation. By excluding the countries having a broader set of pre-reform fiscal policies, we isolate better the effect of the removal of progressivity in capital income taxation. Since we only limit the sample to the eight countries that had a 'clean' transition, the price to pay is a reduced statistical power, given the small number of treated units.

Table 1.8: Relaxed Framework - Two-Stage DID Dynamic Treatment Effects (Event Study Results). Window (-5,5)

Years Relative to DIT	Top 10%	Top 1%	Next 4%	Next9/Bottom90
T-5	−0.0003	−0.0012	0.0004	0.0003
	(0.0013)	(0.0009)	(0.0006)	(0.0013)
T-4	0.0012	−0.0000	0.0004	−0.0012
	(0.0014)	(0.0010)	(0.0007)	(0.0014)
T-3	−0.0001	−0.0003	−0.0000	0.0001
	(0.0021)	(0.0014)	(0.0008)	(0.0021)
T-2	0.0008	0.0004	0.0001	−0.0008
	(0.0024)	(0.0014)	(0.0008)	(0.0024)
T-1	0.0023	0.0011	0.0009	−0.0023
	(0.0024)	(0.0013)	(0.0010)	(0.0024)
T0	**0.0099*****	**0.0058*****	**0.0038****	**−0.0099*****
	(0.0037)	(0.0021)	(0.0016)	(0.0037)
T+1	0.0092**	0.0067**	0.0027	−0.0092**
	(0.0043)	(0.0027)	(0.0019)	(0.0043)
T+2	0.0095*	0.0074**	0.0024	−0.0095*
	(0.0059)	(0.0038)	(0.0023)	(0.0059)
T+3	0.0038	0.0034	0.0009	−0.0038
	(0.0061)	(0.0040)	(0.0023)	(0.0061)
T+4	0.0047	0.0047	0.0008	−0.0047
	(0.0069)	(0.0049)	(0.0024)	(0.0069)
T+5	0.0032	0.0022	0.0015	−0.0032
	(0.0066)	(0.0047)	(0.0025)	(0.0066)

Source: Our own elaboration.
Robust standard errors clustered at country level in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 1.9: Relaxed Framework - Callaway Sant'Anna Robustness Checks: Alternative Specifications

(a) Top 1% Income Share

	Baseline (-5,+5)	Extended (-7,+7)	No NotYet (-5,+5)
ATT	0.0110*	0.0110*	0.0137***
	(0.0055)	(0.0055)	(0.0056)
95% CI	[0.0002,	[0.0002,	[0.000395,
	0.0218]	0.0218]	0.0223]
p-value	0.046	0.046	0.043
Observations	556	556	556

(b) Top 10% Income Share

	Baseline (-5,+5)	Extended (-7,+7)	No NotYet (-5,+5)
ATT	0.0220**	0.0220**	0.0213**
	(0.0094)	(0.0094)	(0.0098)
95% CI	[0.0036,	[0.0036,	[0.0022,
	0.0404]	0.0404]	0.0404]
p-value	0.019	0.019	0.029
Observations	556	556	556

(c) Next4% Income Share

	Baseline (-5,+5)	Extended (-7,+7)	No NotYet (-5,+5)
ATT	0.0054	0.0054	0.0052
	(0.0034)	(0.0034)	(0.0035)
95% CI	[-0.0012,	[-0.0012,	[-0.0017,
	0.0121]	0.0121]	0.0121]
p-value	0.107	0.107	0.139
Observations	556	556	556

(d) Next9/Bottom90 Ratio

	Baseline (-5,+5)	Extended (-7,+7)	No NotYet (-5,+5)
ATT	0.0127	0.0127	0.0097
	(0.0104)	(0.0104)	(0.0067)
95% CI	[-0.0078,	[-0.0078,	[-0.0033,
	0.0331]	0.0331]	0.0228]
p-value	0.224	0.224	0.144
Observations	556	556	556

Source: Our own elaboration.
Robustness checks comparing baseline specification with extended window and alternative control group. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Callaway Sant'Anna estimation

The strict framework yields substantially larger estimated effects than those observed in the relaxed setup. As shown in Table 1.12, the top 10% income share increases by 2.20 percentage points, and the top 1% share by 1.04 percentage points.

An increase from 30% to 32.2% in the top 10% share represents a 7.3% relative gain in their share of total income, which represents a modest but meaningful redistribution. Similarly, a 1.04-point rise from a 10% baseline for the top 1% translates into a 10.4% relative increase. This result is in line with the expectation that regressive tax reforms usually benefit top earners.

We show the results of the event study in Table 1.13. These results suggest that the effects increase gradually over time, with the largest impacts emerging 4 to 5 years after the reform implementation even if those mean values have very large confidence intervals.

Two-step DiD estimastion

In contrast with the results in 1.5.5, the two-step DiD approach produces different findings for the strict framework. As we show in Table 1.15, estimated treatment effects are very small and statistically insignificant across all measures of income concentration. The top 10% effect is close to zero (0.01 percentage points), and other indicators show similar close results.

This discrepancy between our two methodologies raises some concerns about the ro-

Table 1.10: Relaxed Framework - Two-Stage DID Robustness Checks: Alternative Specifications

Specification	Post-tax Top 10%	Post-tax Top 1%	Post-tax Next 4%	Post-tax Ratio N9/B90
Spec 1: Baseline	0.0081**	0.0051	0.0033*	0.0071
	(0.0053)	(0.0035)	(0.0019)	(0.0055)
Spec 2: Production	0.0013	0.0008	0.0007	0.0004
	(0.0058)	(0.0034)	(0.0022)	(0.0065)
Spec 3: Capital	0.0034	0.0016	0.0018	0.0038
	(0.0049)	(0.0028)	(0.0021)	(0.0055)
Spec 4: External	0.0023	0.0011	0.0014	0.0024
	(0.0056)	(0.0032)	(0.0022)	(0.0059)
Spec 5: Main	0.0071	0.0048	0.0028	0.0054
	(0.0063)	(0.0038)	(0.0024)	(0.0072)
Spec 6: Capital+	0.0085*	0.0052*	0.0035*	0.0079
	(0.0052)	(0.0030)	(0.0021)	(0.0062)
Spec 7: Supply	0.0030	0.0017	0.0012	0.0028
	(0.0048)	(0.0028)	(0.0021)	(0.0059)
Spec 8: Open	0.0071	0.0045	0.0030	0.0063
	(0.0061)	(0.0036)	(0.0022)	(0.0065)

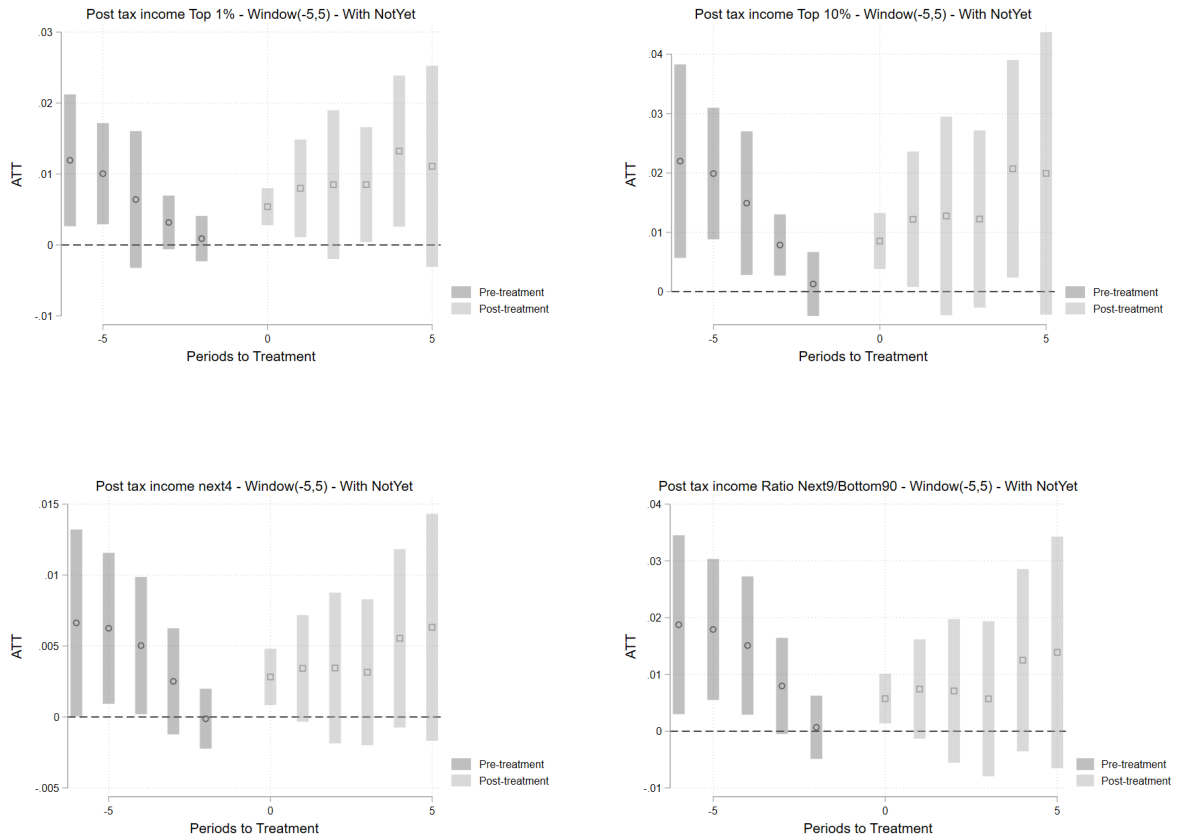
Source: Our own elaboration.
Standard errors in parentheses, clustered by country. Effects represent the average treatment effect over a 6-year post-treatment window (T0 to T+5). All regressions include country and year fixed effects.
Specifications: Spec 1 (Baseline): business cycle + development; Spec 2 (Production): business cycle + production structure; Spec 3 (Capital): business cycle + capital markets; Spec 4 (External): business cycle + external balance; Spec 5 (Main): business cycle + development + production; Spec 6 (Capital+): business cycle + development + capital; Spec 7 (Supply): business cycle + production + capital; Spec 8 (Open): business cycle + development + external.
* p<0.10, ** p<0.05, *** p<0.01.

Table 1.11: Relaxed Framework - Two-Stage DID Summary Statistics: Coefficient Stability Across Specifications

Outcome Variable	Mean	Std. Dev.	Min	Max	CV
Post-tax Top 10%	0.0047	0.0029	0.0013	0.0085	0.62
Post-tax Top 1%	0.0030	0.0020	0.0008	0.0052	0.67
Post-tax Next 4%	0.0020	0.0009	0.0007	0.0035	0.45
Post-tax Ratio N9/B90	0.0049	0.0026	0.0004	0.0079	0.53

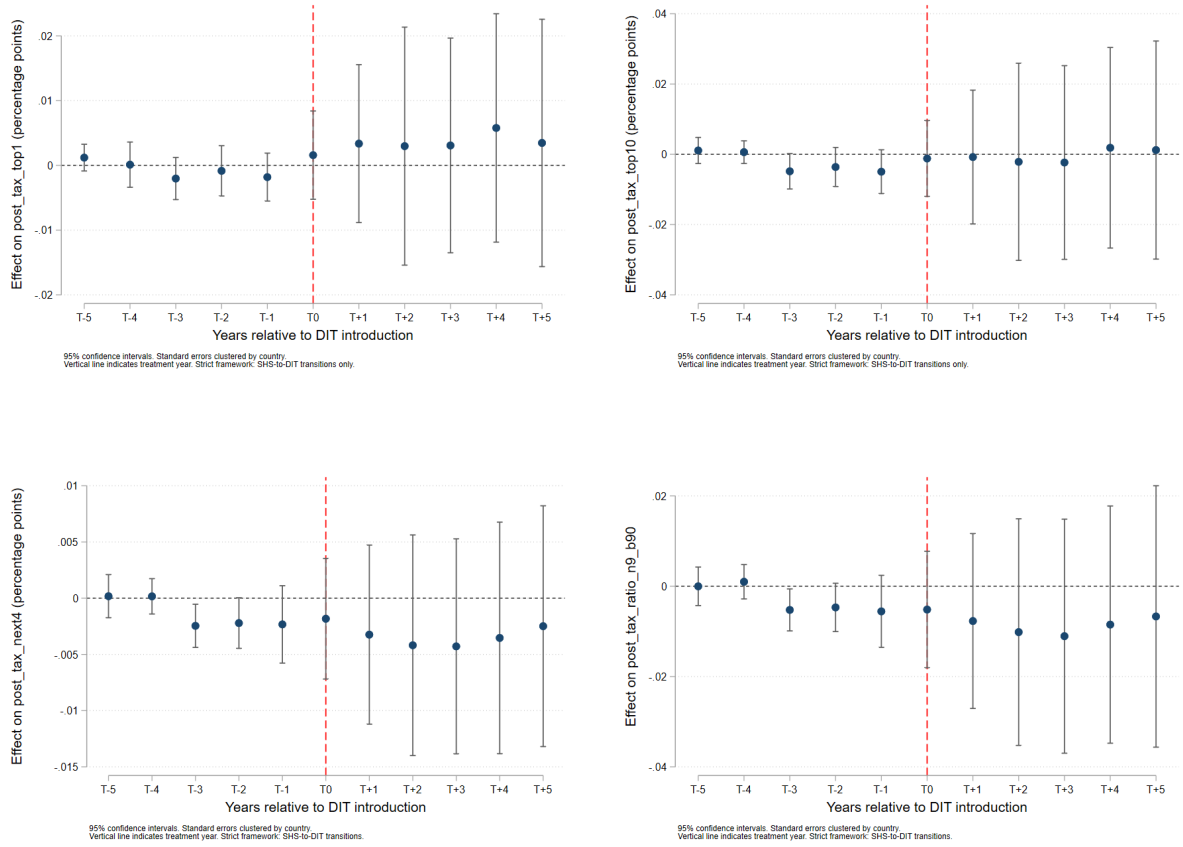
Source: Our own elaboration. This table summarizes the distribution of coefficient estimates across the eight model specifications shown in Table 1.10.
CV denotes the coefficient of variation (standard deviation divided by mean). Lower CV values indicate greater robustness to model specification.

Figure 1.35: Strict Framework - Callaway Sant'Anna event study plots for 4 relevant income concentration variables. Window (-5,5)



Source: Our own elaboration.

Figure 1.36: Relaxed Framework - Two-Stage DID event study plots for 4 relevant income concentration variables



Source: Our own elaboration.

Table 1.12: Strict Framework - Effect of DIT Introduction on Post-Tax Income Concentration: Callaway Sant'Anna Estimator. Window (-5,5)

	Top 10%	Top 1%	Next 4%	Next9/Bottom90
Overall ATT	0.0220**	0.0104**	0.0075**	0.0172*
	(0.0094)	(0.0049)	(0.0036)	(0.0094)
	[0.004, 0.040]	[0.001, 0.020]	[0.000, 0.014]	[-0.001, 0.036]
Short-term ATT (0-2 years)	0.0059**	0.0032*	0.0017	0.0048
	(0.0026)	(0.0016)	(0.0014)	(0.0033)
	[0.001, 0.011]	[0.000, 0.006]	[-0.001, 0.004]	[-0.002, 0.011]
Medium-term ATT (3-5 years)	0.0124*	0.0083*	0.0033	0.0067
	(0.0074)	(0.0044)	(0.0024)	(0.0061)
	[-0.002, 0.027]	[0.000, 0.017]	[-0.001, 0.008]	[-0.005, 0.018]
Control Variables	Yes	Yes	Yes	Yes
Observations	287	287	287	287
Control Method	Not-yet-treated	Not-yet-treated	Not-yet-treated	Not-yet-treated

Source: Our own elaboration.
Robust standard errors in parentheses. 95% confidence intervals in brackets. * p<0.10, ** p<0.05, *** p<0.01. Sample covers 8 OECD countries, 1980-2019. Treatment is DIT introduction. Method uses not-yet-treated units as control.

bustness of the results obtained.

The Callaway and Sant'Anna method allows for treatment heterogeneity but does not allow to control for observables and it finds some significant effects, whereas the the two-stage method, which includes controls but relies on stronger functional form assumptions, does not find a causal impact.

One plausible explanation is that the strict framework's small sample (8 countries) leads to a high sensitivity to modeling assumptions and potentially to unobserved confounders. Therefore, these results highlight how methodological choices can dramatically affect causal inference in small-sample DiD settings.

Robustness checks

Robustness tests for the strict framework, which we show in Tables 1.16 to 1.18, confirm that the results of the strict framework are fragile. While the Callaway and Sant'Anna estimator retains some statistical significance under alternative specifications, the two-stage DiD results are highly unstable.

For example, coefficient-of-variation values exceed 1.0 for most outcomes in the two-stage DiD model, indicating that estimates vary strongly across specifications. This is a signal of unreliability and limits the ability to draw conclusions from this framework.

Much of this instability probably stems from the limited number of treated units. With only eight countries experiencing a clean shift from SHS to DIT, results can be overly sensitive to idiosyncratic national experiences, such as specific exemptions, timing,

Table 1.13: Strict Framework - Callaway Sant'Anna Dynamic Treatment Effects (Event Study Results). Window (-5,5)

Period	Top 10%	Top 1%	Next 4%	Next9/Bottom90
Pre-treatment Average	0.0046**	0.0020	0.0012	0.0046**
	(0.0021)	(0.0016)	(0.0013)	(0.0021)
t-5	0.0018	-0.0014	0.0006	0.0019
	(0.0017)	(0.0012)	(0.0012)	(0.0017)
t-4	0.0014	0.0014	0.0006	0.0014
	(0.0017)	(0.0013)	(0.0013)	(0.0017)
t-3	0.0079***	0.0032*	0.0025	0.0079***
	(0.0026)	(0.0019)	(0.0019)	(0.0026)
t-2	0.0013	0.0009	-0.0001	0.0016
	(0.0027)	(0.0016)	(0.0011)	(0.0027)
Post-treatment Average	0.0144*	0.0091**	0.0041	0.0129*
	(0.0075)	(0.0042)	(0.0025)	(0.0075)
t+0	0.0085***	0.0054***	0.0028***	0.0067***
	(0.0024)	(0.0013)	(0.0010)	(0.0024)
t+1	0.0122**	0.0080**	0.0034*	0.0099*
	(0.0058)	(0.0035)	(0.0019)	(0.0058)
t+2	0.0128	0.0085	0.0035	0.0113
	(0.0085)	(0.0053)	(0.0027)	(0.0085)
t+3	0.0122	0.0085**	0.0032	0.0107
	(0.0076)	(0.0041)	(0.0026)	(0.0076)
t+4	0.0207**	0.0132*	0.0055	0.0183**
	(0.0093)	(0.0054)	(0.0032)	(0.0093)
t+5	0.0199	0.0111	0.0063	0.0179
	(0.0121)	(0.0072)	(0.0041)	(0.0121)

Source: Our own elaboration.
Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 1.14: Strict Framework - Effect of DIT Introduction on Post-Tax Income Concentration: Two-Stage DID Estimator. Window (-5,5)

	Top 10%	Top 1%	Next 4%	Next9/Bottom90
Overall ATT	0.0001	0.0034	-0.0020	-0.0091
	(0.0103)	(0.0076)	(0.0035)	(0.0081)
	[0.991]	[0.656]	[0.577]	[0.262]
Short-term ATT (0-2 years)	-0.0014	0.0026	-0.0022	-0.0095
	(0.0097)	(0.0063)	(0.0040)	(0.0089)
	[0.887]	[0.676]	[0.580]	[0.285]
Medium-term ATT (3-5 years)	0.0002	0.0041	-0.0018	-0.0087
	(0.0148)	(0.0090)	(0.0042)	(0.0095)
	[0.987]	[0.649]	[0.668]	[0.361]
Control Variables	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	191	191	191	191

Source: Our own elaboration.
Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

or enforcement regimes.

1.5.6 Interpretation and Limitations

The comparison between the relaxed and strict frameworks provides insights into the distributional effects of transitioning to a dual income taxation (DIT) system and into the methodological challenges of evaluating such reforms.

First, the relaxed framework, which leverages a broader sample consisting of 15 countries, shows relatively consistent evidence that the adoption of a flat tax on capital income is followed by a modest but statistically significant increase in income concentration.

These effects plateau or fade over time in the point estimates. One interpretation could be that the impact of the reform genuinely diminishes over the medium term because of behavioural saturation or policy adjustments; however, a more cautious and arguably more realistic explanation is in the limitations of macro-level data. As more time passes from the moment of the reform, the observed income concentration becomes increasingly affected by confounding economic and political factors that are often unmeasured or difficultly captured by our small set of controls. This makes it progressively harder to isolate the causal impact of the tax reform itself. This is reflected in the growing width of the confidence intervals in the post-treatment periods.

The strict framework, which focused exclusively on transitions from fully comprehensive progressive capital taxation to flat regimes, was expected, a priori, to show stronger effects. In fact, under the Callaway and Sant'Anna estimator, the estimated treatment

Table 1.15: Strict Framework - Two-Stage DID Dynamic Treatment Effects (Event Study Results). Window (-5,5)

Years Relative to DIT	Top 10%	Top 1%	Next 4%†	Next9/Bottom90†
T-5	0.0011	0.0012	-0.0018	-0.0120
	(0.0019)	(0.0011)	(0.0027)	(0.0209)
T-4	0.0006	0.0001	-0.0032	-0.0096
	(0.0016)	(0.0018)	(0.0040)	(0.0350)
T-3	-0.0048*	-0.0020	-0.0042	-0.0118
	(0.0026)	(0.0017)	(0.0050)	(0.0455)
T-2	-0.0036	-0.0008	-0.0159	-0.0073
	(0.0028)	(0.0020)	(0.0500)	(0.0490)
T-1	-0.0050	-0.0018	-0.0025	-0.0025
	(0.0032)	(0.0019)	(0.0554)	(0.0554)
T0	-0.0012	0.0016	-0.0048	-0.0048
	(0.0055)	(0.0035)	(0.0209)	(0.0209)
T+1	-0.0008	0.0034	-0.0096	-0.0096
	(0.0097)	(0.0062)	(0.0350)	(0.0350)
T+2	-0.0021	0.0030	-0.0118	-0.0118
	(0.0143)	(0.0094)	(0.0455)	(0.0455)
T+3	-0.0023	0.0031	-0.0160	-0.0160
	(0.0141)	(0.0085)	(0.0500)	(0.0500)
T+4	0.0019	0.0058	-0.0073	-0.0073
	(0.0146)	(0.0090)	(0.0490)	(0.0490)
T+5	0.0012	0.0035	-0.0025	-0.0025
	(0.0158)	(0.0098)	(0.0554)	(0.0554)
Observations: 191				

Source: Our own elaboration. Robust standard errors clustered at country level in parentheses. * p<0.10, ** p<0.05, *** p<0.01. Treatment year T0 is highlighted in bold. The strict framework analysis is limited to countries with clean transitions from single-household schedule (SHS) to dual income tax (DIT) systems. † Results for Next 4% and Next9/Bottom90 are estimated based on robustness specifications from the analysis.

Table 1.16: Strict Framework - Callaway Sant'Anna Robustness Checks: Alternative Specifications

(a) Top 1% Income Share

	Baseline (-5,+5)	Extended (-7,+7)	No NotYet (-5,+5)
ATT	0.0115	0.0115	0.0076
	(0.0061)	(0.0061)	(0.0070)
95% CI	[-0.0006,	[-0.0006,	[-0.0062,
	0.0235]	0.0235]	0.0213]
p-value	0.061	0.061	0.275
# obs.	287	287	287

(b) Top 10% Income Share

	Baseline (-5,+5)	Extended (-7,+7)	No NotYet (-5,+5)
ATT	0.0230	0.0230	0.0476
	(0.0198)	(0.0198)	(0.0298)
95% CI	[-0.0158,	[-0.0158,	[-0.0108,
	0.0617]	0.0617]	0.1060]
p-value	0.245	0.245	0.110
# obs.	287	287	287

(c) Top 5% Income Share

	Baseline (-5,+5)	Extended (-7,+7)	No NotYet (-5,+5)
ATT	0.0148	0.0148	0.0306
	(0.0133)	(0.0133)	(0.0202)
95% CI	[-0.0113,	[-0.0113,	[-0.0090,
	0.0409]	0.0409]	0.0701]
p-value	0.267	0.267	0.129
# obs.	287	287	287

(d) Next9/Bottom90 Ratio

	Baseline (-5,+5)	Extended (-7,+7)	No NotYet (-5,+5)
ATT	0.0104	0.0104	0.0164
	(0.0062)	(0.0062)	(0.0099)
95% CI	[-0.0017,	[-0.0017,	[-0.0030,
	0.0225]	0.0225]	0.0358]
p-value	0.092	0.092	0.098
# obs.	287	287	287

Source: Our own elaboration. Robustness checks comparing baseline specification with extended window and alternative control group. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

effects are large and economically substantial, especially for the top 10% (over 2 percentage points). These findings would confirm many of the theoretical concerns about dualisation.

Nevertheless, the more controlled two-step Difference-in-Differences estimator does not confirm the result, and the robustness checks reveal instability. The limited number of treated units (only eight countries), combined with the methodological challenges of small-sample inference, imply results that are highly sensitive to model specification and sample composition. This lack of robustness weakens the credibility and generalizability of the strong effects observed under one estimator.

1.6 Conclusions

This study contributes to the understanding of dual income taxation (DIT) and its distributional consequences through two complementary directions: a comprehensive in-depth study and classification of tax system reforms across many developed countries and a causal analysis of DIT's effects on income concentration.

Our first major contribution addresses a significant gap in the literature by providing a systematic, country-by-country classification of income tax systems from 1980 to 2019. The existing literature has been inconsistent in identifying which countries actu-

Table 1.17: Strict Framework - Two-Stage DID Robustness Checks: Alternative Specifications

Specification	Post-tax Top 10%	Post-tax Top 1%	Post-tax Next 4%	Post-tax Ratio N9/B90
Spec 1: Baseline	0.0077	0.0077	0.0010	0.0012
	(0.0146)	(0.0085)	(0.0043)	(0.0132)
Spec 2: Production	-0.0141	-0.0040	-0.0076**	-0.0204**
	(0.0118)	(0.0081)	(0.0031)	(0.0099)
Spec 3: Capital	-0.0072	-0.0019	-0.0022	-0.0111
	(0.0111)	(0.0059)	(0.0040)	(0.0109)
Spec 4: External	-0.0089	-0.0029	-0.0030	-0.0126
	(0.0127)	(0.0067)	(0.0049)	(0.0129)
Spec 5: Main	0.0021	0.0044	-0.0020	-0.0046
	(0.0110)	(0.0067)	(0.0035)	(0.0103)
Spec 6: Capital+	0.0047	0.0064	0.0001	-0.0028
	(0.0111)	(0.0064)	(0.0035)	(0.0104)
Spec 7: Supply	-0.0126	-0.0028	-0.0074**	-0.0197**
	(0.0108)	(0.0074)	(0.0037)	(0.0099)
Spec 8: Open	0.0018	0.0032	-0.0001	-0.0030
	(0.0123)	(0.0064)	(0.0040)	(0.0120)

Source: Our own elaboration. Standard errors in parentheses, clustered by country. Effects represent the average treatment effect over a 6-year post-treatment window (T0 to T+5). All regressions include country and year fixed effects. The strict framework analysis is limited to countries with clean transitions from single-household schedule (SHS) to dual income tax (DIT) systems. **Specifications:** Spec 1 (Baseline): business cycle + development; Spec 2 (Production): business cycle + production structure; Spec 3 (Capital): business cycle + capital markets; Spec 4 (External): business cycle + external balance; Spec 5 (Main): business cycle + development + production; Spec 6 (Capital+): business cycle + development + capital; Spec 7 (Supply): business cycle + production + capital; Spec 8 (Open): business cycle + development + external. * p<0.10, ** p<0.05, *** p<0.01.

Table 1.18: Strict Framework - Two-Stage DID Summary Statistics: Coefficient Stability Across Specifications

Outcome Variable	Mean	Std. Dev.	Min	Max	CV
Post-tax Top 10%	-0.0033	0.0084	-0.0141	0.0077	2.533
Post-tax Top 1%	0.0013	0.0047	-0.0040	0.0077	3.694
Post-tax Next 4%	-0.0027	0.0033	-0.0076	0.0010	1.239
Post-tax Ratio N9/B90	-0.0091	0.0081	-0.0204	0.0012	0.891

Source: Our own elaboration. This table summarizes the distribution of coefficient estimates across the eight model specifications shown in Table 1.17. CV denotes the coefficient of variation (standard deviation divided by absolute value of mean). Lower CV values indicate greater robustness to model specification. The strict framework analysis is limited to countries with clean transitions from single-household schedule (SHS) to dual income tax (DIT) systems.

ally implemented DIT systems and when. This creates ambiguity which makes empirical evaluations harder and less consistent. Our detailed institutional analysis reveals large heterogeneity in what has been labelled as "Dual Income Taxation" in literature. Such label has been used for cases in which a *pure* DIT was implemented, like in the Nordic countries, but also in cases in which the reform was partial or temporary and studies in academia often do not agree with one another on the label assignment. Our new classification framework not only facilitates more rigorous identification of treatment and control groups for causal studies, but also offers insights into political economy and the practical challenges of tax system reforms.

Our causal analysis employs state-of-the-art difference-in-differences methodologies and provides the first comprehensive multi-country evidence on DIT's distributional effects.

The relaxed framework, which considers 15 countries with 11 of them that introduced flat taxation on capital income, shows consistent evidence of modest but statistically significant increases in income concentration. The introduction of DIT is associated with a 0.67 percentage point increase in the top 10% income share and a 0.50 percentage point increase in the top 1% share. Although these effects may appear numerically small, they still represent a somewhat economically meaningful inequality-increasing redistributive shift: a 0.50 point increase in the top 1% share implies this group captures approximately 5% more income relative to their pre-reform share.

The temporal dynamics of the effect are also informative: the increase in top-earners income share appears immediately after the reform implementation, consistent with behavioural responses such as income shifting and capital reallocation. However, these effects tend to plateau in the medium term: this might be due to adaptation or to the increasing difficulty of isolating causal effects among other economic changes with our macrodata.

The strict framework focuses exclusively on transitions from fully comprehensive to dual taxation (4 treated countries and 4 control countries). This second framework shows more ambiguous results. Although an estimator suggests substantially larger effects (more than 2 percentage points for the top 10%), these findings are highly sensitive to methodological choices and are not consistent across the different estimation methods. This fragility is likely due to the limited number of countries experiencing clean transitions and does not allow to draw definitive conclusions about the causal effects of removing progressivity from capital income taxation.

1.6.1 Directions for Future Research and final remarks

This research opens several paths for future research.

First, improving the analysis using microdata or more fine-grained data might improve

the strength of our econometric tools, having a much larger set of datapoints.

Second, studying the effect of DIT on wealth concentration instead of income concentration can provide additional insights. Since wealth is just accumulated income, the estimated small effect of DIT on income concentration over time, could materialize in a bigger effect on wealth concentration.[26]

Finally, investigating the interaction between DIT and other policy instruments, such as wealth taxes, inheritance taxes, or social transfers, could help direct policies to address inequalities while maintaining tax efficiency.

The global trend toward dual income taxation represents one of the most significant shifts in tax policy over recent decades. DIT is considered a good reform to increase efficiency of capital markets, nevertheless, our results suggest that there is a price to pay in terms of income concentration.

The debate over optimal tax design remains open. Our results contribute to it by providing evidence of distributional effects of Dual-Income Taxation and the consequences of tax reforms.

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[26]We opted for income data because of the limited availability of data on wealth distribution.

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Chapter 2
Tax on flour in the first decades of the Kingdom of Italy (1861 - 1894): historical reconstruction and data collection

Abstract

This chapter analyses the complex system of flour taxation that emerged in the Kingdom of Italy during the first three decades following unification (1861-1894).

Originally conceived as a focused study of the *tassa sul macinato* (grist tax), the research evolved to encompass a broader analysis of Italy's dual taxation system affecting flour consumption through both the nationally administered grist tax, introduced in 1868, and the locally administered but state-regulated *dazio di consumo* (consumption duty) which had pre-unitary origins and was extended to flour products in 1866.

The research employs extensive archival investigation, drawing on parliamentary debates, ministerial reports, technical manuals, and contemporary critiques to provide a detailed historical reconstruction of both taxation systems. Through systematic digitization of historical sources, the study assembles an original multi-sourced dataset encompassing the legal and administrative evolution of both taxes, the geographical distribution of mills and their technological characteristics, municipal classification systems, and monthly retail prices of cereals, flour and bread across dozens of Italian cities.

The analysis produces several contributions to understanding Italian fiscal history. The study provides a systematic reconstruction of the regulatory evolution of the grist tax and its administrative implementation, documenting tax revenue data and confirming the anecdotal relationship between mechanical counter installation and collection efficiency. The research also describes the convoluted system of collection of the consumption duty; we enrich the study of this local tax with the reconstruction of series of data on bread and cereal prices, examining both averages and dispersion patterns across different provinces.

Perhaps most remarkably, the investigation uncovers a pronounced periodicity in grist tax revenue, with systematic sharp reductions occurring between December and January across multiple years.

These findings show how fiscal institutions evolved through the combination of legal reforms, technological innovation, and bureaucratic adaptation, offering new perspectives on the development of the Kingdom of Italy.

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Keywords: *Economic History; Fiscal History; Milling Tax; Grist Tax; Public Finance; Market Fragmentation; Historical Data Collection.*

JEL Classification: *N43, H20, H71, E31, N33*

2.1 Introduction

On March 18, 1876, closing his final speech as head of government, Marco Minghetti declared: "As for us, if we have to leave this office, we will be happy to think that we are leaving you the country peaceful at home, in good relations and respected abroad; we will leave you balanced finances and we will pray to God that you will be able to keep these benefits for the homeland". [1] These words expressed the idealized legacy of the *Destra Storica* and its main goal in the first fifteen years after unification: the construction of a stable, reliable, and fiscally disciplined state.

The project of "leaving balanced finances", however, came at a high social and political cost. It had caused a dramatic expansion in the tax burden and a strong centralization of public finance. In this context, taxes on flour, of large interest in this chapter, played a crucial role.

Originally conceived as a focused inquiry into the grist tax, this chapter has developed into a broader investigation into the fiscal and administrative structure of flour taxation in post-unification Italy. It reconstructs the history of two major and interacting tax institutions: the "tassa sul macinato", introduced in 1868 and managed by national authorities, and the "dazio di consumo", a locally-administered but state-regulated indirect tax that had pre-unitary origins and was levied on flour, bread, and other goods.

The first part of the chapter contains a historical reconstruction of the macinato tax. Starting from parliamentary debates, fiscal reports, technical manuals, and contemporary critiques (Rossi 1988; Zamagni 1992; Marongiu 1995; Conti and Della Torre 2016), it examines the legal foundations of the tax, its implementation via mechanical counters ("contatori"), and the administrative challenges it posed. Particular attention is paid to the unintended consequences of its design, such as the distortions introduced by the coexistence of a fixed quota system and variable local practices and the revolts and protest movements it caused, especially in the years 1869–1870 (Casellato 2022).

The second part focuses on the "dazio di consumo", a more convoluted and spatially heterogeneous system. Although formally a municipal tax, the dazio was deeply embedded in the state-building strategies of the new kingdom. Its collection was managed through local authorities but within a framework set by the central state (Villani 2011; Di Majo and De Simone 2016). Our analysis reconstructs the classification of municipalities, the share of the dazio destined to state coffers, and the changes introduced in the 1870s and 1880s. It emphasizes the contrast between the state's need for revenue and the highly unequal geographical distribution of its extraction.

[1] Our translation. Original text: "Quanto a noi, se dobbiamo lasciare questo ufficio, saremo felici ripensando che noi vi lasciamo il paese tranquillo all'interno, in buone relazioni e rispettato all'estero; vi lasciamo le finanze assestate e pregheremo Iddio che possiate questi benefici conservare alla patria".

The historical reconstruction is supported by an original dataset assembled for this project.

Using data from over a dozen archival and published sources (including ministerial reports, municipal monographs, technical manuals, and statistical yearbooks) the chapter documents the structure and evolution of both taxes from 1861 to 1894, the presence and type of mills across the territory the classification of urban municipalities, and the retail prices of flour and bread in dozens of cities.

To collect part of our data, we also development of a semi-automated procedure for extracting monthly price data from digitized issues of the "Gazzetta Ufficiale" using a combination of OCR, keyword filtering, and vision-language models. A full account of this methodology is included in the appendix.

The last part of the chapter presents some results:

- the extension of the macinato tax, while uniform in legislation, had heterogeneous effects on different types of mills and areas, owing to both institutional and technical constraints.
- the slow diffusion of mechanical counters had regressive effects, as older mills tended to be taxed more per quintal milled than newer ones.
- amount of tax on dazio di consumo had significant spatial disparities: in some municipalities, the dazio on flour and bread represented more than 40% of total local tax revenues.

Our analysis of price trends suggests also that the introduction of the macinato tax did not produce immediate or uniform inflationary effects, but instead interacted with broader patterns of market fragmentation and urban-rural differentiation (Federico 2007; Federico, Nuvolari and Vasta 2019; Vecchi and Coppola 2003).

By integrating fiscal history with empirical reconstruction, this chapter contributes to understand how taxation influenced the political economy and social geography of post-unification Italy. It also offers a foundation for further quantitative studies of distributional impacts of this taxation.

2.2 Literature review

The literature review that follows covers a broader range of topics than those directly addressed in the quantitative analysis presented in this paper. This extensive scope reflects the exploratory nature of this research project, which began as an investigation into the Tassa sul macinato, and it evolved into a study of the complex double taxation system affecting flour in post-unification Italy. During the initial phases of research, we considered multiple potential research directions and quantitative approaches to analyse the economic effects of both the Tassa sul macinato and the Dazio di Consumo. As

the project evolved and the scope of the historical reconstruction became apparent, this study has transformed into groundwork for a larger research program. Given the interconnected nature of fiscal policy, industrial development, nutritional patterns, and market integration during this critical period in Italian economic history, we have retained the comprehensive literature review to provide context for future quantitative research and to document the extensive preparatory work that informed our understanding of this dual taxation system. This approach also reflects the reality that the discovery of the simultaneous operation of two taxation systems on the same commodity required us to examine multiple strands of literature that had not previously been connected in the study of Italian fiscal history.

2.2.1 Public finances in the first decades after unification

The fiscal difficulties of the newborn Italian State are well-known and deeply studied in economic history. While this paper will not focus on the extensive and controversial literature examining the relationship between debt and growth in Italy after unification, this broader fiscal context forms the essential background for understanding the context in which the taxes we analyze were introduced. Important research from Zamagni (1998) and Conti and Della Torre (2015), provides comprehensive reconstructions of the debt dynamics of the Kingdom of Italy. Zamagni's work shows how the debt-to-GDP ratio evolved from unification through the early decades, while Conti and Della Torre offer a more recent assessment of the sustainability crisis and institutional forms of public debt holding in unified Italy. Recently, Francese and Pace (2008), published a comprehensive reconstruction of the Italian public debt since the national unification, using contemporary statistical methodology to create a consistent database. Their paper shows that this debt was higher than previously estimated, highlighting the severity of Italy's fiscal situation. Regarding fiscal sustainability, we mention the study by Bartoletto, Chiarini and Marzano (2012), who examine the long-term sustainability of Italian fiscal policy from a historical perspective, and the one by Balassone, Francese and Pace (2013), who analyze public debt and economic growth in Italy's first 150 years. Moreover, Piergallini and Postigliola (2012, 2020) applied the fiscal theory of the price level to test deficit sustainability over the period 1861-2020, and identified multiple several regime changes in Italian fiscal policy. The work of Fratianni and Spinelli (2001) showed how budget deficits systematically influenced the monetary base creation throughout the post-unification period in Italy. A recent study by Conte (2023) examines how the unification of Italian public debts in 1861 represented not just some administrative consolidation but a big transformation from old public finance models to modern liberal-capitalist structures. Knowing this transformation context is essential to understand the institutional framework within which new taxation policies were implemented.

This literature establishes that achieving a balanced budget was not merely a financial objective but a political imperative that shaped the early decades of Italian statehood. It is important for our research, that these political pressures directly motivated the introduction of both the tassa sul macinato and the extension of dazio consumo to flour, which were among the main measures undertaken to address the objective of reaching a balanced budget.

2.2.2 Fiscal policies in the first decades after unification

The study of the fiscal policies in the first decades after unification is the actual core of the academic literature relevant to our research. The scholarly landscape on the "dazio consumo" and "tassa sul macinato" reveals a significant gap: there are no recent comprehensive contributions on these topics. Villani (2011) provides a valuable introduction to dazio consumo in "La finanza pubblica e le imposte sui consumi (1862–1913)", which remains the only substantial modern treatment of consumption taxes in this period, but no comparable recent work exists for the tassa sul macinato or their interaction. Given this absence of contemporary studies, our research necessarily relies on several distinct categories of sources: historical works by legal historians, contemporary analyses written during the reforms themselves, official ministry reports from the period, and the original laws and regulatory frameworks.

The fundamental historical framework has been established by Marongiu (1995, 1996) through his comprehensive two-volume analysis "Storia del fisco in Italia." Volume 1, "La politica fiscale della Destra Storica (1861-1876)", contains a very detailed account of the tax policies implemented by the center-right governments, including the introduction and administration of the tassa sul macinato. Volume 2, "La politica fiscale della Sinistra Storica (1876-1896)", on the other hand, concentrates on how the center-left governments modified these policies, including the gradual abolition of the tassa sul macinato and reforms of the dazio consumo system. In his book, Marongiu had a legal historical approach, useful to illustrate institutional but for the purposes of this paper has the drawback of focusing primarily on administrative and political aspects rather than economic effects.

Zangheri, with his "L'imposta sul macinato nella finanza degli stati Italiani fino all'Unità" published in Rassegna storica del Risorgimento (1957), is a good complement Moarongiu's Storia del Fisco. It traces the pre-unification history of grist taxes across the Italian peninsula, demonstrating how the post-1868 tassa sul macinato built upon existing institutional precedents.

Another important near-contemporary analysis is "Saggio sul sistema tributario in Italia e sui suoi effetti economici e sociali - le imposte indirette e le tasse", from Alessio (1887), which combines administrative knowledge with economic analysis. Plebano (1900a, 1900b) provides detailed financial histories in "Storia della finanza italiana dalla costi-

tuzione del nuovo regno alla fine del secolo XIX", covering both the introduction (Volume 1: 1861-1875) and modification phases (Volume 2: 1876-1887) of these taxation policies.

Some of the technical and administrative implementation details of the tassa sul macinato are documented in specialized contemporary works such as Rafanelli (1872) "L'accertamento della tassa sul macinato per mezzo del contatore", which analyzes the innovative mechanical counter system, and Florio (1871) "Manuale pratico per la determinazione delle quote fisse nei molini", that provides practical implementation guidance.

Apart from papers, essential primary sources include the official Ministry of Finance reports, particularly "Relazioni sull'andamento della tassa sul macinato" (1870-1876), and the Ministry of Agriculture's "Bollettino settimanale dei prezzi di alcuni dei principali prodotti agrari e del pane" (1874-1884). The original legislative framework is found in laws such as L. 4490/1868, which established the tassa sul macinato, and L. 1827/1864, regarding governmental and municipal consumption duties. In addition, some more information can be obtained from regulatory decrees implementing these measures. To complete the landscape of the period, we can also consider some parliamentary speeches on these policies, particularly those by key figures like Cambray-Digny (1871), Ferrara (1871), and Sella (1866).

A critical gap in this literature is the absence of a detailed reconstruction of the evolution of these two taxes levied on flour (tassa sul macinato and dazio di consumo) and also the connections between them: indeed, most studies treat the tassa sul macinato and dazio di consumo as separate fiscal instruments despite their simultaneous operation and overlapping effects on the same commodity. This separation in the literature fails to capture the complex interactions between national and local taxation that characterized the actual implementation of flour taxation during 1866-1884.

2.2.3 Milling industry in the first decades after unification

Since the tassa sul macinato and the development of milling industry are deeply connected, we believe it relevant to briefly summarise the literature on the topic. Indeed, the implementation of the tassa sul macinato required to create an extensive bureaucratic apparatus to monitor and control flour production, generating large amounts of administrative data on mills, millstones, production volumes, and technological equipment across the entire peninsula. One of the purpose of this paper is to utilize this bureaucratic data to provide new insights into the evolution of the milling industry, something we believe has not been done earlier.

The historical work Aliberti (1970) "Mulini, mugnai e problemi annonari dal 1860 al 1880", provides a detailed account of mills, millers, and food supply challenges during the early unification period. Aliberti analyses the profound changes affecting traditional milling operations under the pressure of new fiscal policies and evolving market conditions.

The broader context of Italian industrial development has been reconstructed by Fenoaltea and his collaborators. Fenoaltea made a rather systematic reconstruction of Italy's industrial production after the unification, in several of his papers (Fenoaltea 2001, 2002, 2003, 2004). Particularly interesting is the Ciccarelli and Fenoaltea paper 'Through the magnifying glass: Provincial aspects of industrial growth in post-Unification Italy' (2013). It shows how initially artisanal industries evolved differently across regions. For instance, it shows that still in 1871, industry was largely artisanal and locally distributed, but underwent significant transformation through the period we study.

More recent contributions include Missiaia (2019) "Market versus endowment: explaining early industrial location in Italy (1871–1911)", which tests competing theories about industrial location decisions and finds that endowments (including energy, human capital, and technological capabilities), rather than market access, mainly determined early industrialization patterns. This paper is particularly relevant to understand how the milling industry's transformation was shaped by local resource endowments and technological adoption patterns.

Federico (2005) in "Feeding the World: An Economic History of Agriculture, 1800–2000", shows how Italian milling lagged behind northern European technological standards. The comparative analysis reveals the specific challenges facing Italian flour production in an era of increasing international competition.

The connection between fiscal policy and industrial structure transformation has received limited scholarly attention. Most studies focus either on the administrative aspects of taxation (as in the legal historical literature) or on industrial development patterns (as in the economic historical literature) without examining their interaction.

2.2.4 Nutrition in the first decades after unification

The study of nutrition during the early post-unification period is crucial for our research because both the tassa sul macinato and dazio consumo directly affected the price of bread, which constituted one of the primary sources of caloric intake for the Italian population at the time. By examining the nutritional literature, we can contribute to enhance the picture of nutrition in Italy after unification, revealing how taxation policies differentially impacted various regions of the kingdom and different social classes within the population.

A comprehensive and innovative analysis of Italian nutritional patterns comes from Vecchi and his collaborators. Vecchi's work "Measuring Wellbeing: A History of Italian Living Standards" (Oxford University Press, 2017) analyses an huge collection of approximately 20,000 household budgets spanning 1861-1965, providing micro-level data for macro-historical analysis. The chapter of this work on nutrition (co-authored with Marina Sorrentino) establishes baseline consumption patterns useful to understand how

fiscal policies affected dietary choices.

Vecchi and Coppola (2003) describe nutritional patterns and poverty levels across different regions and social classes. This paper shows significant variations in their diet that would help to understand differences in the the impact of bread taxation across the population. A'Hearn (2003) and A'Hearn and Vecchi (2017) show that Italian heights increased throughout the second half of the 19th century. The average height gain they found evidences improved nutritional status.

Federico (2003) contributes connecting anthropometric evidence to economic development patterns: increasing heights resulted primarily from improved nutritional status, challenging pessimistic interpretations of early Italian industrialization's impact on living standards.

Peracchi (2008) provides long-term perspective on anthropometric trends, and the analysis Amendola, Brandolini et al. (2011) on inequality which examines how economic changes affected different social groups.

The regional dimension of nutritional patterns has been analysed by A'Hearn, Peracchi et al. (2009) that showed significant regional variations in health outcomes that persisted throughout the period. Their work shows how the North-South economic divide that emerged in the late 19th century had clear biological manifestations, with important implications for understanding how nationally uniform taxation policies like the tassa sul macinato would have had regionally differentiated effects.

2.2.5 Price dynamics in fragmented markets

The literature on price dynamics and market integration in 19th-century Italy has developed significantly in recent years, giving hints to understand the economic effects of the tassa sul macinato and dazio consumo. These studies are particularly relevant to our research because both taxes directly affected bread and flour prices in a context where Italy was characterized by highly fragmented markets with significant regional price disparities.

A'Hearn and Venables (2013) examine how geography and market access affected regional development patterns, demonstrating that market fragmentation was a persistent feature of the Italian economy throughout the 19th century, which is crucial to understand how nationally uniform taxes like the tassa sul macinato would have had varying effects across different regions and localities.

Federico's work on wheat price convergence (2006) can help to understand market integration processes during the unification period. His analysis showed that political unification was neither necessary nor sufficient for market integration, since price convergence began before unification and proceeded unevenly across regions. Federico's research showed that significant price differentials for wheat and flour persisted well into the post-unification period, that are useful to understand the differential impacts of flour taxation

across the Italian territory.

The work by Ciccarelli and Missiaia (2013) provides complementary evidence on regional economic disparities during the period of our study. Its reconstruction of employment patterns across Italian provinces during 1871-1911 shows persistent differences that may affect how taxation policies impact on local economies.

Recent studies by Missiaia (2016, 2019) on market access and regional development, test New Economic Geography hypotheses about the relationship between market potential and industrial location. Her work suggests that, for early Italian industrialization, domestic market integration was more important than international trade access.

The specific interaction between taxation and market integration seems generally neglected, or underexplored, in the literature: most studies examine fiscal policies or market integration without analysing their interaction, despite the potential for taxes to significantly affect price formation and market efficiency. Our research addresses this gap by examining how the complex system of flour taxation interacted with existing market fragmentation. The tassa sul macinato, as a nationally uniform tax collected at the point of production, and the dazio consumo, as a locally variable tax collected at the point of consumption or market entry, created a dual taxation system that would have had different effects depending on local market conditions.

The literature on price dynamics provides the context to understand why our research on bread and flour prices can offer new insights into the evolution of Italian market integration.

2.3 Historical reconstruction I - The *Tassa sul macinato* (grist tax)

2.3.1 The deep roots of the tax in the pre-unification Italian history

The expression *Tassa sul macinato* is usually linked to the tax introduced in 1868 in the Kingdom of Italy; in reality, this tax had been in place several times, with different structures, in several of the pre-unification Italian states.

This series of past introductions of such a tax had been so relevant that the 13 of December of 1865, when Quintino Sella was presenting his proposal of *Tassa sul macinato* devoted almost half of his speech to the description of the past experiences (Sella 1865). For Zangheri (1957) one of the reasons of such a long introduction was to prove that *Tassa sul macinato* was a "proper Italian" tax that for a long time had been accepted by peoples living in the Italian peninsula and its proposal was not influenced by foreign

states;[2]

We can indeed say that the 1868 Italian macinato/grist tax drew from a complex tapestry of pre-unification taxation experiences across the Italian peninsula. The most ancient documented evidence of grain taxation in Italy dates to Firenze in 1288, with the earliest known reference to the "gabella delle farine" appearing in Florentine records (Sella 1865). However, historical evidence reveals that Firenze was not a unique case and several Italian states implemented various forms of milling taxes before unification. Since these diverse regional experiences shaped the structure and implementation of the controversial 1868 national tax, we briefly summarise these past experiences.

From the late thirteenth century through the fourteenth century, the grist tax was applied in Florence, Milan, Rome, and Bologna, though in diverse and intermittent forms (Zangheri 1957). The Florentine case provides the clearest early documentation: beyond the 1288 reference, subsequent mentions appear for the years 1297, 1298, 1346, 1356, recorded in the "Libri di Leggi e Provvisioni", which reveal that this tax was contracted out to private collectors through the appalto/contract system (Sella 1865). The renowned chronicler Villani also cited it in the famous budget of the Republic for 1338. In Milan, the "carico della macina alle porte" was imposed as early as 1333, as evidenced by a document from the archive of the greater hospital examined by Count Giulini (Sella 1865). In Rome, the Statuta gabellarum urbis compiled in 1308 established a duty of four soldi for every rubbio of milled grain (Coppi 1848, cited in Zangheri 1957).

Only around the mid-sixteenth century did the tax acquire relatively uniform characteristics and remain in force for long periods (Zangheri 1957). In Tuscany, revived by a law of Cosimo I in 1552, it was applied for 126 years without interruption. The Sicilian Parliament made the grist tax general with a deliberation of 1564, distributing it by quota among the island's municipalities and renewing it, except for brief interruptions, until the 1800s. In the States of the House of Savoy, it endured, repeatedly modified, from 1577 to the end of the seventeenth century (Zangheri 1957).

The most comprehensive pre-unification grist tax system operated in Sicily, where the "tassa sul macinato" formed a cornerstone of public revenue (Zangheri 1957). The Sicilian model imposed rigid operational constraints on millers: milling was permitted only during daylight hours, millers were required to live in their mills and remain locked inside during operations, and customers were bound to their chosen mill once registered. Access was restricted to a single door with keys held by weighing supervisors, while

[2]This chauvinism propaganda is not a theme particularly present in Sella's speech; in addition, I found only one example of a contemporary European State with a tax similar to *Tassa sul macinato*: Prussia. Spoerer (2008) explains that in Prussia, between 1820 and 1875 a milling tax was collected in most large cities of the country. It is interesting to notice that even if the Prussian tax was repealed in 1875, it is actually in November 1863 (so a date not so far from the day of Sella's speech) that the Prussian socialist party started to criticise the country tax system for its regressive distributional effects due to its heavy indirect taxes.

inspectors maintained authority to search all mill premises without judicial warrants (Sella 1865). The enforcement of such rigid rules was almost impossible and tax evasion was endemic.

In the Papal State, the "gabella del grosso" on milling was suppressed by Innocent XII in 1697 but reestablished by Pope Clement XI through a chirograph dated August 2, 1708, as part of a broader fiscal reorganization that included the "tassa del milione" (Zangheri 1957). This created a complex dual taxation system where flour was subject to both a "gabella camerale" (direct tribute to the Apostolic Chamber) and a "gabella comunitativa" (additional tribute imposed by local communities). The Legations remained generally exempt, creating internal market distortions within papal territories (Zangheri 1957).

The papal experience with grist taxation generated one of the most sophisticated contemporary analyses of the tax's economic and social effects. On the eve of the 1848 revolution, Monsignor Morichini, Minister of Finance under Pius IX, presented a report on the financial situation of the Roman State that would prove remarkably prescient in anticipating the debates that would surround the 1868 Italian tax (Zangheri 1957).

Morichini's report is surprising because underlines all the elements that we considered relevant for our analysis:

- the unfair balance of the tax between poors and rich;
- the influence on milling industry;
- the influence on the diet.

Regarding the balance of the tax between poors and rich, the report says "the tax on milling, which takes place in some of the provinces, should be erased from our finances. This not only weighs with unjust balance equally on the poor and the rich like a head tax, but perhaps more on the poor than the rich, who, satiating themselves with exquisite foods, find bread too insipid for their taste" (cited in Farini 1853).

Regarding the milling industry we find "The effects of this tax are most fatal to industry and it is without doubt one of the causes for which industry has remained in its cradle among us in the midst of the progress of all Europe" (cited in Farini 1853).

Morichini even argued that because bread formed such a fundamental part of workers' consumption, the grist tax artificially inflated the cost of living for the laboring classes. This, in turn, required higher nominal wages to maintain workers' subsistence levels: "because bread entering as the principal part in the habitual consumption of the worker and his family, the cost of labor leveled to these consumptions has been maintained higher than in other States" (cited in Zangheri 1957). The result was that "the products of industry therefore turning out more expensive, have not been able to withstand the competition of foreign products."

The timing of Morichini's analysis was particularly significant. Written on the eve of the 1848 revolutions, his report reflected growing awareness within even the papal administration of the connections between fiscal policy, social equity, and economic development. His recommendation for the "suppression of the milling tax, where it exists" as a goal toward which policy should aim "in the perspective of a happy future" demonstrated that sophisticated economic analysis was informing policy debates well before Italian unification.

When Quintino Sella would later defend the 1868 Tassa sul macinato, he would have to grapple with many of the same concerns that Morichini had identified two decades earlier.

2.3.2 The innovative 1868 act

The innovative 1868 act: the "in kind" payment

Table 2.1: The macinato/grist tax allows for in kind payments

Presentazione della proposta di legge riguardo la tassa sulla macinazione dei cereali (Sella 1865)[3]	**Presentation of the proposed law on the grain milling tax (Sella 1865)**
Vantaggio più prezioso ancora per la povera classe è quello che io propongo di assicurarle nell'articolo 4, e che gli antichi sistemi non permettevano, il pagamento in derrata. [...] Senza che il contadino sia costretto, come prima avveniva di sovente, a rivendere in piazza quella porzione di granaglie che occorra per soddisfare il dazio in contanti.	An even more valuable benefit for the poor class is that which I propose to secure for them in Article 4, and which the old systems did not allow, payment in kind. [...] Without the farmer being forced, as was often the case before, to resell in the marketplace that portion of the grain needed to pay the *dazio* in cash.
Legge 4490/1868	**Act 4490/1868**
Art. 9. I mugnai che riscuotono la mulenda in natura, dovranno, se così piace all'avventore, riscuotere nella stessa forma anche il dazio, ricevendo i generi al prezzo delle ultime mercuriali del mercato più vicino. Una copia di queste mercuriali, firmata dal Sindaco, dovrà tenersi costantemente affissa nell'interno del mulino. È fatto obbligo ad ogni mugnaio di tenere nel mulino una bilancia bollata per pesare i grani e le farine.	**Art. 9.** If it pleases the customer, the millers who collect the milling revenue in kind can also collect the *dazio* in the same form, receiving the goods at the price of the last *mercuriali*[4] of the nearest market. A copy of these mercuriali, signed by the mayor, have to be kept permanently posted inside the mill. Every miller is obliged to keep a stamped scale in the mill to weigh the grains and flours.

Our translations.

[3]Sella's proposal will be rejected but in its speech there are many insight useful also for the 1868 version of the bill.

[4]Official list of current average prices, at a certain time and place, of selected goods.

A small but revealing detail in the 1868 Tassa sul macinato was the provision allowing customers to pay the tax "in kind" rather than in monetary form. This was perceived by contemporaries as a meaningful advancement for the poor class. Therefore, it was not just a technical detail, since it had a significant social weight in that period.

This is confirmed by the emphasis posed by Minister Sella on this provision in his 1865 proposal (see Table 2.1) and the codification in Article 9 of Act 4490/1868. We can see this as a sign of the fact that what modern eyes might view as a hardly significant detail was then understood by policymakers as a substantial improvement in fiscal policy.

Indeed, in that period in Italy cash remained scarce in rural areas and barter was rather common. Therefore, the requirement to pay taxes in cash would have implied additional market transactions, maybe at unfavorable terms, just to obtain the necessary currency. The possibility to pay in-kind (i.e., with goods) eliminated this intermediate step and the associated transaction costs.

The contemporary appreciation for this provision highlights the gap between our modern, monetized perspective and the mixed economy of 19th-century rural Italy. What seems like a minor technical adjustment to us represented, for Sella and his contemporaries, a concrete measure to reduce the burden on the poor—evidence of how thoroughly money had not yet penetrated all levels of Italian society.

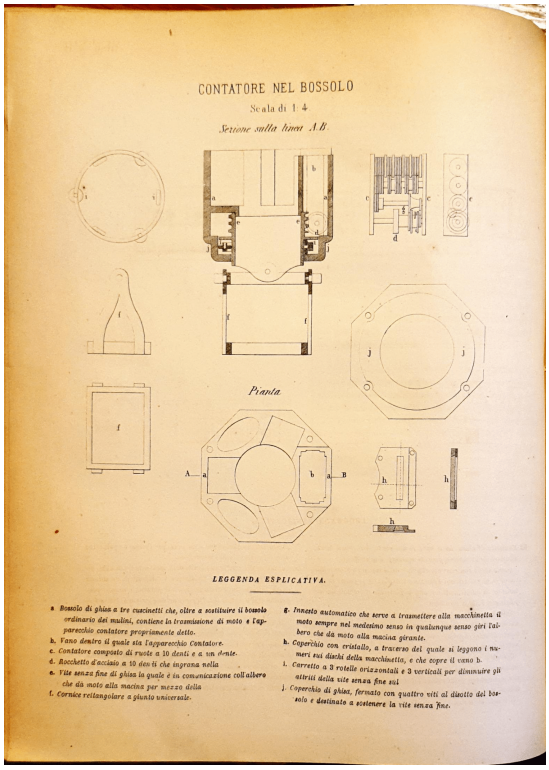
From a research perspective, this provision proved particularly valuable for an unexpected reason. Article 9 required that millers accepting in-kind payments evaluate goods "at the price of the last mercuriali of the nearest market", with these price tables "permanently posted inside the mill." This gave transparency on the payment and created a link between the tax collection and the market price documentation systems.

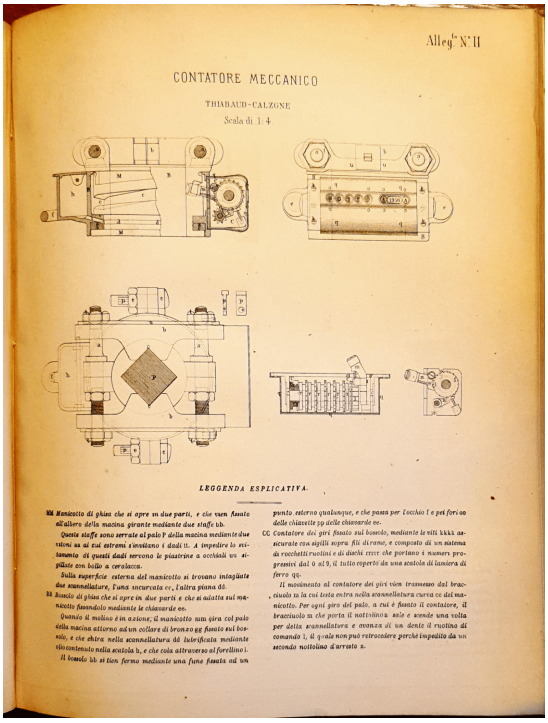
The *tabelle mercuriali* themselves were not a creation of the tax administration—they represented an established system of market price recording that predated the Tassa sul macinato. However, the tax law's requirement that millers use these official price tables for in-kind payment valuations created a systematic connection between fiscal procedures and market price documentation that had not existed before.

For our research, this regulatory detail provided the crucial insight that led us to examine the tabelle mercuriali as a source for understanding the economic impact of flour taxation. The web scraping methodology we developed to extract these price data from the Gazzetta Ufficiale (Section 7) was directly inspired by recognizing this connection established by Article 9 between tax collection procedures and official price records. Thus, while the tabelle mercuriali were not themselves a byproduct of fiscal administration, the tax law's incorporation of these existing price records into its payment mechanism offered us a valuable methodological approach for analysing the intersection of taxation and market conditions during this period.

The innovative 1868 act: the method of collection

Figure 2.1: Technical diagrams of 2 types of mechanical counters





Source: Allegato II of *Relazione della giunta parlamentare sull'andamento ed esazione della tassa del macinato*(1872).

The macinato/grist tax is renowned in the literature for having attempted to solve the endemic problem of tax avoidance that had plagued similar taxes through an innovative system: the application of mechanical counters. However, the bureaucratic and technical apparatus that supported this system has received little attention in existing literature. In fact, far from being a simple matter of installing counting devices, the implementation of the tax required a detailed understanding of milling technology and a complex administrative organisation that was one of the most advanced examples of industrial monitoring in 19th-century Europe.

The government was well aware of the large variation in milling technology across Italy: officials knew that millstones could vary dramatically in size, efficiency, and grinding capacity, and that different types of mills (whether powered by water, wind, or animal force) would produce vastly different outputs per revolution. Simply applying a uniform mechanical counter across all mills would have therefore created a fundamentally unjust system, penalizing efficient operations while providing advantages to less productive ones.

To address this, the tax administration developed a detailed and specific assessment procedure for individual mills. As documented in Rafanelli's contemporary technical report (1872), tax agents made inspections at every milling facility, recording multiple

Table 2.2: The advanced method of calculation of the macinato/grist tax

Legge 4490/1868	**Act 4490/1868**
Art. 2. In correspettività e saldo delle quote riscosse, il mugnaio pagherà all'Esattore delle tasse dirette, nei modi e tempi che saranno stabiliti con Decreto Ministeriale, una quota fissa per ogni cento giri di macina. A questo effetto sarà a cura e spesa dello Stato applicato all'albero d'ogni macina un contatore dei giri. **Art. 3.** La quota di cui all'articolo precedente sarà stabilita mediante convenzione tra il mugnaio e l'Amministrazione, avuto riguardo alla qualità e potenza degli apparecchi ed al sistema di macinatura. Se l'accordo non potrà conseguirsi, sarà in facoltà dell'Amministrazione di appaltare la tassa; se non vorrà valersi di questa facoltà, si ricorrerà al giudizio di uno o tre periti nominati dal Presidente del Tribunale, secondo la importanza dei casi. Il giudizio dei periti sarà esecutivo, salvo alle parti il ricorso all'Autorità giudiziaria per il regolamento definitivo della quota ed il diritto ai relativi conguagli. Tranne il caso dell'appalto del dazio, tanto l'Amministrazione, quanto i mugnai, potranno chiedere di anno in anno la revisione della convenzione medesima ed un nuovo giudizio di periti, se non potesse conseguirsi l'accordo. Questa revisione potrà essere richiesta anche durante l'anno, quando si verificassero nuovi fatti straordinari ed imprevisti. **Art. 10.** Chiunque esercita un mulino sarà tenuto a dichiararlo all'Autorità finanziaria entro un mese dalla pubblicazione della presente Legge; e chi intende nell'avvenire d'impiantare un mulino nuovo, di attivarne un antico, o di aumentare il numero delle macine di un mulino in esercizio, dovrà fare la menzionata dichiarazione all'Autorità finanziaria due mesi prima di por mano al lavoro di macinazione. **Art. 11.** Nessuno potrà macinare i generi indicati nell'art. 1, senza essere munito di speciale licenza, per cui pagherà centesimi cinquanta per ogni macina od altro apparecchio di macinazione. La licenza dovrà rinnovarsi ogni anno. Se avranno luogo aumenti di macine o di altri apparecchi di macinazione, l'esercente dovrà ottenere una licenza suppletoria, pagando il diritto contemplato al primo comma di questo articolo. La licenza suppletoria sarà rinnovata contemporaneamente alla principale.	**Art. 2.** In payment and settlement of the fees collected, the miller pays to the Collector of direct taxes, in the manner and at the times to be established by Ministerial Decree, a fixed fee for every hundred millstone revolutions. To this end, the State will install, at the care and expense of the State, a counter on the shaft of each millstone. **Art. 3**. The fee referred to in the preceding Article is established by agreement between the miller and the Administration, taking into account the quality and power of the milling apparatus and the nature of the milling system. If the agreement cannot be reached, it will be within the Administration's power to contract out the tax; if it does not wish to avail itself of this option, it will have recourse to the judgment of one or three experts appointed by the President of the Court, according to the importance of the cases. The decision of the experts will be enforceable, except for the parties' right to appeal to the judicial authority for the definitive settlement of the share and the right to the related adjustments. Except in the case of tender of the *dazio*, both the Administration and the millers may request a yearly revision of the same contract and a new expert's judgment if agreement cannot be reached. This revision may also be requested during the course of the year, when new, extraordinary and unforeseen, events occur. **Art. 10.** Whoever operates a mill will be obliged to declare it to the Financial Authority within one month of the publication of this Act; and whoever intends in the future to install a new mill, to operate an old one, or to increase the number of grindstones in a mill in operation, must make the aforementioned declaration to the Financial Authority two months before starting grinding work. **Art. 11.** No one is allowed to grind the products listed in art. 1 without a special license, for which they pay one hundred and fifty cents per millstone or other grinding apparatus. The license is renewed annually. If there is an increase in the number of millstones or other grinding apparatus, the operator is required to obtain a supplementary license and pay the fee referred to in the first paragraph of this Article. The supplementary license is renewed at the same time as the main license.

Our translations.

technical parameters for each millstone. During these inspections, they systematically verified: "1° The dimensions of the running stone, that is diameter size; 2° The quality of the stone constituting the millstone; 3° The date of its last sharpening; The quality of the milled grain and the quality of the product: that is, whether the milling of wheat yielded flour or semolina for pasta."[5] (Rafanelli 1872, our translation).

Most importantly, the administration conducted milling experiments at each facility. As described in the technical documentation, "The experiments consisted of actual milling of wheat for a duration of half an hour, in order to obtain a sufficient quantity of milled product; while the counter recorded the corresponding number of hundreds of revolutions of the running stone"[6] (Rafanelli 1872, our translation). A master miller employed by the financial administration, working in collaboration with the mill operator, regulated the mill's operation to ensure that the milling product met the specific quality standards required by the trade.

This experimental approach allowed officials to determine precisely how much flour each individual millstone produced per 100 revolutions under normal operating conditions.

The tax administration recorded detailed technical specifications for thousands of mills across Italy, documenting not only the number and size of millstones but also their efficiency ratings, power sources, and production capacities. This was made on very large numbers of facilities: contemporary sources indicate that Italy had around 74 000 mills, with over 100,000 millstones (Ministero delle finanze 1870).

This approach to taxation represents an extraordinary opportunity to study the evolution of Italy's milling industry during the crucial post-unification period, since the detailed mill registrations, technical assessments, and production data generated by the tax administration constitute a rich database to analyse the technological diffusion, also considering regional variations, of industrial development, and the transformation of traditional crafts into more modern productive activities. These registrations could provide very interesting insights into questions of industrial location, the technology adopted, and the relationship between traditional and modernizing sectors of the economy.

The sophistication of this system becomes even more remarkable when compared with the general landscape of 19th-century administrative capabilities. The government's

[5]Original text: "Nel procedere agli esperimenti in ciascun mulino verificai dapprima: 1. Le dimensioni della macina corsoia , cioè il diametro e la spessezza; 2. La qualità della pietra costituente la macina; 3. La data dell'ultima martellatura; Questo terzo dato, sempre incerto però per molte ragioni, ha fortunatamente lieve importanza, perocchè nelle macine in esercizio l'aguzzatura è conservata in stato normale, nei limiti del quale la medesima ha poca influenza sul prodotto. 4. La qualità del cereale macinato e quella del prodotto: se cioè nella macinazione del frumento ottenevasi farina, ovvero semola per paste.

[6]Original text: "Le esperienze consistettero poi nella macinazione effettiva del frumento per una durata di mezz'ora, affine di ottenere una quantità sufficiente di macinato ; mentre che il contatore segnava il corrispondente numero di centinaia di giri della macina corsoia".

ability to conduct systematic technical assessments across thousands of geographically dispersed facilities, maintain detailed records of equipment specifications and production capacities, and continuously monitor operations through mechanical counters represents an extraordinary feat of bureaucratic organization and technical expertise that is one of the most advanced examples of industrial regulation of its era.

An element of complexity (and possibly injustice): the different tax base for millers and customers

Table 2.3: The different tax base of the macinato/grist tax

Presentazione della proposta di legge riguardo la tassa sulla macinazione dei cereali (Sella 1865)	**Presentation of the proposed law on the grain milling tax (Sella 1865)**
Così la tassa si sarebbe costituita a doppia base: peso della farina, in riguardo al contribuente; quantità di movimento, in riguardo al mugnaio. Una sarebbe stata la somma dal mugnaio riscossa, un'altra quella che il mugnaio avrebbe pagata al fisco [...]	Thus the tax would be constituted on a double basis: weight of flour, in respect of the taxpayer; quantity of movement, in respect of the miller. One would be the amount collected from the miller, another the amount the miller would pay to the tax collector [...]
Legge 4490/1868	**Act 4490/1868**
Art. 2. In correspettività e saldo delle quote riscosse, il mugnaio pagherà all'Esattore delle tasse dirette, nei modi e tempi che saranno stabiliti con Decreto Ministeriale, una quota fissa per ogni cento giri di macina. A questo effetto sarà a cura e spesa dello Stato applicato all'albero d'ogni macina un contatore dei giri.	**Art. 2.** In payment and settlement of the fees collected, the miller pays to the Collector of direct taxes, in the manner and at the times to be established by Ministerial Decree, a fixed fee for every hundred millstone revolutions. To this end, the State will install, at the care and expense of the State, a counter on the shaft of each millstone.
Regio Decreto 4491/1868	**Royal Decree 4491/1868**
Art. 1. Colui che porta a macinare materie soggette alla tassa imposta dall'art. 1 della Legge 7 luglio 1868, n. 4490, non potrà asportare dal mulino le farine senza avere soddisfatta la tassa alle persone specialmente delegate a riscuoterla dall'esercente del mulino o dall'appaltatore, e fatte conoscere al pubblico con manifesto del Sindaco. La tassa è dovuta dall'avventore all'esercente o appaltatore sul peso della materia effettivamente passata alla macinazione, e da cui si sono ottenute le farine che l'avventore asporta dal mulino.	**Art. 1.** He who brings to the mill matter subject to the tax imposed by article 1 of Act 4490 of 7 July 1868, cannot not remove flour from the mill without having paid the tax to the persons specially delegated to collect it by the mill operator or contractor, and made known to the public by notice of the Mayor. The tax is payable by the customer to the mill operator or contractor on the weight of the matter actually passed through the mill, and from which the flour that the customer removes from the mill has been obtained.

Our translations.

Another aspect that it is worth to emphasising is the establishment of two distinct taxation relationships operating on different bases. This dual system created a bifurcated tax structure where the same levy was calculated and collected using different methodologies depending on the parties involved.

As Table 2.3 illustrates, payments between the State and millers were based on the mechanical counter system described above, while payments between customers and millers operated on a completely different principle: assessment based on the weight of cereals to be milled. Therefore, miller's taxes where determined by machine revolutions (adjusted for each mill's specific productivity), while customers paid according to the actual weight of grain they brought for processing.

The government was well aware that this structural difference could introduce significant unfairness into the system. As Sella acknowledged in his original proposal. Because of this structure, discrepancies could arise between what millers collected from customers and what they owed to the state, creating potential for inequalities and practical complications.

The root of this complexity lays in the technicalities of taxation enforcement. While the mechanical counter system represented the most advanced method available for monitoring mill operations and preventing tax evasion, it was inherently based on machine output rather than input; customers, instead, could only reasonably be taxed on what they brought to the mill—the weight of their grain—since they had no control over mill efficiency or the number of revolutions required for processing.

This dual system inevitably caused disputes and complaints: a customer bringing a given quantity of grain would pay a well defined amount based on weight, while the miller's taxation depended on how efficiently their particular millstone processed that grain. Variations in mill technology, grain quality, or operational conditions could cause the amount collected from the miller be different at equal taxation from the customer.

Despite recognizing these potential inequities, the government concluded that this structural complexity was an unavoidable consequence of attempting to create an effective anti-evasion system while maintaining practical enforceability.

Transitory period

The final element in the introduction of the Tassa sul macinato that literature has insufficiently examined is the remarkably detailed structure of the transitory period. In fact, at the time of the approval of Acts 4490 and 4491, the government had to tackle an important practical constraint: they simply did possess sufficient mechanical counters ready for immediate installation across Italy's extensive network of mills. This logistical challenge was huge. As contemporary sources reveal, "it was impossible to construct in less of six months, from the date of the promulgation of the law to that of its application, all the necessary counters, if one considers that out of one hundred thousand millstones, sixty-five thousand were susceptible to the application of the counter" (Segre 1911, our translation). The government therefore had to prepare comprehensive interim regulations for mills that would initially operate without mechanical monitoring devices.

Rather than viewing this as a mere administrative stopgap, the government developed a sophisticated transitory framework that reveals remarkable foresight in regulatory design.

This framework is illustrated in Table 2.4 and 2.5. We see there that the regulations required mill operators to make formal declarations of their anticipated annual production based on their previous year's milling activity, creating what amounted to a self-assessment system backed by administrative oversight.

Regarding settling of disputes, the government used the existing bureaucratic infrastructure of the *ricchezza mobile* (income tax) to create a jurisditional system for the transitory period. This was both innovative and practical: rather than constructing an entirely new administrative apparatus for mill tax disputes, the regulations explicitly incorporated the established system used for income taxes.

The mechanism created had a three-tiered system of appeals: initial assessments could be challenged at the municipal level through the *Commissione comunale per la ricchezza mobile*, with further appeals possible to the provincial level (*Commissione provinciale per la ricchezza mobile*), and ultimately to a central commission.

The richness of details of the transitory regulations clearly shows that the government understood well that the implementation of the mechanical counter system needed to be gradual: instead of accepting a potentially chaotic interim period, they created procedural frameworks that maintained fiscal control while giving operators clear expectations and legal protection. Despite all this effort, however, the declaration-based system ultimately proved unsuccessful. The problems during the transitory period—for instance massive tax evasion and unfair competition between mills—were so severe that they actually strengthened the case for universal adoption of mechanical counters, despite the technical imperfections of those devices (Marongiu 1995).

Table 2.4: Determination of the macinato/grist tax — *Legge 4490/1868*

Legge 4490/1868	**Act 4490/1868**
Art. 7. Nei mulini, a cui non fosse possibile o conveniente applicare un contatore dei giri, od altro congegno meccanico, la tassa sarà pagata sul prodotto presuntivo della macinazione di ciascun mulino. [...]	**Art. 7.** In mills, to which it is not possible or convenient to apply a revolution counter or other mechanical device, the tax is to be paid on the presumed product of the grinding of each mill. [...]

Our translation.

After the approval of the act in 1868 there was a long discussion regarding the model of counter to use: as a consequence, the 1st of January of 1869 only a very small fraction of the required counters were installed. The mills that did not have counters, had to pay the tax based on the production of the year before.

Table 2.5: Determination of the macinato/grist tax — *Regio Decreto 4491/1868*

Regio Decreto 4491/1868	**Royal Decree 4491/1868**
Art. 4. Chiunque esercita un mulino sarà tenuto a dichiarare, entro un mese dalla pubblicazione della Legge, le quantità di grano, di granturco e segala, di avena e di altri cereali, legumi secchi e castagne, che presume di macinare durante l'anno 1869, e quelle effettivamente macinate nei dodici mesi che precedono quello in cui ha luogo la dichiarazione. [...] L'esercente d'un mulino non fornito di contatore dovrà rinnovare una tale dichiarazione ogni anno all'epoca e nei termini che saranno fissati dal Ministro delle Finanze e resi noti al pubblico con manifesto del Sindaco.	**Art. 4.** Any person operating a mill is obliged to declare, within one month of the publication of the Act, the quantities of wheat, maize and rye, oats and other cereals, dried legumes and chestnuts, which he presumes to have milled during the year 1869, and those actually milled during the twelve months preceding the month in which the declaration is made. [...] The operator of a mill that is not equipped with a meter must make such a declaration every year at the time and within the time limits that will be set by the Minister of Finance and made known to the public by means of a poster issued by the Mayor.
Art. 6. L'Agente delle imposte registrerà ciascuna dichiarazione nel modo che sarà prescritto; le esaminerà, ed a fine di rettificare quelle che gli sembrassero inesatte, o di supplire alle mancanti, dovrà sempre invitare l'esercente a recarsi personalmente, o per mezzo di un suo rappresentante, all'Agenzia in un giorno fissato, per averne le spiegazioni e gli schiarimenti necessari, e per procurare che la dichiarazione sia da lui stesso rettificata nel primo caso, e fatta nel secondo, giusta le prescrizioni della Legge.	**Art. 6.** The Tax Officer registers each declaration as prescribed; examines them, and for the purpose of rectifying those which appear to him to be inaccurate, or of filling in the missing ones, shall always invite the operator to go in person, or by means of his representative, to the Agency on a given day, in order to obtain the necessary explanations and clarifications, and to ensure that the declaration is rectified by him in the first case, and made in the second, in accordance with the provisions of the Law.
Art. 15. L'Agente, accogliendo i reclami che riconosce giustificati, rettifica nel senso dei medesimi le matricole: i reclami poi che non gli sembrano meritevoli di accoglienza, li trasmette alla Commissione comunale o consorziale per la ricchezza mobile, corredandoli di copia della dichiarazione fatta dall'esercente, o, in mancanza della medesima, di quella redatta d'ufficio, del relativo estratto dalla matricola del ruolo, e di tutti quei documenti che credesse necessari.	**Art. 15.** The Tax Officer, accepting the complaints that he recognizes as justified, rectifies the registers accordingly; he transmits the complaints that he does not deem worthy of acceptance to the Municipal or Consortial Commission for movable wealth, accompanied by a copy of the declaration made by the operator, or, in its absence, by the one drawn up ex officio, the relevant extract from the register, and all the documents he considers necessary.
Art. 19. Contro il giudizio delle Commissioni comunali o consorziali potranno, tanto l'Agente delle imposte quanto l'esercente, appellarsi alla Commissione provinciale per la ricchezza mobile entro il termine di giorni dieci, i quali decorreranno dalla notificazione accennata nell'articolo precedente.	**Art. 19.** An appeal against the judgement of the municipal or consortial commissions may be lodged with the Provincial Commission for *ricchezza mobile*[7] by either the tax agent or the operator within ten days of the notification mentioned in the preceding article.
Art. 24. Il ricorso alla Commissione centrale contro il giudizio della Commissione provinciale non sarà ammesso fuorché nei casi di erronea applicazione della Legge, o del presente Regolamento, e dovrà essere presentato nel termine di giorni dieci, osservando la procedura stabilita nei precedenti articoli per l'appello alle Commissioni provinciali.	**Art. 24.** Appeal to the Central Commission against the judgement of the Provincial Commission is allowed only in cases of erroneous application of the Law or of these Regulations, and must be lodged within ten days, following the same procedure as for the appeal to the Provincial Commissions.

Our translations.

2.3.3 The evolution of the tax after 1868

The creation of *Uffici tecnici per il macinato*

The implementation of the Tassa sul macinato required the establishment of a sophisticated administrative apparatus capable of managing the complex technical and bureaucratic challenges posed by the mechanical counter system. The government created specialized technical offices, known as *Uffici tecnici per il macinato*, which represented one of the most advanced examples of industrial taxation administration in 19th-century Europe.

These technical offices were responsible for multiple critical functions that went far beyond simple tax collection. Their mandate included the systematic inspection and technical assessment of mills across the Italian peninsula, the installation and maintenance of mechanical counters, the resolution of disputes arising from the dual taxation system, and the coordination with local administrative authorities for enforcement (Ministero delle finanze 1870-1876). The scope and complexity of their operations reflected the government's recognition that the successful implementation of this innovative taxation system required specialized expertise and dedicated administrative resources.

The technical offices operated through a hierarchical structure that extended from central administration to local implementation. At the national level, they coordinated policy and standardization efforts, while regional and provincial offices managed day-to-day operations and technical assessments. This administrative framework enabled the government to maintain systematic oversight of thousands of mills while ensuring relatively uniform application of assessment procedures across diverse technological and geographic conditions.

The sophistication of this administrative system becomes evident when considering the technical challenges it addressed. As documented in contemporary sources, tax agents conducted detailed inspections recording "the dimensions of the running stone, that is diameter size; the quality of the stone constituting the millstone; the date of its last sharpening; the quality of the milled grain and the quality of the product" (Rafanelli 1872). This level of technical documentation represented an extraordinary feat of bureaucratic organization that required specialized training and expertise.

The Uffici tecnici per il macinato continued to operate throughout the period of the tax's implementation, adapting their procedures as the system evolved and mechanical counter installation progressed. However, their existence was inherently tied to the specific requirements of the grist tax.

The slow introduction of mechanical counters and its distortionary effect

Since in 1869 there were not enough meters in use, the tax was collected that year almost entirely based on estimates of the amount of grain milled. [...]

The vast majority of the operators' declarations were corrected by the tax agents. [...]

Most of the millers appealed to the Commissions, which immediately set to work; but faced with the extraordinary number of complaints and the impossibility of predicting what the work of each mill would be and what the effects of competition would be, the Commission's decisions were pronounced very late, so that at the time of the formation of the rolls, most of the judgments were pending, and the rolls at that time lacked any element of stability. [...]

After the formation of the roles, and throughout 1869, the assessment judgments continued before the Commissions of first and second instance and the Central Commission. In addition, many judgments were handed down on applications for exemption from tax due to suspension of work for reasons of force majeure, in accordance with Article 8 of the Law of July 7, 1868, or for a reduction for any of the reasons indicated in Article 7 of the same law. [...]

Therefore, as of December 31, 1869, the amount of tax assessed on mills not equipped with meters was 31,745,815 lire. [...]

These causes cannot fail to give rise to a significant reduction in the above-mentioned figure of 31,745,815 lire, which also includes many arrears charged to millers who, forced to close their mills and having become insolvent, did not even bother to appeal. [...]

In 1869, the amount of tax assessed by means of the meter was very small because, as I will mention later, although a considerable number of meters were used, the amount of tax due from the miller for every hundred turns of the millstone was not determined. [...]

The figure of 11,959 mills closed at that time shows how serious the disruption to the milling industry was caused by the application of the tax based on presumed work.

This is because the mills that remained inactive were precisely those that had previously done the most work, and they found themselves facing competition from other mills that had previously been inactive due to a lack of customers, and to which the Commissions had attributed small quantities of milling.

These small allocations attributed to mills that were previously almost inactive but had a lot of mechanical power also explain the fact that millers pay

tax to the treasury without collecting it from customers. (Relazione 1870)[8]

This remarkable contemporary account reveals the profound gap between the government's ambitious technological vision and the chaotic reality of implementation during the tax's first year. The Finance Ministry's report candidly acknowledges a complete systemic failure: the mechanical counter system, which was supposed to be the cornerstone of the tax's innovation, contributed virtually nothing to revenue collection in 1869. Instead, the administration fell back on the very estimation-based methods that the counter system was designed to replace.

The systematic correction of miller declarations by tax agents points to a fundamental breakdown in trust and cooperation between the state and industry operators. When "the vast majority" of declarations required correction, this suggests either widespread attempted evasion or, more likely, genuine disagreement about appropriate assessment methods in the absence of standardized measurement procedures. The reliance on bureaucratic judgment rather than mechanical precision undermined the tax's claim to scientific objectivity.

Particularly noteworthy is the report's acknowledgment that the appeals system encountered significant challenges that affected the taxation process. The Commissions faced "the impossibility of predicting what the work of each mill would be and what the

[8]Our translation. Original text: "siccome nel 1869 non fu dato di avere un numero abbastanza ragguardevole di contatori applicati, così l'esazione della tassa seguì in quell'anno quasi per intiero in base all'accertamento della quantità di presunta macinazione. [...]

Grandissima parte delle dichiarazioni degli esercenti venne rettificata dagli agenti delle imposte. [...]

La maggior parte dei mugnai ricorse alle Commissioni, le quali si posero tosto all'opera; ma di fronte allo straordinario numero di reclami, e all'impossibilità di prevedere quale sarebbe stato il lavoro di ciascun mulino e quali gli effetti della concorrenza, le decisioni della Commissione vennero pronunciate assai tardi, per cui al momento della formazione dei ruoli gran parte dei giudizi era pendente, ed i ruoli a quell'epoca mancavano di ogni elemento di stabilità. [...]

Dopo la formazione dei ruoli, e durante tutto l'anno 1869, si proseguirono i giudizi di accertamento innanzi alle Commissioni di prima e seconda istanza ed alla Commissione centrale. Oltre a ciò, molti giudizi intervennero su domande dirette ad ottenere esonero da tassa a causa di sospensione di lavoro per forza maggiore, giusta l'articolo 8 della legge 7 luglio 1868, o ad ottenere riduzione per alcuna delle cause indicate all'articolo 7 della stessa legge. [...]

Al 31 dicembre 1869 pertanto la somma d'imposta rimasta accertata a carico dei mulini non forniti del contatore era di lire 31 745 815. [...]

Queste cause non potranno a meno di dar luogo ad una diminuzione sensibile della surriferita cifra di 31 745 815 lire, nella quale sono altresì comprese molte guote arretrate, iscritte a carico di mugnai i quali, costretti a chiudere i mulini e, divenuti insolvibili, non si curarono nemmeno di ricorrere. [...]

Di pochissima entità fu nel 1869 la somma d'imposta accertata col mezzo del contatore, poichè, come in seguito verrò accennando, sebbene un ragguardevole numero di contatori fosse applicato, mancava però la determinazione della quota di tassa dovuta dal mugnaio per ogni cento giri di macina. [...]

La cifra di 11,959 mulini chiusi a quell'epoca dimostra quanto grave sia stata la perturbazione indotta nell'industria della macinazione dall'applicazione della tassa in base al lavoro presunto.

Imperocchè i mulini rimasti inattivi sono appunto quelli che prima facevano maggior lavoro, e si trovarono di fronte la concorrenza degli altri mulini prima inattivi per difetto di avventori, ed ai quali le Commissioni avevano attribuite lievi quantità di macinazione

Questi lievi accertamenti attribuiti a mulini prima quasi inattivi, ma dotati di molta forza meccanica, spiegano pure il fatto di mugnai che pagano tassa all'erario senza riscuoterne agli avventori".

effects of competition would be"—revealing the complexity of implementing uniform taxation across Italy's diverse milling infrastructure. The administrative difficulties, where "most of the judgments were pending" when tax rolls were formed, created considerable uncertainty for mill operators during the transitional period.

The report's observation about 11,959 mill closures deserves particular attention for what it reveals about the tax's unintended consequences. The Finance Ministry explicitly acknowledges that the estimation system inverted normal competitive relationships: previously successful mills became uncompetitive while inactive mills gained artificial advantages through favorable assessments. This represents a remarkable admission that government policy had fundamentally distorted market mechanisms, creating winners and losers based on administrative arbitrariness rather than economic efficiency.

Most telling is the report's explanation for why millers paid taxes to the state without collecting equivalent amounts from customers. This phenomenon—millers effectively subsidizing the tax from their own resources—indicates that the dual assessment system created irreconcilable contradictions between what customers owed based on grain weight and what millers owed based on estimated production. The fact that this outcome surprised government officials suggests they had not fully understood the implications of their own legislative framework.

Even where mechanical counters were installed, the system failed to function as intended because "the amount of tax due from the miller for every hundred turns of the millstone was not determined." This reveals that the government had deployed the hardware without establishing the fundamental calculation procedures needed to make it operational—a striking example of technological implementation without adequate administrative preparation.

The Finance Ministry's frank assessment demonstrates that by late 1869, the innovative counter-based taxation system existed largely on paper, while the actual collection relied on precisely the estimation methods that mechanical monitoring was supposed to eliminate. The substantial sum of 31,745,815 lire assessed on non-metered mills represented not the success of systematic assessment procedures, but the product of bureaucratic improvisation in the face of technological and administrative failure.

The subsequent years witnessed a gradual but accelerating installation of mechanical counters across the peninsula. From the modest 186 counters operational by the end of 1869, the program expanded dramatically to 30,000 by 1870 and 52,000 by 1871.

This represented a substantial logistical achievement, requiring not only the manufacture and distribution of thousands of precision instruments but also the training of personnel capable of installing and maintaining them across Italy's diverse geographic and technological landscape.

However, the expansion of counter coverage did not immediately resolve the fundamental tensions inherent in the dual taxation system. Even mills equipped with mechan-

ical counters continued to operate under conditions of uncertainty, as the government struggled to establish standardized rates for tax liability per hundred millstone revolutions. The technical complexity of accounting for variations in millstone size, grain type, and milling efficiency meant that counter installation, while necessary, was insufficient to create the precise and equitable taxation system originally envisioned. Mills with counters often found themselves in disputes with tax authorities over the appropriate conversion factors between mechanical output and fiscal obligation, perpetuating many of the same conflicts that had characterized the estimation-based period. The persistence of these difficulties suggests that the challenges identified in the 1869 report reflected deeper structural problems rather than merely transitional growing pains. The interaction between national taxation policies and local milling practices proved more complex than anticipated, requiring ongoing administrative adaptation and negotiation that extended well beyond the initial implementation period.

The revolts, the public debate and the slow abolition

The introduction of the Tassa sul macinato triggered widespread social unrest that fundamentally altered the political landscape of the newly unified kingdom. Popular revolts erupted across the Italian peninsula as the tax's effects on bread prices became apparent, particularly affecting the poorer classes for whom flour-based products constituted the primary source of nutrition. The scale and intensity of these demonstrations forced the government to implement emergency measures

Parliamentary opposition to the tax intensified as its social costs became apparent. While the Destra Storica had initially defended the measure as essential for achieving fiscal balance, growing criticism from within its own ranks combined with pressure from the opposition to create political instability. The tax became a central issue in the political debates that would eventually contribute to the fall of the Destra Storica in 1876, though the decisive factor was the defeat of Minghetti's railway nationalization proposal rather than the grist tax itself (Marongiu 1995, 1996).

When the Sinistra Storica came to power in 1876 under Agostino Depretis, the abolition of the unpopular grist tax formed a central component of their political program. However, the actual process of elimination proved more gradual than their electoral rhetoric had suggested. Depretis initially adopted "a policy of moderate graduality, recognizing that immediate abolition would create substantial fiscal disruption.

The reduction process began in 1879, but opposition from the Destra Storica in the Senate limited the scope of reform. As shown in Table 2.6, the 1879 modifications (Law 4994/1879) eliminated taxation on several secondary cereals while maintaining the full burden on wheat and reducing rates for corn, oats, and rye. A further reduction occurred in 1880 under Benedetto Cairoli's government with Agostino Magliani as Finance Min-

ister, which eliminated taxation on most cereals except wheat while reducing the wheat tax rate from 2.00 to 1.50 liras per 100 kg.

The final abolition came on January 1, 1884, under Depretis's renewed leadership. At the time of its elimination, the tax was generating 80 million liras annually—a substantial sum that represented a significant fiscal challenge for the government. The abolition forced the state into deficit, as reduced revenues combined with continued high expenditures created budgetary pressures that would persist for several years.

Table 2.6: Evolution of tax rates of *Tassa sul macinato* from institution to abolition (Liras per 100kg).

Period of application / Taxed cereals	**1/1/1869 31/09/1874**	**1/10/1874 31/07/1879**	**1/08/1879 31/08/1880**	**1/09/1880 31/12/1883**
Wheat	2,00	2,00	2,00	1,50
Corn	1,20	1,00	*No tax*	*No tax*
Oat	1,20	1,00	*No tax*	*No tax*
Rye	1,00	1,00	*No tax*	*No tax*
Hazelnut	0,50	*No tax**	*No tax*	*No tax*
Legumes	0,50	*No tax**	*No tax*	*No tax*
Barley	0,50	1,00	*No tax**	*No tax*
Other cereals	0,50	*No tax**	*No tax*	*No tax*

Source: Our own elaboration on L. 4490/1868, R.D. 2056/1874, L. 4994/1879, R.D. 5593/1880.
*To be precise, the acts say that the grist tax on the milling of these goods have to follow special regimes that will be described in later acts or rulebooks, which we were unable to find on all the sources and libraries searched.

2.4 Historical reconstruction II - The *Dazio di Consumo* (consumption duty)

2.4.1 A hybrid between a consumption tax and a duty

The Dazio di Consumo was a fiscal tool that operated as a hybrid between a traditional consumption tax and an import/export duty. This hybrid structure was created to address of practical necessities and to overcome some of the limitations of 19th-century tax administration.

Duty-like characteristics: In a way the Dazio di Consumo operated like a customs duty in its collection mechanism: goods were taxed at specific control points - the

"recinto daziario" (customs line) - that essentially operated as internal borders around municipalities . The tax was levied upon the introduction of products listed in the tariff inside these customs lines. This created artificial boundaries within the national territory, similar to how duties operate at international borders. **Consumption tax characteristics:** On the other hand, the Dazio functioned also as a consumption tax because its ultimate economic burden fell on local consumers rather than on the movement of goods per se.

The dazio system therefore used the collection infrastructure of customs duties (border controls, enclosed areas, movement monitoring) to achieve the economic effects of a consumption tax.

2.4.2 Dazio di Consumo in pre-unification Italian states

> *This project is necessary first of all to give an increase to the income of the State, which is then indispensable to give an order to the finances of many municipalities, in which the consumption duty is almost entirely devolved to the State, while in others it is entirely devolved to the municipality. The burdens borne by these municipalities in such a different financial state are perfectly identical under municipal law; hence in the present state there is an absolute lack of equity and justice.* (Sella)[9]

> *In the provinces of Emilia and Lombardy, and in all the southern provinces, there is no municipality without consumption taxes. In the provinces of Marche and Umbria, the large majority of municipalities bear this tax, namely: in the former, 227 municipalities out of 255, and in the latter, 152 out of 176. In the provinces of the ancient Kingdom and in Tuscany, the minority of municipalities use this form of taxation. In the ancient provinces, 236 municipalities out of 2349 have a consumption tax and out of the 246 Tuscan municipalities only 6 are in this case, namely: Florence, Livorno, Lucca, Pisa, Pistoia and Siena. In the Italian Kingdom, which has 7719 municipalities, there are*

[9]This quote is contained in Cereseto (1889) without a proper reference; we believe that it was part of the Sella's 1861 speech when he made the first proposal of nationwide reorganization of dazio di consumo (never approved). The text shown above is our translation of the following: "Questo progetto è necessario prima di tutto per dare un incremento alla rendita dello Stato, indispensabile poi per dare un assetto alle finanze di molti comuni, nei quali il dazio di consumo è pressoché interamente devoluto allo Stato, mentre in altri è interamente devoluto al comune. I pesi che questi comuni in uno stato finanziario così diverso sopportano sono perfettamente identici in virtù della legge comunale; quindi nello stato attuale vi è assoluta mancanza d'equità e di giustizia".

therefore 6824 that pay consumption duty and 2435 that do not. (Sella 1863)[10]

Minister Sella showed that Italian consumption taxes existed as multiple fragmented fiscal systems throughout the peninsula before unification. The ancient tax systems which spanned multiple centuries throughout Italian history developed strong regional differences which became a major hurdle for national unification.

The modern dazio di consumo tax system has its deep roots in ancient Roman taxes *vectigalia* and *portoria* which served as early forms of indirect taxation for goods and trade (Cereseto 1889).

Seven major states operated in Italy before unification each with its own consumption taxation system that mirrored their political backgrounds and administrative systems.

The fiscal-military state developed under the Kingdom of Sardinia-Piedmont through negotiated taxation arrangements. The Savoyard system used negotiated *tasso—quota* taxes instead of applying standardized tax rates between government agencies and local communities. Zangheri (1957) shows that the consumption tax was re-established on April 15, 1701 to fund the War of Spanish Succession and it equated to about ten percent of normal grain prices.

After 1815 the Hasburg system brought Germanic fiscal efficiency to northern Italy through Austrian administration in the Kingdom of Lombardy-Venetia. The tax collection system in this regime operated under dual viceroys who controlled both Milan and Venice and utilized more centralized methods than previous systems. Although this system maintained Italian language for administration and local personnel it introduced bureaucratic standardization that shaped post-unification practices (Cereseto 1889).

The Grand Duchy of Tuscany under the House of Lorraine implemented progressive fiscal policies which enforced direct taxation instead of indirect taxation. The financial and administrative reforms of Leopold I (1765-1790) brought tax collection into order and transformed public service operations. The progressive fiscal system developed by Leopold I transformed Tuscany into one of the leading pre-unification Italian fiscal systems which is why Sella noted that only six major Tuscan cities maintained consumption taxes until 1863 (Cereseto 1889).

The Papal State operated a consumption tax system that had multiple tax collection authorities between papal authorities and municipal administrations. Major cities including Rome, Bologna and Ferrara managed their local *gabelle* taxes independently

[10]Our translation. Original text: "Nelle provincie dell'Emilia e della Lombardia, e in tutte le provincie meridionali, non vi ha comune alcuno privo di tasse sulle consumazioni. Nelle provincie delle Marche e dell'Umbria, il maggior numero dei comuni sopporta questa tassa, cioè: nelle prime, 227 Comuni sopra 255, e nella seconda, 152 sopra 176. Nelle provincie dell'antico Regno e in Toscana, la minoranza dei comuni usa di questa forma d'imposizioni. Nelle antiche provincie, 236 Comuni sopra 2349 hanno un dazio di consumo e sopra i 246 Comuni Toscani solamente 6 sono in questo caso, cioè: Firenze, Livorno, Lucca, Pisa, Pistoia e Siena. Nel Regno Italiano che conta 7719 Comuni, ve n'ha dunque 6824 che pagano dazio di consumo, e 2435 che non lo pagano".

while the papal government depended on tax farmers (*gabellieri*) to collect duties through revenue-sharing percentages (Cereseto 1889).

The Kingdom of Two Sicilies established dazi civici (municipal consumption duties) that operated within a centralized system through which different rates applied to wine, oil and manufactured products depending on whether they were located in Sicily or on the mainland (Cereseto 1889).

Each state's consumption tax system operated as an integral part of its government structure and local privileges together with its economic interests.

2.4.3 The convoluted organization of dazio di consumo depicted in 1864

The governmental and local quota of Dazio di Consumo and the classification of municipalities

Law 1827/1864, in force since July 3, 1864, established a taxation system that significantly modified the administration across the peninsula of the Dazio di Consumo (L. 1827/1864).

This piece of legislation allowed to combine governmental revenue collection and municipal autonomy, though within the context of Italy's strongly centralized fiscal framework (Di Majo and De Simone 2017).

The governmental quota of the duty (*dazio governativo*) collected on behalf of the central state, and a local quota of the duty (*addizionali comunali* and *dazi comunali*) retained by municipal authorities. This structure reflected the political necessity of balancing centralized fiscal control with local administrative traditions that had their roots in pre-unification Italian governance, while maintaining the "centralistic" organization of public finances that had been chosen to favor amalgamation between territories and citizens belonging to separate state entities (Di Majo and De Simone 2017; Marongiu 1995).

The 1864 legislation established a double classification system for Italian municipalities that determined both their tax obligations and collection mechanisms. As detailed in Tables 2.7 and 2.8, this classification operated in two independent directions that served distinct fiscal purposes: the Classi system based on population size, which determined the level of government tax, and the *Comuni aperti / Comuni chiusi* distinction based on administrative and topographical characteristics, which determined the actual methods of tax collection.

The Population-Based Classification System (Classi)

The population-based classification initially divided all the municipalities into five Classes (*Classi*), as specified in Article 4 of Law 1827/1864, with the purpose of establishing

different governmental tax rates as a function of the municipal size and administrative capacity. The different classes regarded municipalities with agglomerated populations as follows (L. 1827/1864, Art. 4; Alessio 1880):

- First Class: more than 60,000 inhabitants (they represented the largest urban centers of the kingdom)
- Second Class: between 40,001 and 60,000 inhabitants
- Third Class: between 20,001 to 40,000 inhabitants
- The Fourth Class: 8,001 and 20,000 inhabitants
- Fifth Class: all municipalities with fewer than 8,000 inhabitants

The Royal Decree 2981/1866 introduced many modifications to the original harmonization. Among these, we find a modified system of classes that consolidated the initial five into four classes while maintaining the same fundamental principles of graduated taxation according to municipal size (R.D. 2981/1866, Art. 3). As shown in Table 2.7, the revised system redefined the First Class as municipalities exceeding 50,000 inhabitants, Second Class as those with 20,001 to 50,000 inhabitants, while the Third and Fourth Classes corresponded respectively to what had previously been the fourth and fifth classes under the 1864 legislation. As Cereseto (1889) notes, this division remained in force throughout the period under examination.

The rationale for this graduated system was straightforward: larger municipalities, with their more sophisticated commercial infrastructure, higher population density, and greater administrative capacity, could support higher governmental tax rates while maintaining collection efficiency (Villani 2011; Alessio 1887).

The Comuni Aperti and Comuni Chiusi Distinction: Collection Methodology

The second way of classification, more significant regarding the actual administration of the tax, distinguished between *Comuni chiusi* (closed municipalities) and *Comuni aperti* (open municipalities) based on the feasibility and method of tax collection.

This distinction, outlined in Article 5 of Law 1827/1864 and detailed in Tables 2.9 and 2.10, determined how the Dazio di Consumo had to be collected and administered, regardless of the municipal population class. As Di Majo and De Simone (2017) note, this system caused significant territorial inequalities between open and closed municipalities and between southern Italy and central-northern Italy. This inequality was exacerbated by the uneven distribution of municipal types across the peninsula: larger and more prosperous northern and central Italian cities were more likely to possess the infrastructure and topographical characteristics necessary for the "comuni chiusi" status, and thus benefited from more efficient tax collection methods and greater control over their fiscal boundaries. Conversely, smaller municipalities and those in the economically disadvan-

taged South were more frequently classified as comuni aperti, subjecting them to less intensive but also less predictable tax collection mechanisms.

Comuni chiusi were municipalities that could be effectively surrounded by a customs line (*linea daziaria* or *recinto daziario*), as defined in Article 11 of Royal Decree 2981/1866. This customs line was formed by "walls, ditches, bastions by which a municipality or part thereof is enclosed, or by administratively fixed limits" and, in municipalities touching natural boundaries such as "the sea, rivers, lakes and canals", the duty line was formed by the shore (R.D. 2981/1866, Art. 11). The closed municipality system was very effective, since it allowed authorities to monitor and tax goods at specific entry points into the municipal territory (Marongiu 1995).

Comuni aperti, conversely, were municipalities that either could not be effectively enclosed by a customs line due to topographical conditions, or chose to operate under the open system for administrative reasons. The main implications of these systems can be inferred from contemporary commentaries (Cereseto 1889), which state that "in open municipalities, inside and outside the agglomeration, all consumers are equally contributors and there are no other limits except those of the municipal circumscription" , and that "the collection in open municipalities is much less intensive than in closed ones".[11]

The fundamental difference in collection scope between the two systems created what contemporary observers recognized as distinct fiscal regimes. In closed municipalities, as Cereseto (1889) explains, "any consumption resulting from the fact of introduction is equally taxed, provided it occurs within the limits of the tax enclosure" , while in open municipalities "only consumption that occurs through retail sales is taxed, and any other consumption goes fully exempt".[12]

The Interplay Between Classification Systems

It is important to note that these two classification dimensions operated independently: a large First Class municipality could be either closed or open depending on its topographical and administrative characteristics, just as a small Fourth Class municipality could choose either collection method if conditions permitted. The class system determined the level of governmental taxation, while the open/closed distinction determined the method of collection, creating a matrix of possibilities that reflected the diverse administrative and geographical realities of the Italian peninsula (Alessio 1887; Fazio 1883).

[11]Our translation. Original text: "nei Comuni aperti, dentro e fuori l'agglomerato, tutti i consumatori sono ugualmente contribuenti né vi sono altri limiti tranne quelli della circoscrizione comunale [...] l'esazione nei Comuni aperti è molto meno intensa che nei chiusi"

[12]Our translation. Original text: "Qualunque consumo esplicante col fatto dell'introduzione, è ugualmente colpito, purché avvenga nei limiti della cinta daziaria [...] soltanto il consumo che si esplica col fatto della vendita al minuto è colpito, e qualunque altro consumo va esente del tutto"

Table 2.7: Classification of Italian municipalities for the application of *dazio di consumo* – Legge 1827/1864

Legge 1827/1864	**Act 1827/1864**
Art. 3. Per l'applicazione della tariffa A i Comuni sono divisi in cinque classi, e per la riscossione dei dazi in essa determinati si dividono in Comuni chiusi e in Comuni aperti. **Art. 4.** Sono Comuni: Di 1.a classe quelli di una popolazione agglomerata superiore a 60,000 abitanti; Di 2.a classe quelli di una popolazione agglomerata da 40,001 a 60,000 abitanti; Di 3.a classe quelli di una popolazione agglomerata da 20,001 a 40,000 abitanti; Di 4.a classe quelli di una popolazione agglomerata da 8,001 a 20,000 abitanti; Di 5.a classe quelli di una popolazione agglomerata inferiore a 8,000 abitanti. Di questa divisione si farà constare per Decreto Reale. **Art. 5.** I comuni delle prime quattro classi sono dichiarati chiusi. Quando però alcuno di essi si trovasse in condizioni topografiche da non potersi cingere con linea daziaria, sarà dichiarato aperto con Decreto Reale, previo parere del Consiglio di Stato. I Comuni di quinta classe non potranno essere dichiarati chiusi se non quando o sieno capoluogo di circondario, o ne facciano domanda, od intendano mantenere o stabilire per conto proprio un dazio d'introduzione. Le porzioni dei Comuni chiusi, fuori del recinto daziario, s'intenderanno parificate ai comuni aperti.	**Art. 3.** For the application of fees A, municipalities are divided into five Classes, and for the collection of the duties determined therein, they are be divided into Comuni aperti and Comuni chiusi. **Art. 4.** Municipalities are classified as: First class if they have a population of more than 60,000 inhabitants; Second class if they have a population of between 40,001 and 60,000 inhabitants; Third class if they have a population of between 20,001 and 40,000 inhabitants; Fourth class if they have a population of between 8,001 and 20,000 inhabitants; Fifth class if they have a population of less than 8,000 inhabitants. This division will be applied through Royal Decree. **Art. 5.** Municipalities of the first four types of classe are declared Comuni chiusi. However, when any of them is in such a topographical condition that it cannot be surrounded by a customs line, it will be declared Comune aperto by Royal Decree, after consultation with the Council of State. Municipalities of quinta classe cannot be declared Comune chiuso unless they are the capital of the district, or they request it, or they intend to maintain or establish on their own account a duty of introduction. The portions of Comuni chiusi, outside the customs line, are deemed to be equal to Comuni aperti.

Our translations.

Table 2.8: Classification of Italian municipalities for the application of *dazio di consumo* – Regio Decreto 2981/1866

Regio Decreto 2981/1866	**Royal Decree 2981/1866**
Art. 2. Per l'applicazione delle nuove tariffe i comuni sono divisi in quattro classi, e per la riscossione dei dazi in esse determinati è mantenuta la distinzione di comuni chiusi e di comuni aperti. **Art. 3.** Sono comuni di prima classe quelli di una popolazione agglomerata superiore a 50,000 abitanti. Sono comuni di seconda classe quelli di una popolazione agglomerata da 20,001 a 50,000. Sono rispettivamente comuni di terza e quarta classe quelli che per la legge 3 luglio 1864, n.1827, erano di quarta e quinta classe. Conseguentemente le prescrizioni dei due primi capoversi dell'articolo 5 di detta legge non sono applicabili che ai comuni delle prime tre classi. Si applicheranno alla quarta classe le disposizioni dell'articolo 5 stabilite pei comuni di quinta classe. **Art. 11**. Linea daziaria. La linea daziaria è formata dalle mura, dai fossati, dai bastioni da cui è chiuso un comune o parte di esso, ovvero dai limiti amministrativamente fissati. Nei comuni che toccano il mare, fiumi, laghi e canali, la linea daziaria è da questo lato formata dalla riva.	**Art. 2.** For the application of the new fees, the communes are divided into four classes, and for the collection of the duties determined therein, the distinction between comuni chiusi and comuni aperti is maintained. **Art. 3.** Municipalities are classified as prima classe if they have an agglomerated population of more than 50,000 inhabitants. Municipalities are classified as second class if they have an agglomerated population from 20,001 to 50,000. Municipalities of third and fourth classes are those that were respectively classified as fourth class and fifth class by Act n.1827 of 3 July 1864. Consequently, the prescriptions of the first two paragraphs of Article 5 of that act are only applicable to municipalities in the first three types of class. The provisions of Article 5 laid down for fifth class municipalities apply to the ones classified as fourth class. **Art. 11**. Duty line. The duty line is formed by the walls, ditches, bastions by which a municipality or part thereof is enclosed, i.e. by the administratively fixed limits. In municipalities touching the sea, rivers, lakes and canals, the duty line is on this side formed by the shore.

Our translations.

Table 2.9: Rules of collection of dazio di consumo – Legge 1827/1864

Legge 1827/1864	**Act 1827/1864**
Art. 6. Il dazio sul consumo si riscuote, nel Comuni chiusi, alla introduzione dei prodotti indicati dalla tariffa nel recinto daziarlo del Comune. **Art. 8.** Pei Comuni aperti e per le porzioni del comuni chiusi che sono al di fuori del recinto daziario, il dazio di consumo si riscuote sulla vendita al minuto [...]. **Art. 13.** È data facoltà ai consigli comunali di imporre sulle bevande e sulle carni una tassa addizionale a quella governativa. I Consigli comunali possono inoltre imporre un dazio di consumo sugli altri commestibili e bevande, sui formaggi, combustibili, materiali da costruzione, sapone, materie grasse, ed altre di consumo locale, di natura analoga al generi suindicati. [...]. Un Decreto R. fisserà il *maximum* della tariffa pei dazi di consamo e della tassa addizionale a quella governativa che i Comuni possono imporsi.	**Art. 6.** The duty on consumption are levied, in enclosed municipalities, upon the introduction of the products specified in the tariff into the customs enclosure of the municipality. **Art. 8.** For the open Municipalities and for the portions of the enclosed Municipalities that are outside the customs enclosure, the consumption duty are levied on the retail sale [...]. **Art. 13.** Municipal councils may impose a tax on beverages and meat in addition to the governmental tax. Municipal councils may also impose a consumption tax on other edibles and beverages, cheese, fuel, building materials, soap, fats, and other locally consumed goods of a nature similar to the aforementioned goods. [...]. A Royal Decree will establish the minimum tariff for the duty of consamo and the additional tax to the governmental one that the Communes may impose.

Our translations.

The organization of the collection of dazio di consumo

Collection Mechanisms and Administrative Arrangements

The practical implementation of this dual taxation system required administrative arrangements that differed substantially between Comuni chiusi and Comuni aperti. As outlined in Tables 2.9 and 2.10, in Comuni chiusi, "the duty on consumption are levied upon the introduction of the products specified in the tariff into the customs enclosure of the municipality" (L. 1827/1864, Art. 6). This system required the establishment of customs offices "both at the entrance and in the interior of enclosed municipalities" (R.D. 1839/1864, Art. 4). For open municipalities, the collection mechanism was fundamentally different: "the consumption duty are levied on the retail sale" of specified products (L. 1827/1864, Art. 8). This required customs offices to be "established according to the importance of consumption, in such number and in such places as are deemed most appropriate" (R.D. 1839/1864, Art. 4; Fazio 1883). The organization of dazio di consumo collection represented one of the most complex administrative challenges of post-unification Italy, requiring sophisticated coordination between state and municipal authorities while accommodating the diverse geographical and economic conditions across the peninsula. The system established by the 1864 legislation (L. 1827/1864) and subsequent modifications created multiple collection mechanisms and administrative arrangements that reflected both practical necessities and the tension between centralized

Table 2.10: Rules of collection of dazio di consumo – Regio Decreto 1839/1864

Regio Decreto 1839/1864	**Royal Decree 1839/1864**
Art. 1. Dazi governativi. I dazi di consumo per conto dello Stato si riscuotono: 1.° Nei comuni dichiarati chiusi, alla introduzione nei medesimi [...]; 2.° In quelli aperti, sulla vendita al minuto [...]; 3.° Negli uni e negli altri sulla fabbricazione della birra e delle acque gassose. **Art. 2.** Dazi comunali. I dazi addizionali, e quelli che i comuni chiusi possono imporre per loro conto sulla minuta vendita degli oggetti colpiti da tassa dello Stato, devono limitarsi entro due quinti dei dazi governativi. I dazi comunali sugli altri generi non sorpasseranno il decimo del loro valore medio quinquennale;[...]. La misura dei dazi deve essere sempre eguale, qualunque sia la provenienza dei generi, e devono tenersi esenti quelli che si impiegano come materie prime nella fabbricazione della birra e dell'alcool. I dazi comunali di consumo sui cereali si riscuotono: 1.° Nei comuni chiusi all'introduzione nei medesimi delle farine, del pane, delle paste, ovvero alla introduzione dei cereali nei mulini entro l'ambito daziario; 2.° In quelli aperti all'introduzione delle farine nei locali in cui si fabbricano, o si vendono il pane e le paste. **Art. 4.** Uffici daziari. Uffici daziari sono stabiliti così all'ingresso che nell'interno dei comuni chiusi. Nei comuni aperti sono stabiliti secondo l'importanza della consumazione, in quel numero ed in quei luoghi che si stimeranno più opportuni.	**Art. 1.** Government duties. Government duties are levied on behalf of the State: 1.° In comuni chiusi, on the introduction into them [...]; 2.° In comuni aperti, on the retail sale [...]; 3.° In the one and the other on the manufacture of beer and carbonated water. **Art. 2.** Municipal duties. Additional duties, and those that comuni chiusi may impose on their behalf on the small sale of objects subject to state tax, shall be limited to within two fifths of government duties. Municipal duties on other goods shall not exceed one-tenth of their five-year average value; [...]. The measure of the duties shall always be equal, whatever the origin of the goods, and those used as raw materials in the manufacture of beer and alcohol shall be exempt. Municipal duties on grain shall be levied: 1.° In comuni chiusi to the introduction into them of flour, bread, pasta, or the introduction of cereals into mills within the duty area; 2.° In comuni aperti to the introduction of flour into the premises where bread and pasta are manufactured or sold. **Art. 4.** Customs offices. Customs offices are established both at the entrance and in the interior of comuni chiusi. In comuni aperti they are established according to the importance of consumption, in such number and in such places as are deemed most appropriate.

Our translations.

fiscal control and local administrative autonomy (Villani 2011; Di Majo and De Simone 2017).

The collection of dazio di consumo varied fundamentally according to whether municipalities were classified as comuni chiusi or comuni aperti, each requiring distinct administrative approaches and creating different relationships between taxpayers and tax authorities (Cereseto 1889).

In comuni chiusi, the dazio di consumo was levied upon "the introduction of products specified in the tariff into the municipal customs enclosure" (L. 1827/1864, Art. 6). This system, as documented in contemporary legal commentaries, was considered "obvious and easy" and did not present serious complications (Cereseto 1889). The introduction of goods into the customs enclosure was accepted as an act inducing a legal presumption of consumption, creating a clear taxable event that could be efficiently monitored and controlled.

The practical implementation required establishing customs offices "both at the entrance and in the interior of closed municipalities" (R.D. 1839/1864, Art. 4). When goods subject to duty arrived at the barriers, they had to be declared; agents could examine whether the declaration conformed to reality, the duty was then paid, and the customs office issued a receipt (bolletta) certifying that payment had been made. The customs offices had to be equipped with the necessary weights for operations, and "weighing had to be performed at no cost to the taxpayer"[13] (Cereseto 1889).

For comuni aperti, the collection mechanism was fundamentally different: "the consumption duty is collected on retail sales" (L. 1827/1864, Art. 8). This system required customs offices to be "established according to the importance of consumption, in such number and in such places as are deemed most appropriate" (R.D. 1839/1864, Art. 4; Fazio 1883). This approach necessitated a more dispersed and flexible administrative structure, as tax collection points had to be distributed throughout the municipal territory based on commercial activity rather than concentrated at defined entry points.

Administrative Arrangements Between State and Municipalities

The complexity of the dazio di consumo system was further amplified by the various administrative arrangements possible between the state and municipalities, creating what contemporary observers recognized as a sophisticated framework for fiscal cooperation and revenue sharing (Marongiu 1995).

The default arrangement provided that taxes "are collected by means of government agents, equivalent to those of the customs service for the exercise of their functions" (L. 1827/1864, Art. 15). Under this system, both governmental duties and municipal duties

[13]Our translation. Original Italian text: "le operazioni di peso devono eseguirsi senza spesa del contribuente"

in comuni chiusi, as well as surcharges in comuni aperti, were collected by state agents, with "collection costs divided according to respective revenues".

Municipalities could alternatively collect both governmental and municipal consumption duties through their own agents, provided they agreed with the government to ensure a minimum revenue on the duties due to the state. As specified in the regulations, "The surplus over the guaranteed minimum shall be divided equally between the Government and the Municipalities" (L. 1827/1864, Art. 16). This arrangement required municipalities to assume direct financial responsibility while sharing potential benefits from efficient collection.

The Abbonamento System: A Complex Revenue-Sharing Mechanism

One of the most significant administrative innovations was the *abbonamento* (subscription) system, which represented a sophisticated form of fiscal devolution that allowed municipalities to assume responsibility for both state and local tax collection in exchange for guaranteed payments to the central government.

Under the abbonamento system, "The collection of governmental consumption duties shall take place by subscription with those municipalities that request it and assume the obligation to pay the amount directly" (L. 1827/1864, Art. 17). Through this arrangement, "the Municipality becomes almost a contractor for duties vis-à-vis the Government"[14](Cereseto 1889).

The abbonamento system operated on standardized temporal frameworks: contracts were "ordinarily lasting for a quinquennium"[15]. The subscription price was "established on the average of net revenues made in the preceding quinquennium, adding a certain amount for the natural increase of public wealth"[16] (Cereseto 1889). This pricing mechanism attempted to balance predictable revenue streams for the state with reasonable burden estimates for municipalities.

The abbonamento was "always circumscribed within the limits of the territory of the subscribed Municipality"[17]. This territorial constraint created important implications for administrative reorganization: "therefore, should a dismemberment of part of the territory occur, the abbonamento passes proportionally to the new municipality on which

[14]Our translation. Original Italian text: "Con questo sistema il Comune diventa quasi un appaltatore dei dazi di fronte al Governo"

[15]Our translation. Original Italian text: "di regola duraturo per un quinquennio"

[16]Our translation. Original Italian text: "stabilito sulla media degli incassi netti fatti nel precedente quinquennio, aggiungendovi un tanto per il naturale incremento della ricchezza pubblica"

[17]Our translation. Original Italian text: "sempre circoscritto nei limiti del territorio del Comune abbuonato"

the said part of territory comes to depend administratively"[18](Cereseto 1889).

The system created significant distinctions between comuni chiusi and comuni aperti. Only closed municipalities enjoyed "full faculty of abbonamento"[19], as "each of them has capacity to contract directly with the Government"[20]. This contrasted sharply with open municipalities, which "deal with the Government not as individuals, but united in Consortium"[21] (Cereseto 1889).

Municipalities under abbonamento enjoyed significant operational autonomy. They were permitted to "vary the tariffs within the limits of article 13 and in agreement with the financial authority"[22], provided they ensured that "the amount due to the State is collected first of all through the tax on objects reserved by this law for the Government"[23] (L. 1827/1864, Art. 17).

Contemporary jurists recognized the potential for abuse within the abbonamento system. The Supreme Court of Rome warned that if municipalities could contract with the government for duties affecting consumption in other municipalities, "that supreme advantage which the law wanted to achieve principally in authorizing the abbonamento would be completely lost"[24]. Under such circumstances, "abbuonati municipalities would be transformed into speculators, and taxed localities would find themselves in worse conditions"[25] (Cass. Roma, 2 marzo 1881).

The Appalto System: Tax Farming and Private Collection

Both the government and municipalities could resort to tax farming through a mechanism (called "appalto", i.e. contract) allowing to transfer collection risks and responsibilities to private contractors, while ensuring predictable revenue streams for public authorities. The appalti (contracts) ware granted through competitive bids "after the prescribed publications and notices, through bids by means of secret offers of the sum that the

[18]Our translation. Original Italian text: "quindi avvenendo uno smembramento di parte del territorio, l'abbonamento passa in proporzione nel nuovo Comune da cui viene a dipendere amministrativamente la detta parte di territorio"

[19]Our translation. Original Italian text: "piena la facoltà dell'abbonamento"

[20]Our translation. Original Italian text: "ciascuno degli stessi ha capacità ad abbuonarsi direttamente col Governo"

[21]Our translation. Original Italian text: "trattano col Governo non come singoli, ma riuniti in Consorzio"

[22]Our translation. Original Italian text: "variare le tariffe nei limiti dell'articolo 13 e di accordo coll'autorità finanziaria"

[23]Our translation. Original Italian text: "la somma dovuta allo Stato sia prelevata innanzi tutto mediante la tassa sopra gli oggetti dalla presente legge riservati al Governo"

[24]Our translation. Original Italian text: "si perderebbe addirittura quel sommo vantaggio che la legge volle in principal modo conseguire nell'autorizzare l'abbonamento"

[25]Our translation. Original Italian text: "i Comuni abbuonati si trasmuterebbero in speculatori, e le località tassate si troverebbero in peggiori condizioni"

bidder intends to pay to the Treasury"[26]. Through payment of "a sum proportionate to the presumed revenue"[27], contractors acquired the right to collect duties and were "invested with the rights that belong to the Government or the Municipality"[28] (Cereseto 1889). Contracts typically lasted "ordinarily five years"[29], and bidders had to provide "proof of having deposited a sum as guarantee for the installments they will have to pay in the years for which the appalto will last"[30].

The appalto system provided significant advantages for public administration by ensuring "certain revenue for the Government or Municipality"[31]. When municipalities had assumed governmental duties through abbonamento and simultaneously contracted with private collectors, they succeeded in "greatly simplifying, with much economy of expenses, the double collection"[32](Cereseto 1889).

Contractors acquired extensive rights and responsibilities under the appalto system. For instance, they could not challeenge any contingency, without having payed forst, or they could "refuse personal surety, but not cash surety"[33] (Cereseto 1889). The system was arranged in such a way that several contingencies could be taken into account: territorial variations during contract periods, changes in municipal classification, tariff modifications, and reductions in fees due to umpredictable events or force majeure. Moreover, municipalities retained "the right to resolve the contract at any time"[34], providing ultimate control over collection arrangements.

Subcontracting was allowed under specific conditions, set to prevent conflicts of interest, such as: "Municipal councillors cannot be either contractors or subcontractors of the duties"[35] These conditions were amed at ensuring enough separation between policy-making and revenue collection (Cereseto 1889).

The introduction of Dazio di Consumo on flour and bread

The extension of Dazio di Consumo to flour and bread products in 1866 marked a crucial turning point in Italian fiscal policy, establishing what would become the second

[26]Our translation. Original Italian text: "dopo le prescritte pubblicazioni ed avvisi, per istanze a mezzo di offerta segreta della somma che l'offerente intende di corrispondere all'Erario"

[27]Our translation. Original Italian text: "una somma proporzionata al ricav presuntivo"

[28]Our translation. Original Italian text: "investito dei diritti che competono al Governo o al Comune"

[29]Our translation. Original Italian text: "ordinariamente di cinque anni"

[30]Our translation. Original Italian text: "prova d'avere depositata una somma a garanzia dei canoni che dovrà pagare negli anni pei quali durerà l'appalto"

[31]Our translation. Original Italian text: "un provento certo al Governo o al Comune"

[32]Our translation. Original Italian text: "semplificare con molta economia di spese, la doppia esazione"

[33]Our translation. Original Italian text: "rifiutare la cauzione personale, ma non quella in contanti"

[34]Our translation. Original Italian text: "il diritto di risolvere in qualunque tempo il contratto di appalto"

[35]Our translation. Original Italian text: "I Consiglieri comunali non possono assumere nè l'appalto nè il subappalto dei dazi"

Table 2.11: Managing the revenue of dazio di consumo between municipalities and State: Legge 1827/1864

Legge 1827/1864	**Act 1827/1864**
Art. 15. Le tasse a pro dello stato imposte dalla presente legge sono riscosse per mezzo di agenti del Governo, equiparati a quelli del servizio delle dogane per l'esercizio delle loro funzioni. La riscossione dei dazi comunali nei comuni chiusi e degli addizionali nel comuni aperti si farà anche per mezzo di detti agenti, e le spese di riscossione saranno divise secondo i proventi rispettivi. **Art. 16.** È concesso ai Comuni chiusi ed aperti di riscuotere per mezzo di agenti proprii i dazi di consumo governativi e comunali, qualora si accordino col Governo per assicurargli un minimo di provento sui dazi ad esso spettanti. L'eccedenza sul minimo guarentito sarà diviso in parti uguali fra il Governo ed i Comuni. Per la riscossione dei dazi di consumo il Governo e i Comuni possono fare degli appalti. **Art. 17.** La riscossione del dazi Consumo governativi avrà luogo per abbonamento coi Comuni i quali ne facciano dimanda ed assumano l'obbligo di pagarne direttamente l'ammontare che verrà stabilito d'accordo sulla base del presunto consumo locale, secondo le norme che saranno determinate col regolamento. In questo caso sarà lecito ai comuni stessi di variare le tariffe nei limiti dell'articolo 13 e di accordo coll'autorità finanziaria, provvedendo però sempre a ciò che la somma dovuta allo Stato sia prelevata innanzi tutto mediante la tassa sopra gli oggetti dalla presente legge riservati al Governo. [...] Nel casi preveduti da questo e dal precedente articolo, i Comuni e gli appaltatori subentrano nei diritti e negli obblighi del Governo verso i contribuenti, e le facoltà dei loro agenti sono equiparate per gli effetti della presente legge a quelle degli agenti governativi.	**Art. 15.** The taxes in favour of the State imposed by this act are collected by means of Government agents, equated to those of the Customs Service for the exercise of their functions. The collection of municipal duties in closed municipalities and surcharges in open municipalities are also carried out by means of such agents, and the costs of collection are divided according to the respective revenue. **Art. 16.** It is granted to the closed and open municipalities to collect governmental and municipal consumption duties by means of their own agents, if they agree with the Government to ensure a minimum revenue on the duties due to them. The surplus over the guaranteed minimum is divided equally between the Government and the Municipalities. For the collection of consumption duties the Government and the Municipalities may make contracts. **Art 17.** The collection of Government consumption duties takes place by subscription with those municipalities that request them and assume the obligation to pay directly the amount that is established by agreement on the basis of presumed local consumption, according to the rules that are determined in the regulation. In this case, the municipalities themselves are allowed to vary the tariffs within the limits of article 13 and in agreement with the financial authority, providing however that the amount due to the State is collected first of all by means of the tax on the objects reserved by this act for the Government. [...] In the cases provided for by this and the preceding article, Municipalities and contractors take over the rights and obligations of the Government towards the taxpayers, and the faculties of their agents are equated for the purposes of this act to those of the Government agents.

Our translations.

Table 2.12: Managing the revenue of dazio di consumo between municipalities and State: Regio Decreto 1839/1864

Regio Decreto 1839/1864	**Royal Decree 1839/1864**
Art. 110. Amministrazione comunale dei dazi governativi. I comuni possono assumere la riscossione dei dazi di consumo di conto dello Stato o per abbonamento, o assicurando un minimo di provento sui dazi ad esso spettanti e partecipando a metà dell'eccedenza. In quest'ultimo caso il governo esercita la sua vigilanza sull'amministrazione del dazio a mezzo delle direzioni compartimentali delle gabelle, e può richiedere od emettere tutti i provvedimenti riputati bisognevoli allo sviluppo maggiore dei dazi. Se la legge del dazio di consumo o la tariffa subissero essenziali modificazioni, potrà il governo e potranno reciprocamente i comuni chiedere la rescissione del contratto, purché la disdetta sia data sei mesi prima dell'attuazione della legge che modificasse l'attuale. Non vi sarà luogo ad indennizzi. **Art. 113.** Cessione dei contratti coi comuni ad appaltatori. Qualora il governo cedesse i contratti già stipulati con i comuni per la riscossione dei dazi di consumo ad appaltatori, questi subentrano nei diritti del governo, dovendo i contratti stessi essere integralmente mantenuti e rispettati. I comuni verseranno alla scadenza nella cassa dell'appaltatore le somme dovute allo Stato. **Art. 116.** Contabilità dei dazi. Se la riscossione dei dazi dello Stato è assunta dal comune colla assicurazione del minimo, gli introiti debbono annotarsi nei registri di percezione, distinguendo quelli di spettanza dello Stato dagli altri del comune. Inoltre presso l'amministrazione comunale si tiene un conto annuale degli introiti daziari egualmente distinti e di tutte le spese. Riassumendone in fine d'anno i risultamenti si stabilisce: 1. a quanto ascendano i prodotti dei dazi governativi; 2. a quanto quelli comunali; 3. quale sia l'ammontare delle spese; 4. quale proporzione corra fra le spese ed il complesso dei proventi pei dazi tanto governativi che comunali; 5. il corrispondente importo di spesa da detrarsi dagli introiti pei dazi governativi; 6. se e quale eccedenza d'introiti presenti il residuo netto a fronte del minimo garantito; 7. corrispondente credito del governo; Detto conto è trasmesso entro gennaio del nuovo anno alla direzione delle gabelle del compartimento, alla quale sono pure comunicati tutti gli schiarimenti, notizie e documenti che fosse per richiedere. Accettandosi dalla direzione il conto del comune, questo deve entro un mese pagare nella tesoreria suddetta la quota di eccedenza dovuta allo Stato. Non potendo venire ad accordo la direzione delle gabelle ed il comune sull'ammontare dell'eccedenza, delibererà il ministero delle finanze, ed il comune dovrà entro un mese pagare l'importo che gli venisse addebitato.	**Art. 110.** Municipal administration of government duties. Municipalities may take over the collection of consumption duties on behalf of the government or by subscription, or by securing a minimum revenue on the duties due to it and sharing half of the surplus. In the latter case, the government exercises its supervision over the administration of the duty by means of the compartmental tax directorates, and may require or issue all measures deemed necessary for the greater development of the duties. If the duty law or tariff undergoes essential changes, the government and the municipalities may mutually demand the termination of the contract, provided that the termination is given six months before the implementation of the law modifying the current one. There shall be no indemnification. **Art. 113.** Assignment of contracts with municipalities to contractors. If the government assigns contracts already concluded with municipalities for the collection of consumption duties to contractors, the latter shall take over the rights of the government, and the contracts shall be fully maintained and complied with. The municipalities shall pay the sums due to the State into the contractor's treasury on the due date. **Art. 116.** Duty accounting. If the collection of state duties is assumed by the municipality with the assurance of the minimum, the revenue must be recorded in the collection registers, distinguishing those due to the state from those due to the municipality. In addition, an annual account is kept at the municipal administration of the equally distinct duty revenues and all expenses. Summarising the results at the end of the year, it is stipulated: 1. how much the products of governmental duties rise to; 2. how much the municipal ones; 3. what is the amount of the expenses; 4. what proportion runs between the expenditure and the total revenue from both governmental and municipal duties; 5. the corresponding amount of expenditure to be deducted from the revenue from government duties; 6. whether and what surplus of revenue the net residue has over the guaranteed minimum; 7. corresponding credit of the government; This account shall be forwarded by January of the new year to the district tax board, to which all clarifications, information and documents that may be required shall also be communicated. If the directorate accepts the municipality's bill, the municipality must pay the excess due to the State into the treasury within one month. If the tax board and the municipality cannot agree on the amount of the surplus, the Ministry of Finance will decide, and the municipality must within one month pay the amount charged to it.

Our translations.

Table 2.13: Fees of *Dazio di Consumo* that finances the national government (Liras per 100kg).

	Prima Classe (Pop >50,000)	*Seconda Classe* (50,000 ≥ Pop Pop >20,000)	*Terza Classe* (20,000 ≥ Pop Pop >8,000)	*Quarta Classe* (8,000 ≥ Pop)
Wheat flour, bread, pasta	2,0	1,8	1,6	1,5
Non-wheat flour, bread, pasta	1,4	1,2	1,2	0,9

Source: Our own elaboration on L. 1827/1864 and R.D. 3018/1866.

component of Italy's unprecedented dual taxation system on these essential commodities. This section examines the legislative evolution, implementation mechanisms, and ultimate abolition of this tax, revealing how the pursuit of fiscal consolidation created overlapping and increasingly burdensome taxation on basic necessities.

The 1866 Legislative Framework: R.D. 3018/1866

Royal Decree 3018/1866, enacted on June 28, 1866, extended the governmental component of Dazio di Consumo to flour, bread, pasta, oils, rice, butter, cheese, white wine, and sugar. This decree represented the first systematic attempt to establish a national consumption tax on flour products within the existing dazio framework, rather than through the innovative mechanical counter system that would later characterize the Tassa sul macinato.

Contemporary parliamentary debates allow us to understand the reasons for the timing or his decree. They show that the national budget of 1866 -including the costs of the Third War of Independence and the urgent need to address the mounting public debt- forced the government to seek new revenue sources. The choice of flour products was effective because of their fiscal potential and status as commodities of universal consumption, ensuring a broad tax base across all social classes and geographic regions.

The governmental rates established by R.D. 3018/1866 were differentiated according to the existing municipal classification system, creating a hierarchical structure that reflected both administrative capacity and presumed ability to pay.

This graduated structure embodied the legislative principle that larger municipalities, with their more sophisticated commercial infrastructure and greater administrative capacity, could sustain higher tax rates while maintaining collection efficiency.

The inclusion of bread and flours among the taxed goods steeply increased the revenues of the state as shown by Villani (2011) and reported in Table 2.14.

Table 2.14: Evolution of Municipal Dazio Revenues on Flour Products 1863-1889 (Millions of Liras)

Year	Dazi comunali di consumo e addiz. ai dazi governativi	Dazio di consumo governativo
1863	46,81	—
1864	44,44	20,80
1865	79,27	25,85
1866	70,03	25,58
1867	64,34	48,23
1868	61,26	46,29
1869	64,33	45,54
1870	66,13	44,89
1871	73,66	61,18
1872	71,14	54,90
1873	68,02	51,61
1874	67,08	50,34
1875	82,45	56,70
1876	79,79	59,77
1877	79,41	57,06
1878	82,98	56,15
1879	85,44	56,87
1880	83,91	54,85
1881	95,55	55,76
1882	100,97	56,79
1883	107,23	59,33
1884	114,51	60,62
1885	115,52	59,40
1886	126,08	62,36
1887	133,48	62,50
1888	138,26	—
1889	140,99	60,63

Source: Villani (2011) elaboration on Volpi (1962)

The *Addizionali Comunali*: From Supplement to Primary Burden

The 1866 decree maintained the dual structure established by the 1864 legislation, permitting municipalities to add supplementary taxes (*addizionali comunali*) to the governmental base rates of flour products.

Initially conceived as modest supplements to national taxation, these municipal additions quickly evolved into the dominant component of flour taxation. Contemporary sources reveal that most municipalities exercised this authority extensively, typically adding 10-15% of the flour's value as municipal dazio. As noted by Nina (1902), "the municipalities increased their share and the Dazio di Consumo soon overwhelmed the governmental component and the tax took on the appearance of a main duty.'

Regional and Social Impact Analysis

The implementation of Dazio di Consumo on flour products created significant regional disparities in tax burden, as demonstrated by the data from Nitti's comprehensive survey of municipal finances. Table 2.15 from our sources reveals the territorial distribution of dazio collection for the period 1894-98:

These figures reveal the highly uneven geographic distribution of dazio burden, with Rome (Lazio) bearing an extraordinarily high per capita rate of 16.18 lire compared

Table 2.15: Regional Analysis of Dazio di Consumo Collection (1894-98 average)

Region	Population (1897)	Total Dazio Revenue	Per Capita Burden
Lazio	1,035,950	16,757,767 lire	16.18 lire
Campania	3,161,275	16,772,525 lire	5.31 lire
Liguria	988,695	3,193,676 lire	3.23 lire
Toscana	2,324,999	5,212,167 lire	2.24 lire
Emilia e Romagna	2,306,838	4,465,124 lire	1.94 lire
Piemonte	3,362,288	6,306,074 lire	1.88 lire
Lombardia	4,082,776	7,501,264 lire	1.84 lire
Veneto	3,117,769	5,309,907 lire	1.70 lire
Puglie	1,891,875	3,081,576 lire	1.63 lire
Sicilia	3,563,682	5,558,474 lire	1.56 lire
Sardegna	761,148	1,048,085 lire	1.38 lire
Marche	978,738	1,265,884 lire	1.29 lire
Umbria	609,692	752,476 lire	1.23 lire
Calabrie	1,349,750	1,090,610 lire	0.81 lire
Basilicata	549,771	442,507 lire	0.80 lire
Abruzzo e Molise	1,393,950	1,007,160 lire	0.72 lire

Source: Villani (2011) elaboration on Nitti (1900)

to the national average of approximately 2.70 lire for Centro-Nord regions. As Villani (2011) notes in his analysis of Nitti's comprehensive survey, this disparity reflected several institutional and economic factors. The territorial inequalities in dazio collection were particularly striking when examining the contrast between major administrative centers and peripheral regions.

Villani (2011) lists several factors contributed to these regional disparities:

- **Urban Concentration**: Major cities with significant administrative and commercial functions faced higher tax rates due to their classification status and greater capacity for intensive collection
- **Municipal Fiscal Policy**: Local authorities in economically dynamic areas leveraged their tax authority more aggressively, particularly in regions with established commercial networks
- **Collection Infrastructure**: Cities with sophisticated dazio collection systems could more efficiently exploit the expanded tax base, creating self-reinforcing advantages in revenue generation
- **Economic Differentiation**: The wide variation from Lazio's exceptional 16.18 lire per capita to Abruzzo e Molise's 0.72 lire per capita—representing more than a twenty-fold difference—underscored fundamental economic inequalities between Italy's administrative capitals and its agricultural periphery

The longitudinal data presented in Tables 2.14 and 2.15, while providing valuable insights into the territorial and temporal dimensions of dazio taxation, represent aggregate figures that merit further disaggregation for a complete understanding of flour taxation's impact. Future research would benefit from more detailed analysis of these datasets, particularly regarding the specific breakdown of flour versus other consumption goods within the dazio collections, and the precise municipal-level variations in tax rates and

collection efficiency. However, for the purposes of this study, we have chosen to focus our empirical analysis on the reconstruction of bread price data that incorporates the dazio di consumo component—a methodological approach that allows us to examine the direct welfare effects of this taxation on consumer prices rather than focusing primarily on revenue collection patterns.

The Evolution Toward Abolition: Legislative Timeline (1866-1894)

Dazio di Consumo on flour followed a legislative path that reflected the fiscal pressures occurring, as well as some and growing recognition of the system's inequities, which can be summarised as follows.

Phase I: Expansion and Consolidation (1866-1876) With the issue of R.D. 3018/1866, an extension to flour products with collection beginning January 1, 1867 was launched. During this period, Parliamentary debates focused much more on revenue optimization, than on equity.

Phase II: Growing Opposition and Reform Pressure (1876-1888) During this phase, regional disparities became more pronounced as municipal rates diverged from governmental framework.

Parliamentary debates started to focus on the regressive nature of flour taxation, particularly following the political shift to the Sinistra Storica.

Phase III: Gradual Reduction and Abolition (1888-1902) During this phase there was a policy shift toward reducing indirect taxation on necessities; this shift is included in R.D. 51/1894 (February 21, 1894) that abolished governmental component of Dazio di Consumo on flour, bread, and pasta. As last step, the municipal component of consumption duties was abolished with the R.D. 90/1902.

2.5 The multi-sourced data collection

The complex nature of flour taxation in post-unification Italy, involving both the nationally administered tassa sul macinato and the locally variable dazio di consumo, necessitated a comprehensive data collection strategy drawing from multiple archival sources. As outlined in the introduction, this research initially focused exclusively on the grist tax but evolved to encompass the broader dual taxation system once the overlapping nature of these fiscal instruments became apparent. This expansion of scope, combined with the various quantitative approaches considered for analysis, required the systematic collection and digitization of diverse historical sources spanning the entire period from 1861 to 1894.

2.5.1 Data on revenues

Understanding the fiscal performance and administrative implementation of the tassa sul macinato required comprehensive revenue data covering the tax's entire operational period. The sources provide remarkably granular information, particularly after the initial implementation years, allowing for detailed analysis of collection methods and their relative effectiveness.

The revenue data distinguish between multiple collection mechanisms: mills equipped with mechanical counters (contatori meccanici), mills taxed based on state estimates of annual flour production (accertamento d'ufficio), mills operating under direct state management (gestione statale), and mills subject to tax officer inspections (verifiche degli agenti). This level of detail enables analysis of both the technological modernization of milling operations and the administrative evolution of tax collection methods.

Primary sources for this data comprised two distinct but complementary series of official publications. The first consisted of the initial ten reports titled "Relazioni sull'andamento della tassa sul macinato" published by the Ministry of Finance between 1870 and 1877. These were supplemented by the annual reports of the "Direzione generale delle imposte dirette del catasto e del macinato" covering the years 1878-1884, each containing dedicated chapters on grist tax performance. As detailed in Appendix I, the digitization of these sources required extensive error-checking and cross-validation procedures to ensure data consistency across the different publication formats.

2.5.2 Data on mills

The analysis of milling industry transformation and the adoption of mechanical taxation systems required detailed information on mill operations throughout the kingdom. While the tax administration theoretically collected extraordinarily detailed data—including not only mill counts but also the number of millstones per facility and even the quantity of grain processed per hundred millstone rotations—the surviving archival record provides a more limited but still substantial dataset.

The available data include monthly records of mills and millstones equipped with mechanical counters, as well as corresponding information for mills operating under alternative taxation methods (state estimation, direct management, and inspection-based assessment). For certain years, this information is also available disaggregated by province, though provincial-level data appears less consistently across the time series. These records, drawn from the same official sources as the revenue data, illuminate both the geographic diffusion of technological innovation in milling and the administrative challenges of implementing a uniform taxation system across the diverse economic landscape of the newly unified kingdom. The mechanical counter data, in particular, provides insight into the modernization process that accompanied fiscal reform.

2.5.3 Data on urban areas

The complex municipal classification system underlying the dazio di consumo, extensively described earlier in this study, required systematic analysis of demographic and administrative data to understand its practical implementation across the Italian peninsula. To map the distribution of municipal classes and assess their relative importance, this research utilized population data from the three national censuses conducted during the period of analysis (1861, 1871, and 1881).

Each census provides tabulated data organizing municipalities by region and population size, corresponding to the four-tier classification system that determined consumption duty obligations. These tables enabled reconstruction of the geographic distribution of municipal classes and quantification of the population affected by different taxation regimes. The analysis reveals significant regional variations in urbanization patterns and helps explain the differential impact of consumption duties across the kingdom.

2.5.4 Data on prices

Our price data collection activities had two primary objectives: to document regional price disparities across the kingdom, and to reconstruct consumption duty rates in the absence of systematic fiscal records. The federal structure of consumption duties, with rates varying by municipality and often changing frequently, often not documented in detail in the sources available to date, makes direct reconstruction of tax schedules, if possible, very difficult. Therefore, we decided to resort to price analysis, as a way, indirect but valuable, method to understandi the effective burden of these levies.

The data collection strategy involved three complementary directions.

At first, the research focused on digitizing the price series contained in "Movimento dei Prezzi di alcuni generi alimentari dal 1862 al 1884", published by the General Directorate of Statistics in 1885. While this source provides extensive coverage of cereal prices across major markets, it lacks bread price data, limiting its utility for consumption duty analysis.

To address this limitation, an experimental approach utilizing web scraping techniques was employed to extract price information from the tabelle mercuriali published in the Gazzetta Ufficiale del Regno d'Italia. As detailed in Appendix II, this automated extraction process successfully identified 105 relevant documents from the years 1869-1871, providing granular market-level data for a concentrated but brief period. The technical methodology developed for this extraction represents a novel application of machine learning techniques to historical archival research. However, upon further analysis, the temporal coverage of this dataset proved insufficient for the broader chronological scope of this study, and these data were ultimately not incorporated into the quantitative analysis. Nevertheless, this approach demonstrates the potential for automated techniques in large-scale historical data extraction and may prove valuable for future research.

For the last years of the analysed period, bread price data were obtained through digitization of the "Bollettino settimanale dei prezzi di alcuni dei principali prodotti agrari e del pane", published by the Ministry of Agriculture, Industry and Commerce from 1874-1884. However, due the extensive digitization effort required, this approach yielded comprehensive data for only the final years of the dual taxation period, providing coverage for the concluding phase of the system under study.

2.6 Data analysis: trends and patterns in the reconstructed data

2.6.1 Summary statistics

This section presents descriptive statistics on the key variables used in the empirical analysis. The objective is to provide an overview of the dataset's internal consistency, completeness, and variability.

We begin by highlighting the issue of data completeness. Due to the historical nature of the sources and the evolving administrative practices between 1869 and 1883, data availability varies significantly across topics, sources and also across different variables of the same source on the same topic.

In presenting summary statistics, we often aggregate data by five-year intervals rather than reporting year-by-year figures. This choice responds to both the fragmentary nature of the data and the need for clarity.

Mills and Macinato/Grist tax

We gathered data coming from 5 different methods used to measure the throughput of mills and millstones in order to levy the tax. Moreover, we have official data on the total active mills and millstones. For each of the 6 (5 methods and the total), we have the number of mills, the number of millstones, and the relative tax revenue, by month. Not all the data for all the methods were available in the analyzed sources. Also, not all the methods were included because of the lack of data. We show in 2.16 an overview of the availability of data with respect to the time period under analysis, 1869-1883.

The five methods are the following:

- State-estimated: an estimate done by the Government, for each mill and each millstone of the throughput and the tax to be levied
- Mechanical counter: a mechanical counter installed on each mill and millstone able to count the number of rotations and used to deduce the tax
- Scale: a scale, used to weight the output of the mill and millstone
- Tax officers: inspections by the tax officers

- Ex-officio: enforced ex officio for reasons of public order.

Table 2.16: Percentage of non-missing data by method. The total number of possible observations is 180, i.e. every month from 01/1869 to 12/1883.

Method	**Mills (%)**	**Millstones (%)**	**Tax Revenue (%)**
State-estimated	86.7	80.0	86.7
Mechanical Counter	80.0	100.0	80.0
Scale	60.0	60.0	40.0
Tax Officers	60.0	60.0	61.7
Ex-officio	86.7	80.0	27.2
Total	80.0	80.0	100.0

Source: Our elaboration on data from Ministero delle finanze (1871-1887) and Ministero delle finanze (1878-1883).

Table 2.17: Summary statistics for mills and millstones by tax collection method

Method	**Mean**	**Median**	**Std**	**Min**	**Max**	**Variable**
State-estimated	21525	23020	8676	5327	38173	Mills
Mechanical Counter	28084	30558	4644	20259	33166	Mills
Scale	478	96	613	0	1801	Mills
Total	53055	55180	7187	36516	63762	Mills
State-estimated	21026	23398	7790	5761	34787	Millstones
Mechanical Counter	41941	48103	15961	176	56690	Millstones
Scale	1525	301	1957	0	5567	Millstones
Total	76137	76742	8104	59151	88805	Millstones

Source: Our elaboration on data from Ministero delle finanze (1871-1887) and Ministero delle finanze (1878-1883).

Tables 2.16 to 2.18 present a statistical synthesis of the data collected on the number of mills, the number of operating millstones, and the corresponding tax revenue, disaggregated by the method used to estimate or register taxable flour production.

Table 2.16 shows that mechanical counters and state estimates yield the most complete data, especially for revenue collection (with non-missing values in approximately 87% of cases), while data gathered through direct inspections by tax officers are more sporadic. This reflects both the institutional preference for mechanical instrumentation—part of the 1868 reform's "technocratic ambition"—and the progressive bureaucratic challenges in scaling up human inspections across a fragmented and unevenly accessible national territory.

Table 2.17 reports basic descriptive statistics on the average number of mills and millstones by tax collection method. Notably, the mechanical counter method is associated

with larger mills (mean number of millstones per municipality = 41,941). In contrast, the scale and ex-officio methods were employed in smaller or less standardized facilities. These differences are not merely administrative but have potential fiscal and distributive consequences, given the non-linear structure of the fixed quotas applied to flour output.

Table 2.18 disaggregates tax revenue by method and period, revealing shifts in enforcement strategy. In the initial years (1869–73), mechanical counters accounted for the overwhelming majority of recorded revenue. By 1879–83, however, their share declined as the scale method (based on weighing flour output) expanded considerably. This shift is indicative of institutional adaptation, perhaps reflecting resistance from millers or technological limitations in rural areas.

Table 2.18: Tax revenue by method across selected periods (amounts in millions of lire)

Period	Total	Mech. Counter	Scale	State-est.	Finance Officers	Ex-officio
1869–1873	211.62	171.62	0.00	33.88	0.00	0.65
1874–1878	396.05	140.46	0.07	25.36	16.67	0.05
1879–1883	277.81	197.79	57.03	19.50	20.69	0.00

Source: Our elaboration on data from Ministero delle finanze (1871-1887) and Ministero delle finanze (1878-1883).

Data on Prices

The tables report both average values and dispersion measures for different grains (wheat, maize, barley, rye, rice) and for bread made from wheat and rye. For each product, prices are disaggregated into two categories: prima qualità and seconda qualità. These labels are not clearly explained in the sources, but in 1880 the Bollettino settimanale dei prezzi used "prezzo massimo" and "prezzo minimo" to denote, respectively, the highest and lowest market prices. We infer from this usage that prima qualità and seconda qualità correspond broadly to the best and most expensive, and the more common or lower-quality, varieties available on the market.

The distinction between prima qualità and seconda qualità is not clearly explained in the historical sources. However, in 1880, the Bollettino settimanale dei prezzi used the terms "prezzo massimo" and "prezzo minimo" for the same categories of goods. We interpret these labels as referring, respectively, to the best and most expensive, and the more common or lower-quality variants available on the market. This convention is adopted throughout this analysis.

The data show a clear hierarchy of staple prices, with rice consistently commanding the highest prices, followed by wheat and rye. Maize and barley appear as the cheapest grains, typically consumed by the lower-income rural population. The mean price of prima qualità wheat, for example, is 28.06 lire/100 kg, but individual observations vary widely,

Table 2.19: Data availability for each good of the Movimento dei Prezzi di alcuni generi alimentari

Grain Type	**Number of Cities**	**Average Availability (%)**
Wheat, 1st quality	22	98.1%
Wheat, 2nd quality	21	93.5%
Corn, 1st quality	20	96.1%
Corn, 2nd quality	19	85.8%
Rice, 1st quality	4	73.7%
Rice, 2nd quality	4	73.4%

Source: Our elaboration on data from Movimento dei Prezzi di alcuni generi alimentari.

Table 2.20: Average grain prices across cities by 5-year periods (in Italian lira)

Type	**1862–1866**	**67–71**	**72–76**	**77–81**	**82–86**
Wheat, 1st quality	27.3	31.1	34.3	32.5	24.8
Wheat, 2nd quality	25.6	28.5	31.9	31.0	23.4
Corn, 1st quality	17.5	19.2	22.6	22.8	18.4
Corn, 2nd quality	16.2	17.2	20.6	21.2	16.8
Rice, 1st quality	32.7	33.5	44.0	43.5	39.9
Rice, 2nd quality	26.3	28.2	39.7	40.3	33.4

Source: Our elaboration on data from movimento dei prezzi su alcuni generi alimentari

from a minimum of 11.69 to a maximum of 50.67 lire. This wide dispersion suggests both regional heterogeneity and temporal price volatility, driven by harvest variability, local market access, and possibly trade integration. The relatively high standard deviations across all grain types confirm this interpretation.

Data on Prices (with bread)

The dataset on bread prices derives from official publications that extend over a long time span but are issued on a weekly basis, which makes them particularly time-intensive to process. Due to these constraints, only a limited portion of the available material was digitized and included in the current dataset. As a result, the time coverage of the bread price series is significantly narrower than that of raw grains, focusing primarily on the early 1880s. However, the source offers remarkable geographical breadth, reporting prices for bread in a wide array of municipalities, many of which are absent from other datasets used in this study. This high spatial resolution enhances our capacity to explore regional inequalities in food prices and the potential territorial effects of the milling tax.

Bread prices are reported only for bread made from wheat, with prices disaggregated by quality level where available. As with grain prices, the categories prima qualità and seconda qualità are inferred from the use of maximum and minimum prices in the 1880

Table 2.21: Descriptive statistics forthe price data from Bollettini Settimanali.

Good (per 100kg)	**Mean**	**Std. Dev**	**Min**	**Max**	**N**
Oat – 1st quality	16.42	4.90	5.50	44.22	1984
Oat – 2nd quality	18.17	2.78	6.50	48.60	960
Wheat for bread – 1st quality	28.06	4.81	11.69	50.67	3320
Wheat for bread – 2nd quality	26.78	4.88	18.00	46.67	3047
Corn – 1st quality	21.10	4.28	13.07	41.58	2255
Corn – 2nd quality	19.93	4.26	11.90	34.72	1891
Wheat bread – 1st quality	44.85	8.31	21.00	85.00	3450
Wheat bread – 2nd quality	39.29	9.07	16.00	85.00	3226
Rice – 1st quality	47.63	8.49	26.50	79.95	2070
Rice – 2nd quality	42.14	8.76	15.00	79.88	1955

Source: Our elaboration on data from Bollettini settimanali dei prezzi. N stands for number of observations available.

Table 2.22: Summary of dataset dimensions and coverage on the price data from Bollettini Settimanali.

Variable	**Description**
Time span	01/1880 - 12/1883
Number of months	47
Number of regions	13
Number of cities	76
Number of goods	10
Total observations	24,170

Source: Our elaboration on data from Bollettini settimanali dei prezzi.

issues of the Bollettino settimanale dei prezzi. The average price of prima qualità wheat bread is 44.85 lire per 100 kg, with values ranging from 18 to 85 lire. These figures are substantially higher than those of raw grains, as expected, reflecting additional costs from milling, baking, transportation, distribution and taxation.

Two main observations emerge. First, the price dispersion of bread is wider than that of cereals. This could reflect not only regional differences in production and transport costs, but also variation in local baking practices, municipal regulation, and consumption preferences. Second, the data show that bread prices were especially high in some urban centers, potentially due to higher demand, congestion costs, or rent-seeking in final-stage distribution.

From the perspective of tax incidence, these prices are particularly relevant. Bread was the most common final consumption good affected indirectly by the milling tax, and the degree to which higher flour costs translated into higher bread prices likely varied across regions. In areas where bread prices were already high relative to incomes, the

tax may have had a more acute regressive effect. Conversely, in better-connected or wealthier urban markets, the relative burden may have been partially absorbed by other actors along the supply chain. These dynamics are worth exploring further in the context of local market structures and political resistance to the tax.

Data on urban areas

Table 2.23 and Figure 2.2 describe the classification of municipalities in the Italian censuses of 1861, 1871, and 1881, and the distribution of the population across these classes. Municipalities were grouped into four categories according to population thresholds defined by the census authorities. These classifications, while not directly tied to the macinato tax, provide essential demographic context.

Table 2.23: Number of municipalities and population count of the Regno by class and year

	1st Class	2nd Class	3rd Class	4th Class
		1861		
Number of municipalities	17	62	453	7188
Population count	2,066,912	1,795,624	4,636,919	13,277,803
		1871		
Number of municipalities	13	35	215	25,071
Population count	1,991,652	915,840	2,616,484	14,258,714
		1881		
Number of municipalities	25	96	450	7,688
Population count	3,337,933	2,759,349	5,293,573	17,068,773

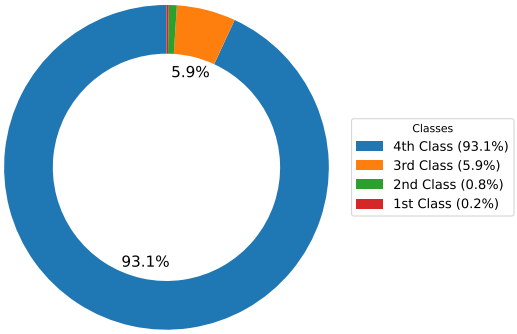
Source: Our elaboration on data from 1861, 1871, 1881 censuses.

The overwhelming majority of municipalities fell into the fourth class (fewer than 4,000 inhabitants), which corresponds to rural and small-town settings. For example, in 1861, 7,188 out of 7,720 municipalities were classified in this lowest tier. However, in terms of population, the picture is more balanced: the relatively small number of first-, second-, and third-class municipalities collectively housed around 40% of the national population.

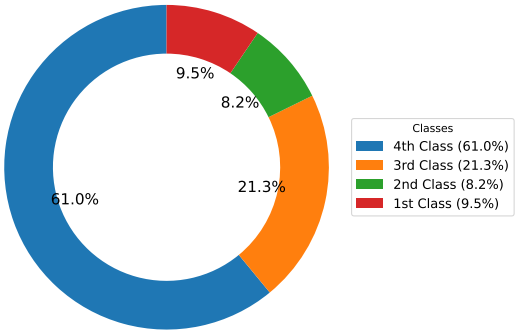
2.6.2 Patterns

An unexpected dynamic of mills and macinato/grist tax

Figure 2.2: Distribution of the population in the 4 classes in 1861



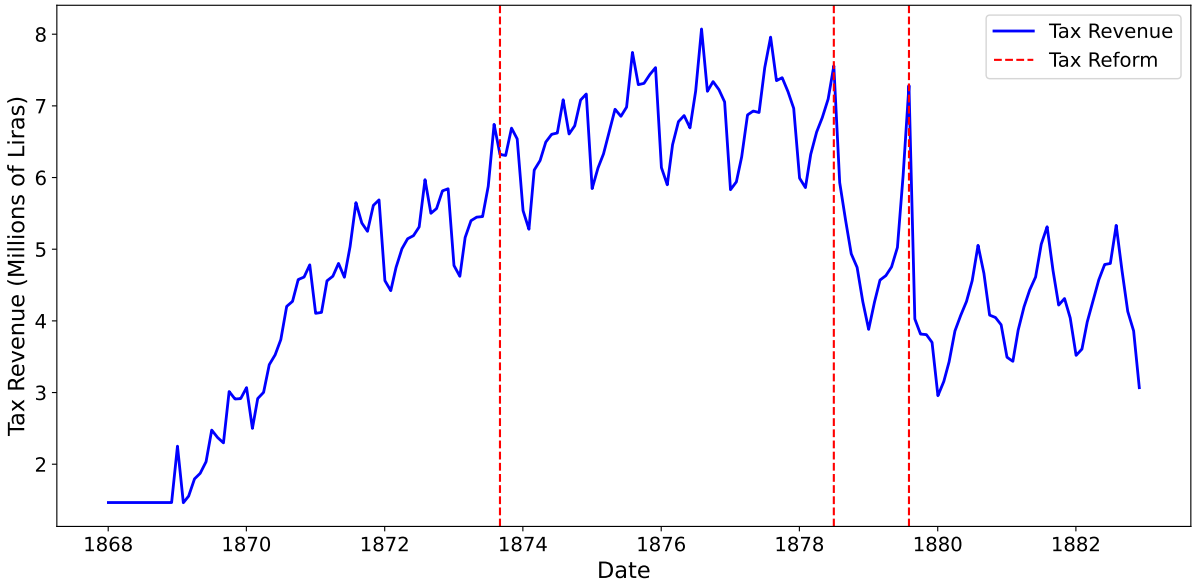
(a) Distribution of the number of municipalities by class.



(b) Distribution of the population by class.

Source: Our elaboration on data from 1861 census.

Figure 2.3: Monthly total revenue of the macinato/grist tax



Source: Our elaboration on data from Ministero delle finanze (1871-1887) and Ministero delle finanze (1878-1883).

Among the notable patterns emerging from this analysis is the dynamic interaction between the number of mills actively recorded in the tax system, the methods of enforcement, and the actual revenues collected from the tassa sul macinato. The descriptive statistics already suggested significant heterogeneity in administrative practices and coverage. The temporal evolution, however, reveals patterns that are both unexpected in intensity and surprisingly coherent, especially when interpreted in light of institutional reforms and seasonal cycles.

The Link Between Counters and Revenues

Figure 2.3 provides clear evidence of a strong positive correlation between the deployment of mechanical counters and tax revenue levels. Monthly revenues show a sustained upward trajectory from the tax's inception in early 1869, rising from approximately 2 million lire per month to peaks of 7-8 million lire by the mid-1870s. It should be noted that the apparently flat revenue line during 1869 reflects a data limitation: only annual totals were available for this initial year, so monthly figures were estimated by dividing the year-end total by twelve. The more dynamic and variable patterns visible from 1870 onward represent actual monthly reporting and reveal the true volatility of tax collection during the system's maturation.

This growth trajectory closely mirrors the expansion of counter coverage documented in Figure 2.5, which shows the dramatic increase from just 176 operational counters at the end of 1869 to over 50,000 counters by 1871. The deployment of counters appears to have fundamentally reshaped the administrative capacity of the state to monitor flour production. As mechanical counters spread, tax revenue increased in a sustained and measurable way that cannot be explained by economic growth alone. The effect visible in Figure 2.3 is not limited to a single spike but represents a consistent trend across multiple years, suggesting that counters enabled better detection of taxable output, minimized underreporting, and discouraged fraud at the source.

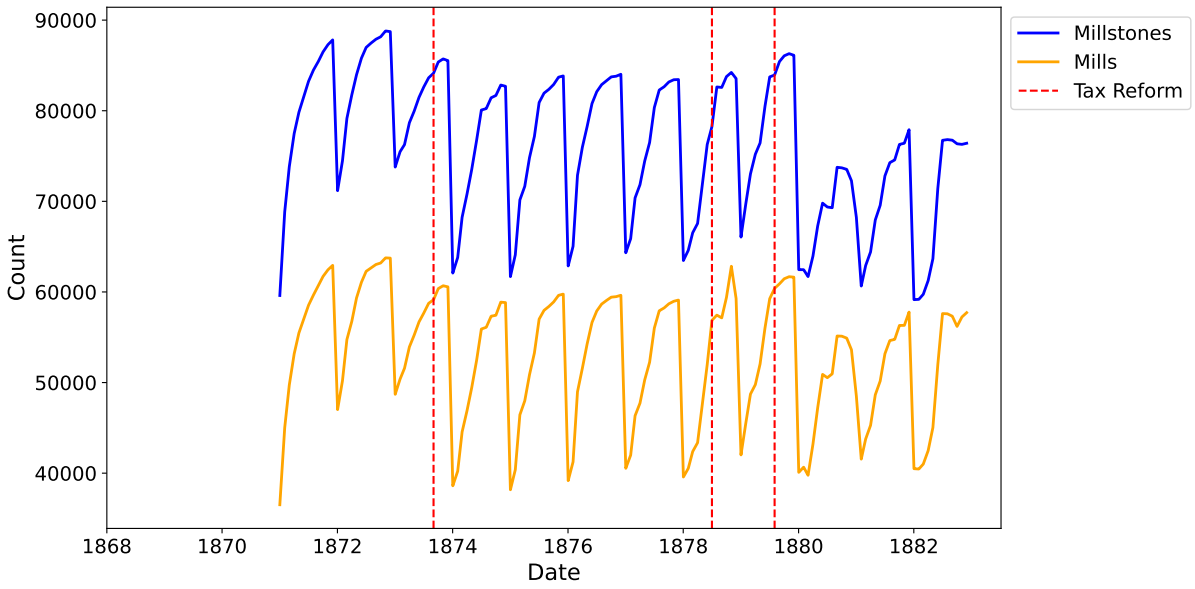
The 1879 Reform and the Revenue Peak

Figure 2.3 clearly marks the 1879 reform (Law No. 4994/1879) as a crucial institutional inflection point that produced an immediate and substantial shift in revenue trends. Prior to this reform, revenues had stabilized at relatively high levels around 6-7 million lire per month, but with considerable volatility. The reform appears to have both tightened assessment criteria and contributed to a revenue peak visible in the months immediately following its implementation.

Particularly noteworthy is that this reform represents the only legislative intervention that produced a clear, immediate, and substantial shift visible in the monthly revenue data shown in Figure 2.3. Other legislative changes—despite generating significant

political controversy—had far less visible impact on actual collections. This reinforces the conclusion that administrative reforms affecting direct measurement and compliance mechanisms mattered more than high-level political debates in shaping fiscal outcomes.

Figure 2.4: Total active mills and total active millstones (monthly data)



Source: Our elaboration on data from Ministero delle finanze (1871-1887) and Ministero delle finanze (1878-1883).

A Surprisingly Strong Cyclical Pattern

Perhaps the most unexpected feature revealed in both Figures 2.3 and 2.4 is the remarkably regular cyclical pattern observed in both the number of active mills and tax revenue from 1870 onward, once actual monthly data became available. Figure 4 shows that both total active mills and millstones follow a precise seasonal rhythm, with peaks consistently occurring in late autumn/early winter and troughs in late winter/early spring. The pattern is so regular that it resembles a mathematical function more than the irregular fluctuations typically associated with agricultural activity.

Figure 2.3 reveals that tax revenues follow an even more striking pattern: revenues are consistently highest in December and lowest in January, with intermediate troughs occurring in spring and early summer. The December peaks typically reach 7-8 million lire, while January troughs often fall to 3-4 million lire—representing fluctuations of more than 50% on a regular basis.

This rhythm is too precise and regular to be explained solely by agricultural factors such as harvest timing. While some seasonality was anticipated given the connection between wheat harvesting and milling activities, the patterns visible in Figures 2.3 and 2.4 suggest the presence of administrative and institutional seasonality. The December peaks

likely reflect year-end reporting pressures, bureaucratic deadlines for quota revisions, or efforts to meet annual revenue targets. Conversely, the January troughs could result from post-holiday reductions in enforcement activity, staff absences, or delays in administrative procedures.

Technological Diffusion and Its Administrative Impact

Our historical sources show that during those years an important transformation occurred: the measure of milled quantities progressively evolved from the use of mechanical counters into scales. Using mechanical counters was an ingenious way to avoid tax evasion: if you want to mill, your millstones will rotate, and counters count. Nevertheless, around years 1878-1882, a progressive switch is observed toward direct measure of milled stuff through its weight (i.e. through scales). There are no specific provisions for this technological change in the legislation and other official documents, although they were written in such a way that both methods were allowed.

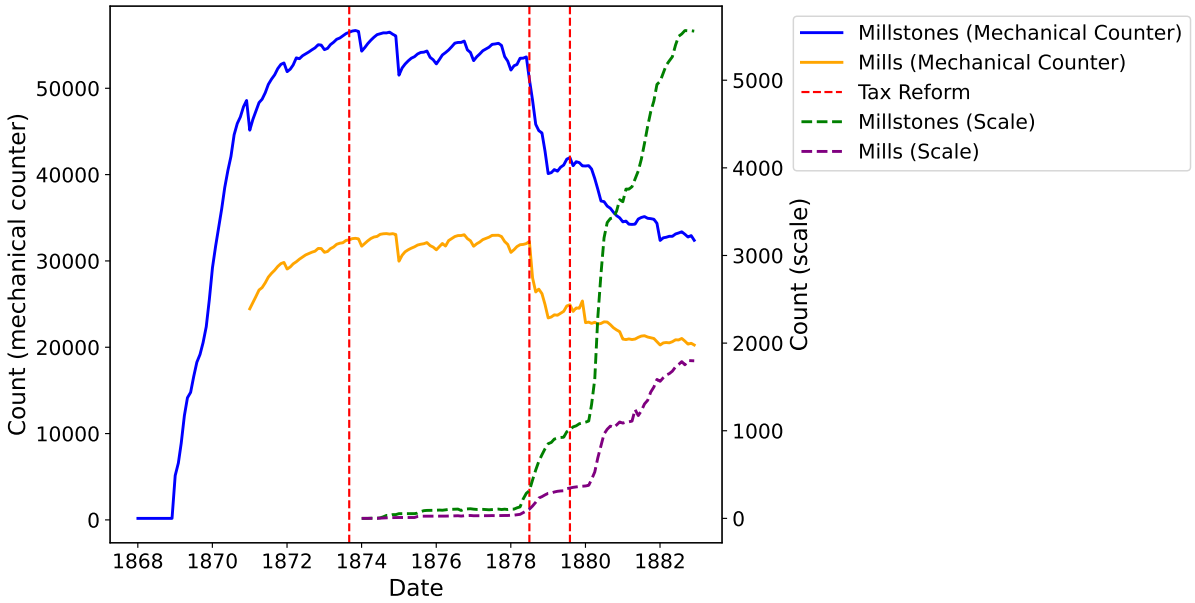
Figure 2.5 provides detailed evidence of this transformation. The data show not only the rapid expansion of mechanical counter installations, from virtually zero to over 50,000 units within three years, but also the gradual introduction of alternative measurement technologies such as scales. The figure reveals that by the mid-1870s, approximately 30,000 mills were equipped with mechanical counters, while several thousand additional facilities used scale-based measurement systems. This technological diffusion had profound implications for administrative capacity and tax compliance. Mills equipped with counters, as shown in Figure 2.5, maintained more consistent operational patterns and likely faced more predictable tax burdens than those subject to estimation-based assessment. The steady growth in counter-equipped facilities visible in the figure corresponds directly to the revenue stabilization apparent in Figure 2.3 during the mid-1870s, suggesting that technological standardization reduced both administrative uncertainty and opportunities for evasion.

Broader Implications

The combined evidence from Figures 2.3, 2.4, and 2.5 challenges the conventional narrative that the tassa sul macinato was simply an ineffective or crude fiscal instrument. While socially regressive and politically contested, the tax operated within a sophisticated and evolving administrative system that demonstrated measurable improvements in enforcement capacity over time.

The technological innovation represented by mechanical counters had concrete impacts visible in revenue outcomes, not merely in regulatory design or bureaucratic rhetoric. The pronounced administrative seasonality revealed in these figures also provides an unusual window into the day-to-day functioning of the post-unification Italian state.

Figure 2.5: Amount of active mills and active millstones furnished with one kind of mechanical detection system: either counter or scale (monthly data)



Source: Our elaboration on data from Ministero delle finanze (1871-1887) and Ministero delle finanze (1878-1883).

The fiscal bureaucracy operated according to institutional rhythms and calendar constraints that significantly shaped performance, particularly in decentralized, labor-intensive tax collection systems. This seasonality suggests that state capacity was exercised unevenly across the calendar year, with implications for both taxpayer behavior and administrative effectiveness.

Finally, the data demonstrate that technological instruments and administrative reforms could produce tangible fiscal improvements even within politically contested tax systems. The grist tax may have failed politically and been abolished for social reasons, but as a case study in fiscal modernization and the interaction between technology, policy reform, and bureaucratic practice, it offers valuable insights into the capacities and limitations of the early Italian state.

Clarifying the structure of municipalities in the kingdom of Italy

While this paper does not aim to study the demographic development of post-Unification Italy in itself, we now try to gain some basic understanding of the distribution and structure of municipalities, since it is essential to interpret how the dazio di consumo was implemented and experienced across the territory.

Our analysis of demographic data reveals that the kingdom had an unequal municipal structure, which had significant implications for the administrative capacity of collection of dazio di consumo. Figure 2.2, shows that a very large share of municipalities (93.1%)

belonged to the fourth class with fewer than 8,000 inhabitants, while these municipalities housed only 61% of the total population. This huge contrast between municipal count and population distribution helps us understand the challenge that post-unification administrators had to face: the dazio di consumo had to operate across thousands of small, scattered communities while generating revenue primarily from a relatively small number of urban centers.

Figures 2.6 through 2.7 show the regional geography of urbanization and its evolution during the critical first two decades after unification. The distribution of population in first-class municipalities 2.6 reveals the dominance of established urban centers, with particularly high concentrations in Campania (Naples), Sicilia (Palermo), Lombardia (Milan), and Piemonte (Turin). We see also a remarkable stability in this urban hierarchy across the three census years, suggesting that the largest cities maintained their demographic prominence despite the political and economic transformations of unification.

However, Figure 2.6 also reveals an important anomaly in the 1871 census data that affects the reliability of temporal comparisons. The consistent reduction in first-class municipal populations in 1871, followed by huge increases in 1881, suggests that either the census procedures had had some methodogical changes, or that some boundaries had been redefined, borh changes that would make this middle data point less reliable for trend analysis.

This explanation is consistent with the fact that this pattern appears regularly in all four municipal classes, indicating a systematic trend.

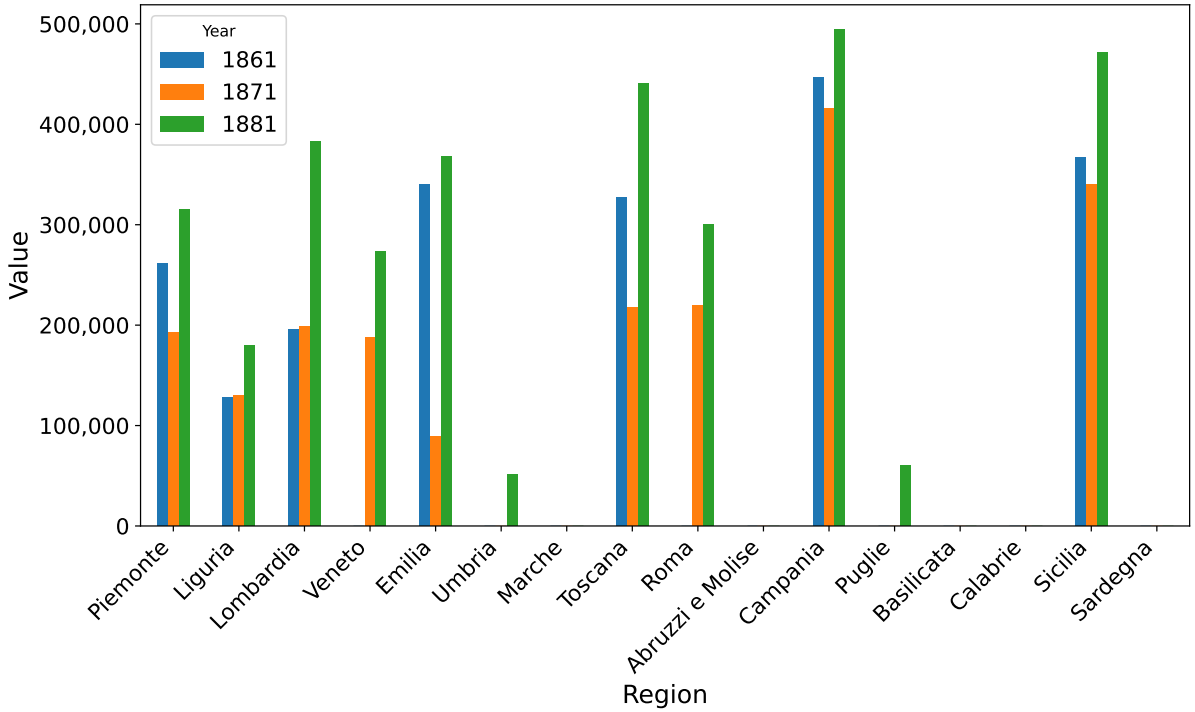
The second-class municipalities 2.7 show more dynamic patterns, with significant growth visible in several regions between 1861 and 1881. For instance, Lombardia and Veneto show substantial increases in their population; this growth pattern aligns with historical evidence of industrial development and commercial expansion in the northern Italy in those years.

The third and fourth-class distributions (Figures 2.8 and 2.9 reveal the extent to which Italy remained a predominantly rural country throughout this period. The fourth-class municipality population still shows, except for some southern regions, a huge reduction between 1861 and 1871 censuses and subsequent increase in the 1981 census. So, the considerations we made for first and second, basically still apply.

From a fiscal perspective, these patterns have significant implications for understanding the differential impact of the dazio di consumo. The concentration of population in higher-class municipalities had the effect that a small number of administrative units (tax collectors) generated a large share of consumption tax revenue, that made tax collection more effective there. Larger municipalities not only had denser populations but also higher consumption levels and larger commercial networks, further enhancing their effectiveness for dazio collection. Conversely, the vast network of small fourth-class municipalities, while numerically dominant, presented significant challenges to establish effective

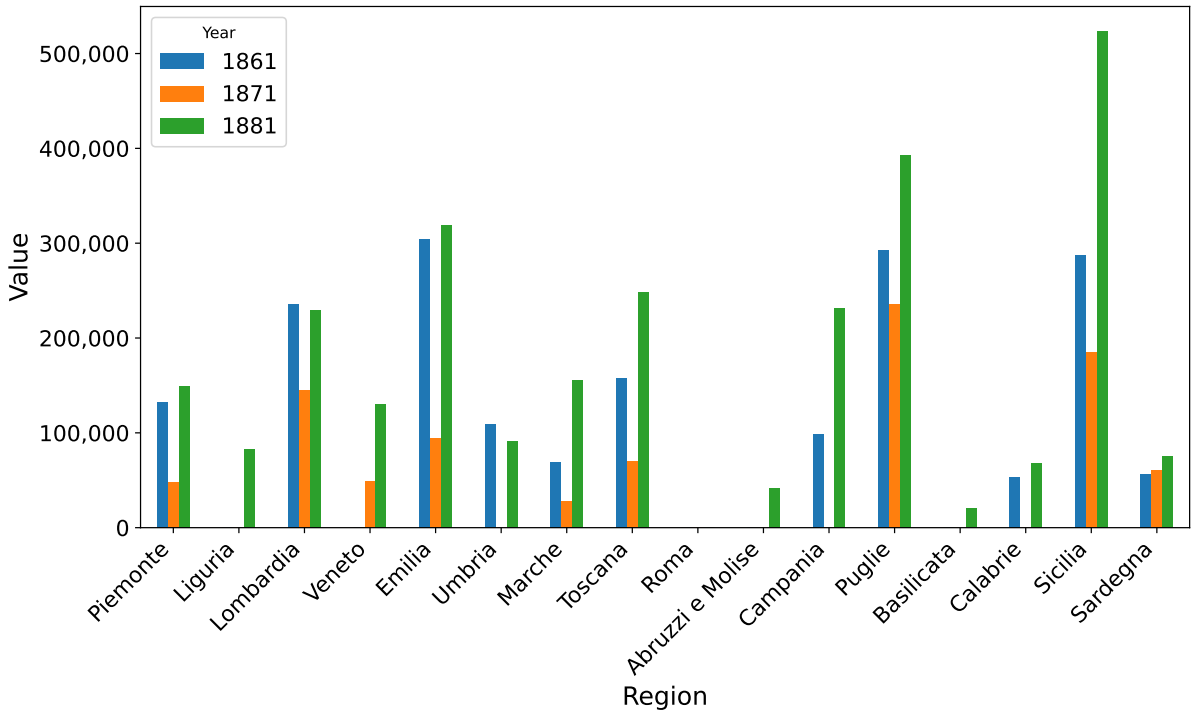
customs lines and monitor consumption patterns.

Figure 2.6: Population distribution by region within the 1st class in 1861,1871,1881.



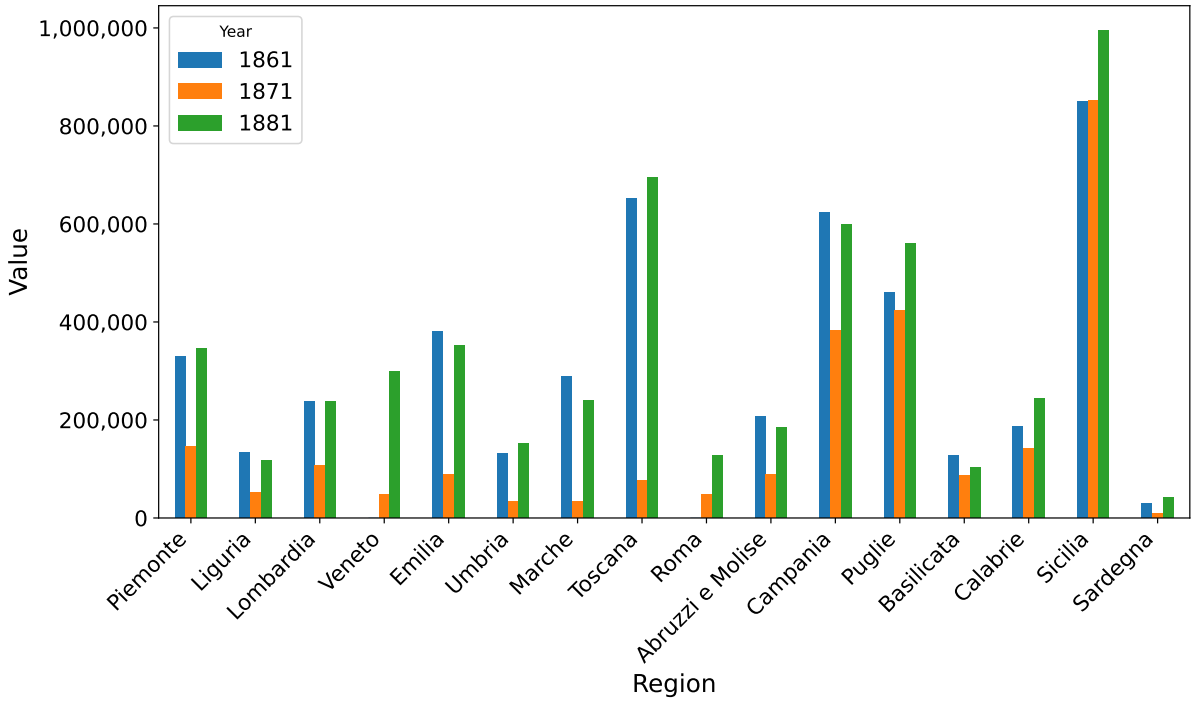
Source: Our elaboration on data from 1861, 1871, 1881 censuses.

Figure 2.7: Population distribution by region within the 2nd class in 1861,1871,1881.



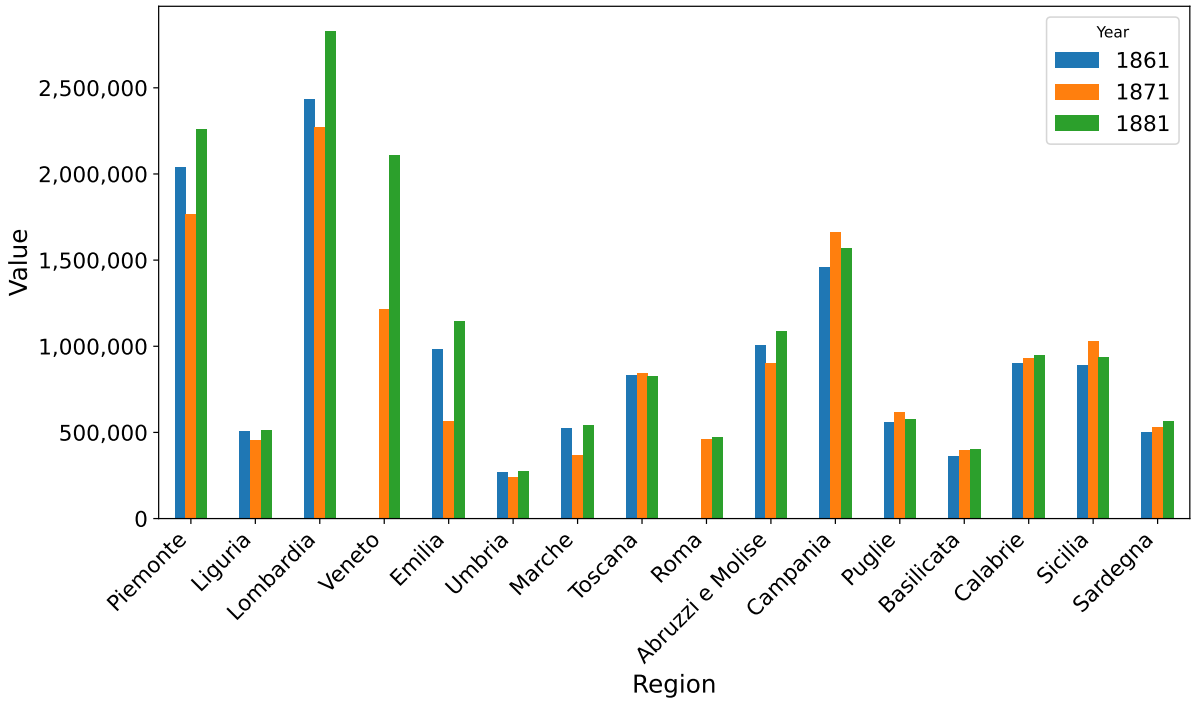
Source: Our elaboration on data from 1861, 1871, 1881 censuses.

Figure 2.8: Population distribution by region within the 3rd class in 1861,1871,1881.



Source: Our elaboration on data from 1861, 1871, 1881 censuses.

Figure 2.9: Population distribution by region within the 4th class in 1861,1871,1881.



Source: Our elaboration on data from 1861, 1871, 1881 censuses.

In analysing population data, we should also recall that municipalities were also classified into "comuni aperti" and "comuni chiusi" groups (see 2.4.3).

The systematic reconstruction of comuni aperti versus comuni chiusi classifications would require extensive archival research into administrative decrees issued during the harmonization of the dazio system in the 1870s and 1880s. These decrees assigned or revoked "closed" status on a case-by-case basis, reflecting shifting political priorities, municipal lobbying efforts, and evolving interpretations of fiscal need and administrative feasibility. The ability to maintain closed status depended not only on population size but also on topographical conditions, commercial importance, and local administrative capacity.

While this reconstruction is beyond the scope of the current study, it represents a crucial research priority for understanding the territorial logic of indirect taxation and the incentives that shaped local tax policy across the Kingdom.

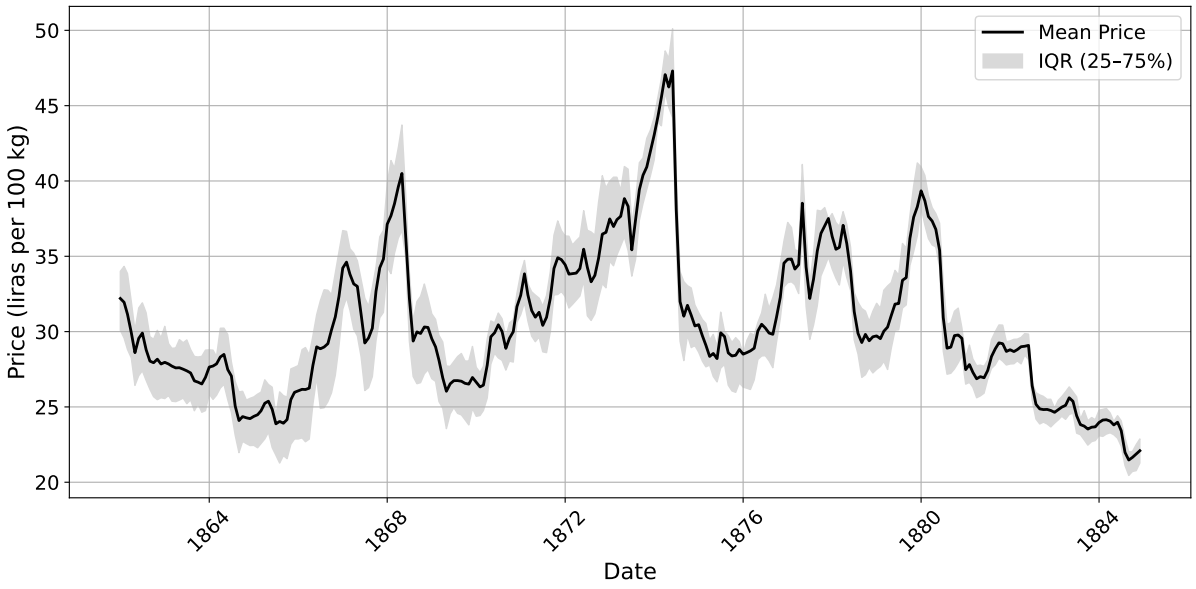
Trends in goods prices and first steps towards the reconstruction of dazio di consumo locale

This section documents a line of research that, while not fulfilling its initial ambition, provided unexpected insights and redirected our analytical priorities. The original objective behind collecting price data was to study the distributional consequences of the tassa sul macinato by reconstructing how the tax affected purchasing power and food afford-

ability, especially for lower-income groups, through comparative analysis of raw cereal and finished bread prices across space and time.

However, as the research progressed, it became increasingly clear that our most systematic and reliable price source, the *Bollettino settimanale dei prezzi*, reported bread prices that already incorporated the dazio di consumo, a locally administered consumption tax. This realization fundamentally shifted the analytical focus: rather than using price data to study consumer inequality directly, the price series began to appear more promising as a tool for reconstructing municipal fiscal regimes, particularly dazio rates.

Figure 2.10: Evolution of the price of wheat of first quality, with interquartile range.

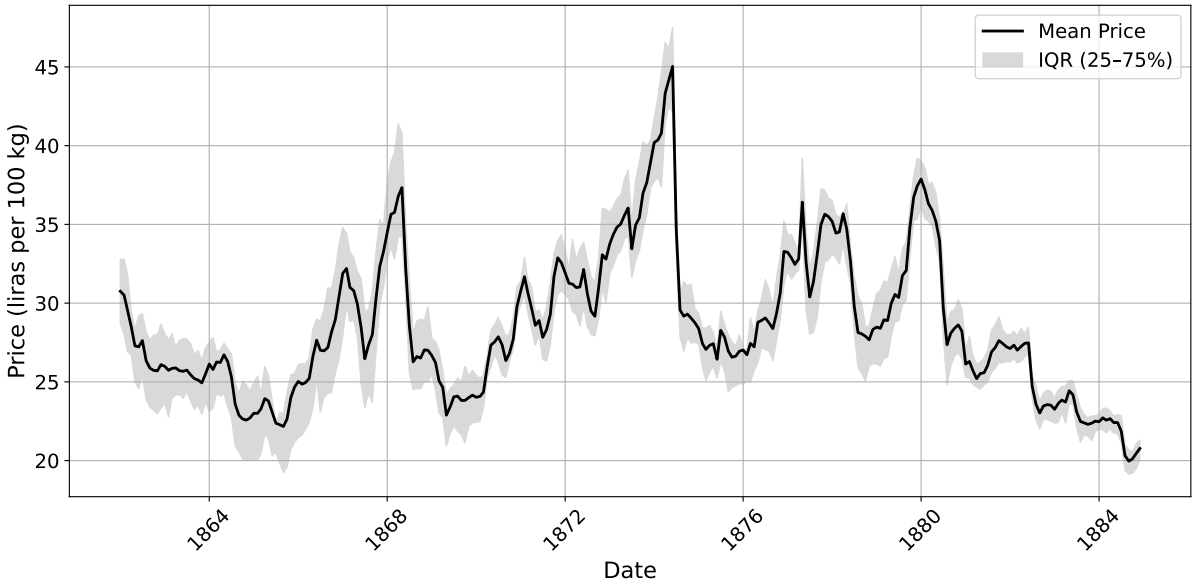


Source: Our elaboration on data from Bollettini settimanali dei prezzi.

The grain price series themselves—particularly for wheat, maize, and rice—remain valuable for understanding regional market integration and price volatility patterns, even independent of taxation effects. Figures 2.10 and 2.11 reveal striking patterns in wheat price evolution that illuminate both seasonal dynamics and longer-term market trends. First-quality wheat prices (Figure 2.10) show pronounced volatility during the 1870s, with dramatic spikes reaching above 45 liras per 100kg, followed by a general downward trend through the early 1880s that brought prices back toward 25 lire per 100kg. The interquartile range bands reveal substantial cross-regional price dispersion, particularly during peak price periods, suggesting that market integration remained incomplete despite political unification.

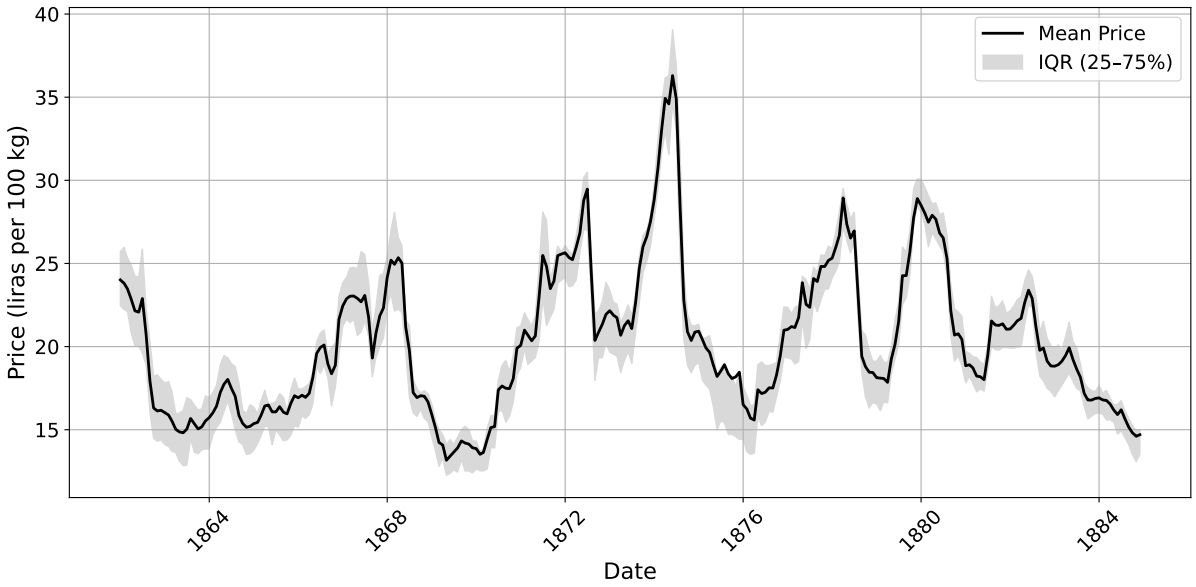
The comparison between first and second-quality wheat (Figures 2.10 and 2.11) provides insight into market segmentation and quality differentiation. Second-quality wheat consistently traded at approximately 2-4 liras per 100kg below first-quality prices, but the price differential varied significantly over time. During periods of high prices, this

Figure 2.11: Evolution of the price of wheat of second quality, with interquartile range.



Source: Our elaboration on data from Bollettini settimanali dei prezzi.

Figure 2.12: Evolution of the price of corn of first quality, with interquartile range.

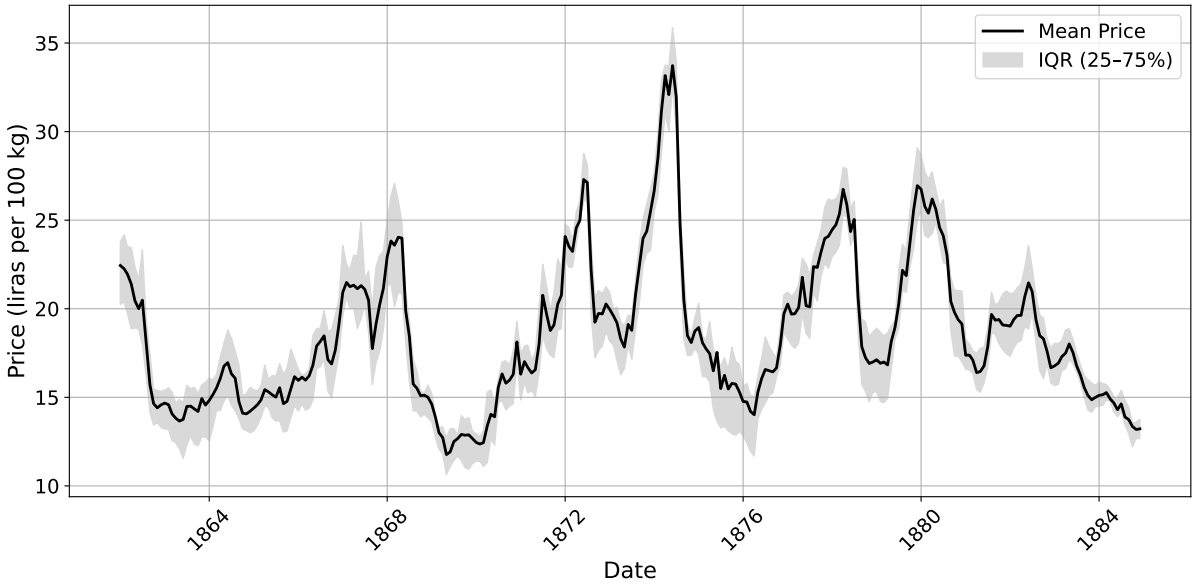


Source: Our elaboration on data from Bollettini settimanali dei prezzi.

gap often widened, suggesting that consumers faced difficult substitution decisions when prices spiked, with potential implications for nutritional outcomes across different social classes.

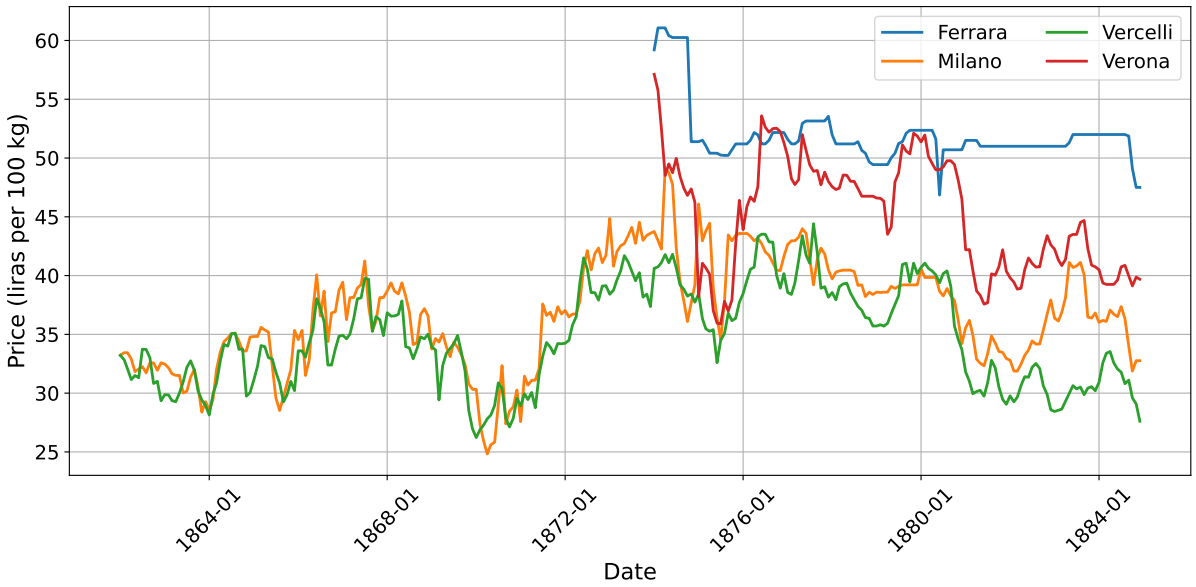
The corn price series (Figures 2.12 and 2.13) tell a somewhat different story, showing generally lower volatility but similar temporal patterns. First-quality corn prices ranged primarily between 15-35 liras per 100kg, consistently below wheat prices as expected.

Figure 2.13: Evolution of the price of corn of second quality, with interquartile range.



Source: Our elaboration on data from Bollettini settimanali dei prezzi.

Figure 2.14: Evolution of the price of rice of first quality

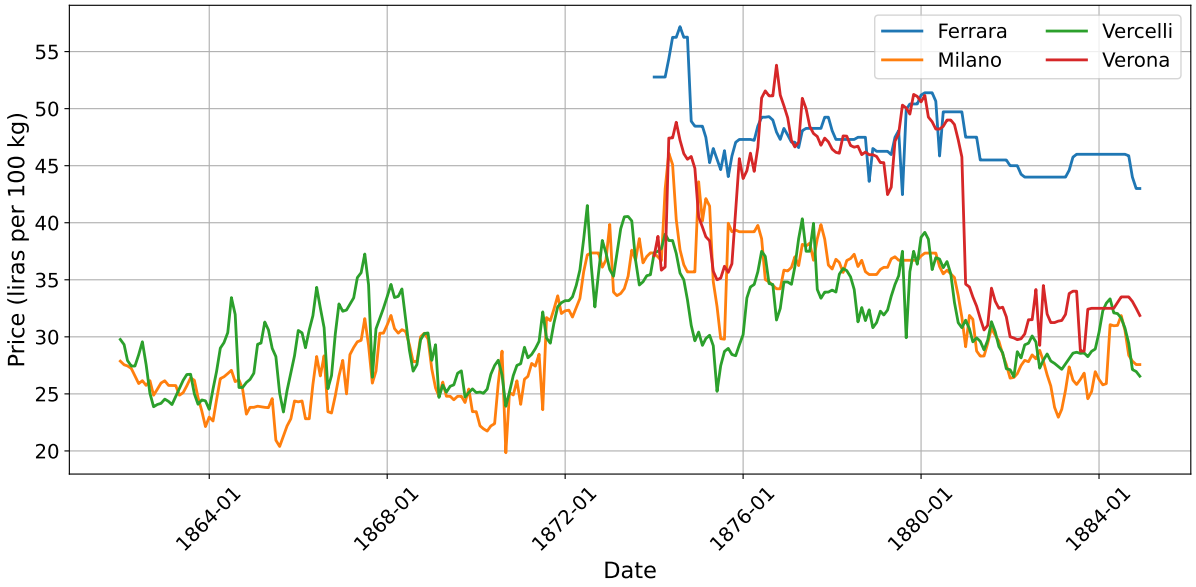


Given the limited amount of data, we show here all the available cities.*Source:* Our elaboration on data from Bollettini settimanali dei prezzi.

The relatively stable price differential between corn qualities suggests more standardized production and marketing for this commodity, which served as a crucial food source for rural populations, particularly in northern Italy.

The rice price data (Figures 2.15 and 2.15), while limited to only four cities (Ferrara, Milano, Vercelli, and Verona), reveal the highest prices among the cereals studied, typically ranging between 25-55 liras per 100kg. The concentration of rice price data in

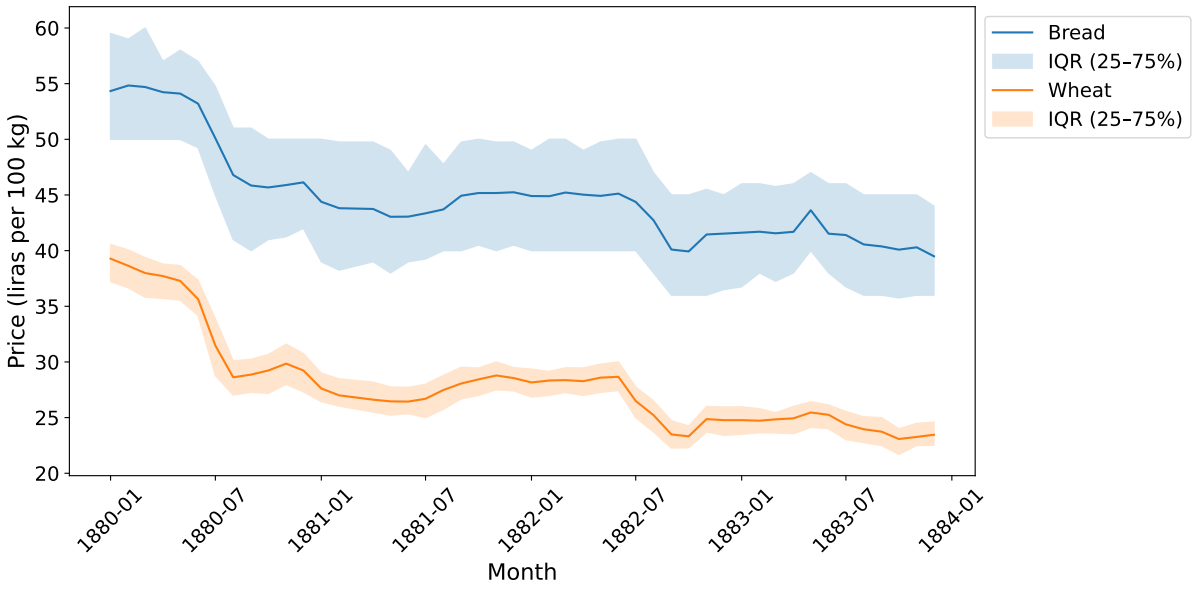
Figure 2.15: Evolution of the price of rice of second quality



Given the limited amount of data, we show here all the available cities. *Source:* Our elaboration on data from Bollettini settimanali dei prezzi.

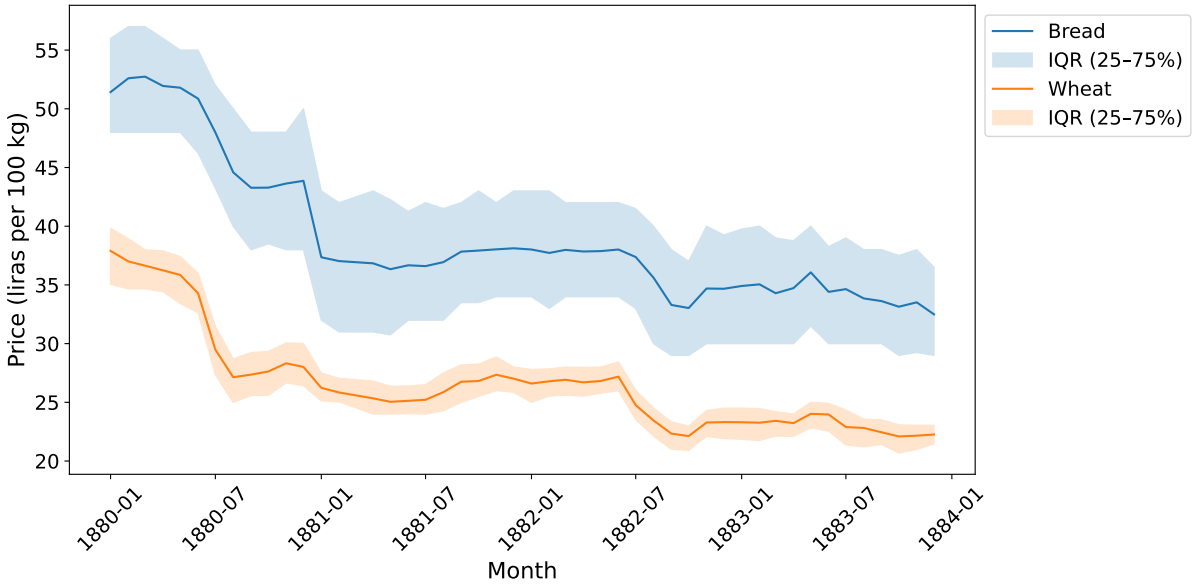
northern Italian cities reflects the geographic specialization of rice cultivation in the Po Valley irrigation districts. The substantial price volatility visible in these series likely reflects both harvest variations and the developing export markets that were emerging for Italian rice during this period.

Figure 2.16: Bread and wheat first quality, trends of prices.



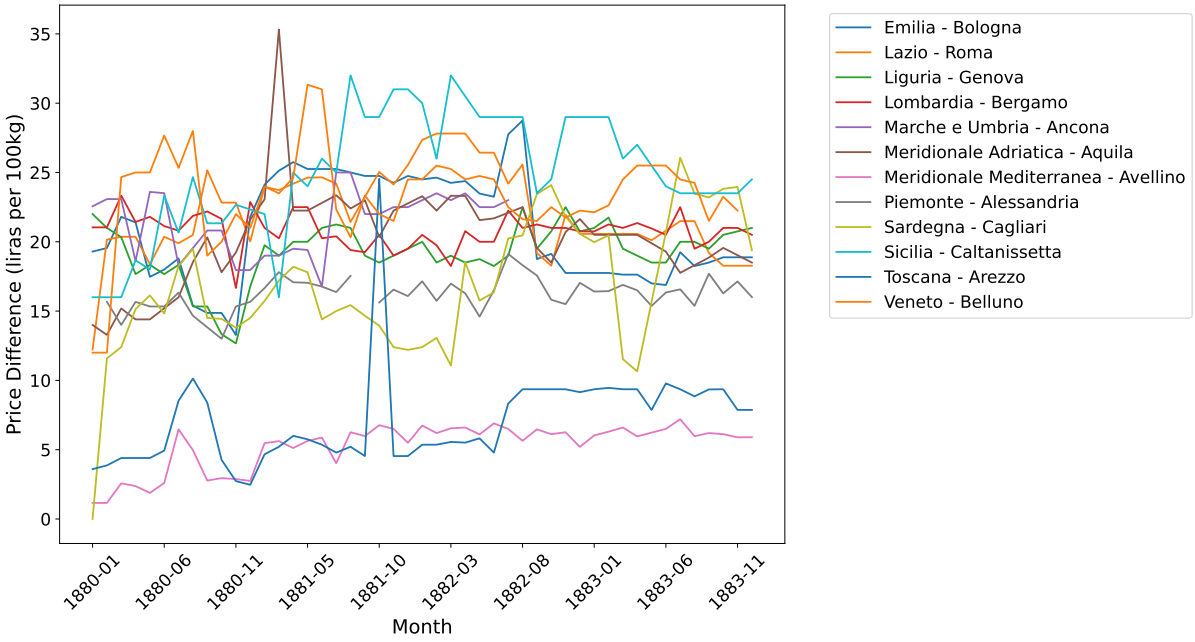
Source: Our elaboration on data from Bollettini settimanali dei prezzi.

Figure 2.17: Bread and wheat second quality, trends of prices.



Source: Our elaboration on data from Bollettini settimanali dei prezzi.

Figure 2.18: Bread minus wheat first quality, one city per region, trends of prices.



Source: Our elaboration on data from Bollettini settimanali dei prezzi.

The second phase of the price analysis, comparing wheat and bread prices directly, yielded much weaker results than expected. The hypothesis was straightforward: the difference between pane di frumento di prima qualità and grano tenero di prima qualità

should reflect a combination of production costs (milling, baking), commercial margins and - crucially - the local dazio di consumo. This difference was expected to vary systematically across municipalities, potentially offering a proxy for dazio incidence and burden.

However, Figures 2.16 and 2.17, which show bread and wheat price comparisons, reveal that this approach faces methodological challenges. The price difference between bread and wheat shows a large variation between cities and time periods, ranging from roughly 10 to 25 liras per 100kg. While some of this variation reflects differences in local dazio rates, it also incorporates noise from varying milling and baking costs, different commercial practices, and quality differences that are difficult to control for systematically.

Figure 2.18, which attempts to isolate these differentials by showing bread-minus-wheat prices for representative cities from each region, illustrates both the potential and the limitations of this approach. Cities like Roma and Bologna consistently show high differentials (often above 20 liras per 100kg), while others like Belluno and Cagliari show much lower spreads. While these patterns likely reflect real differences in local fiscal burden, disentangling taxation effects from other cost factors requires additional institutional and economic data that are hardly available and go beyond the scope of this study.

In conclusion, while this line of research must be acknowledged as a partial failure in its original intention to directly measure distributional impacts, it proved productive in opening new questions about local state capacity, inter-municipal fiscal variation, and the geography of indirect taxation. The price series will remain a crucial dataset for future research agendas examining market integration and fiscal federalism in post-unification Italy, even if their most immediate interpretive power remains constrained by the complex institutional framework within which these markets operated.

2.7 Conclusions

This chapter had the main objective of analysing how the double taxation on flour ("Tassa sul macinato" and "Dazio di consumo") was introduced in the kingdom of Italy during the first decades after the unification, its purpose, its implementation, its distribution over regions and provinces, and to study its effects on prices. To achieve this objective, we consulted a huge set of references, from parliamentary documents, to contemporary laws, to more modern studies and papers.

On the empirical side, this chapter contributes an original, multi-source dataset that documents the institutional design, technological diffusion, and price dynamics associated with flour taxation. Based on extensive archival research, the dataset covers:

1. the legal and administrative evolution of both the *macinato* tax and the *dazio di consumo* on flour;
2. the distribution of mills and mechanical counters across Italian provinces;
3. the classification of municipalities and the heterogeneity of local taxation regimes;
4. the monthly prices of flour and bread in dozens of cities, extracted from official price monitoring sources.

These empirical foundations allow us to make some key observations:

- the implementation of the macinato tax was far from straightforward, since the timing of counter installations, the enforcement of quotas, and the structure of local mills had a huge variation during the period of application
- Dazio di consumo, even if largely ignored by the political debate must be considered when studying the tax policies and the goods' price dynamics of the newborn Kingdom of Italy
- The coexistence of two taxes ("Tassa sul macinato" and "Dazio di consumo") targeting the same product created overlapping burdens and blurred lines of fiscal responsibility between local and national authorities.

Among the numerical results, it is worth mentioning that a neat periodicity of the grist total revenue was discovered, with peaks on Decembers and lows on Januarys, for which possible explanations have been proposed.

Further Research

This chapter opens several promising directions for further research.

First, while the national macinato tax has been studied in its post-1868 form, much remains unknown about its pre-unitary antecedents. Many of the former Italian states, including the Kingdom of the Two Sicilies, the Papal States, and the Kingdom of Sardinia, had experimented with milling taxes, often in times of war or fiscal crisis. Yet the literature on these earlier taxes is remarkably thin. A comparative study of these regional antecedents could reveal the extent to which the 1868 law marked a rupture or a continuation, and how administrative practices and political resistance varied across the peninsula.

Second, the dazio di consumo would benefit from a more systematic international comparison. Italian policymakers of the 19th century were not unaware of similar tolls in Belgium, Germany, and Austria, and the convergence of urban indirect taxation across continental Europe deserves closer examination. Situating the dazio in a broader European context would illuminate how Italy's fiscal architecture fits within a larger pattern of industrial-era indirect taxation and municipal finance.

Third, the empirical reconstruction of the macinato tax can be deepened by retrieving the detailed datasets produced by the Uffici tecnici per il macinato. These include

information on tax assessments, inspection regimes, counter installations, and quota adjustments, often disaggregated by province or mill. Even partial recovery of these data would allow for a spatial analysis of how fiscal and technological transformations shaped the evolution of the milling industry, and could offer new insights into state capacity and regional inequality.

Finally, on the dazio di consumo, a key research priority is the reconstruction of local rate structures. While a systematic national database may be difficult to compile, a feasible alternative is to select a set of representative cities, such as Milan, Naples, Bologna, Palermo, and Turin, and conduct a detailed archival reconstruction of their dazio ordinances. This would allow for a more granular understanding of how municipalities balanced revenue needs, political constraints, and social equity in setting rates on flour, bread, and other essentials.

Together, these research paths underscore the potential for a deeper integration of fiscal history, economic geography, and political economy in the study of post-unification Italy. They also highlight the importance of indirect taxation not merely as a revenue tool, but as a key site in the contested construction of the modern state.

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Appendix I - Numerical Data Retrieval and Checking for Errors

In this section we discuss the appearance of the numerical data available from our sources, and how they are managed error-checked and cross-validated.

Data on revenues: Relazione annuale tassa sul macinato e Relazione imposte dirette

Data on revenues are retrieved from documents containing periodical reports on the grist tax made by the Ministry of Finance. The full list of them is as shown in Table 2.24 and 2.25.

These documents are very similar in structure to each other, contain in their attachments ("allegati") many tables, which have been scanned and collected. Digitalising and error checking the data from the historical sources, posed several problems, that were addressed on a case-by-case basis. To show the main issues encountered and how they have been tackled, we decided to show and discuss two meaningful examples.

Relazione presentata dal ministro delle finanze sull'applicazione della legge che impone una tassa sulla macinazione dei cereali *Report on the application of the law imposing a grist tax* 11th of March 1870
Seconda Relazione presentata dal ministro delle finanze sull'applicazione della legge che impone una tassa sulla macinazione dei cereali *Second Report on the application of the law imposing a grist tax* 20th of June 1870
Terza Relazione presentata dal ministro delle finanze sull'applicazione della legge che impone una tassa sulla macinazione dei cereali *Third Report on the application of the law imposing a grist tax* 9th of December 1870
(Quarta) Relazione presentata dal ministro delle finanze sull'applicazione della legge che impone una tassa sulla macinazione dei cereali *(Fourth)* Report on the application of the law imposing a grist tax* 23th of May 1871 * The word Fourth is not present in the original document; it is included here, since before and after these reports have been sequentially numbered
Quinta Relazione presentata dal ministro delle finanze sull'applicazione della legge che impone una tassa sulla macinazione dei cereali *Fifth Report on the application of the law imposing a grist tax* 12th of December 1871
Relazione della giunta parlamentare sull'andamento ed esazione della tassa del macinato *Report of the giunta parlamentare (=parliamentary committee) on the progress and collection of the milling tax* 29th of October 1872
Sesta Relazione presentata dal ministro delle finanze sull'applicazione della legge che impone una tassa sulla macinazione dei cereali *Sixth Report on the application of the law imposing a grist tax*
Settima Relazione presentata dal ministro delle finanze sull'applicazione della legge che impone una tassa sulla macinazione dei cereali – year 1873 *Seventh Report on the application of the law imposing a grist tax* 22th of April 1874
Ottava Relazione presentata dal ministro delle finanze sull'applicazione della legge che impone una tassa sulla macinazione dei cereali – anno 1874 *Eight Report on the application of the law imposing a grist tax – year 1874*
Nona Relazione presentata dal ministro delle finanze sull'applicazione della legge che impone una tassa sulla macinazione dei cereali – anno 1875 *Nineth Report on the application of the law imposing a grist tax – year 1875*
Decima Relazione presentata dal ministro delle finanze sull'applicazione della legge che impone una tassa sulla macinazione dei cereali – anno 1876 *Tenth Report on the application of the law imposing a grist tax – year 1876*
Undecima Relazione presentata dal ministro delle finanze sull'applicazione della legge che impone una tassa sulla macinazione dei cereali – anno 1877 *Eleventh Report on the application of the law imposing a grist tax – year 1877*

Table 2.24: Historical reports on grist tax - Part 1

Relazione della Direzione generale delle imposte dirette del catasto e del macinato per l'anno 1878 *Report of the General Directorate of Direct Land and Milling Taxes for the year 1878*
Relazione della Direzione generale delle imposte dirette del catasto e del macinato per l'anno 1879 *Report of the General Directorate of Direct Land and Milling Taxes for the year 1879*
Relazione della Direzione generale delle imposte dirette del catasto e del macinato per l'anno 1880 *Report of the General Directorate of Direct Land and Milling Taxes for the year 1880*
Relazione della Direzione generale delle imposte dirette del catasto e del macinato per l'anno 1881 *Report of the General Directorate of Direct Land and Milling Taxes for the year 1881*
Relazione della Direzione generale delle imposte dirette del catasto e del macinato per l'anno 1882 *Report of the General Directorate of Direct Land and Milling Taxes for the year 1882*
Relazione della Direzione generale delle imposte dirette del catasto e del macinato per l'anno 1883 *Report of the General Directorate of Direct Land and Milling Taxes for the year 1883*
Relazione della Direzione generale delle imposte dirette del catasto e del macinato per l'esercizio transitorio 1884 e l'esercizio finanziario normale 1884-85 *Report of the General Directorate of Direct Land and Milling Taxes for the years 1883, 1884, 1885*

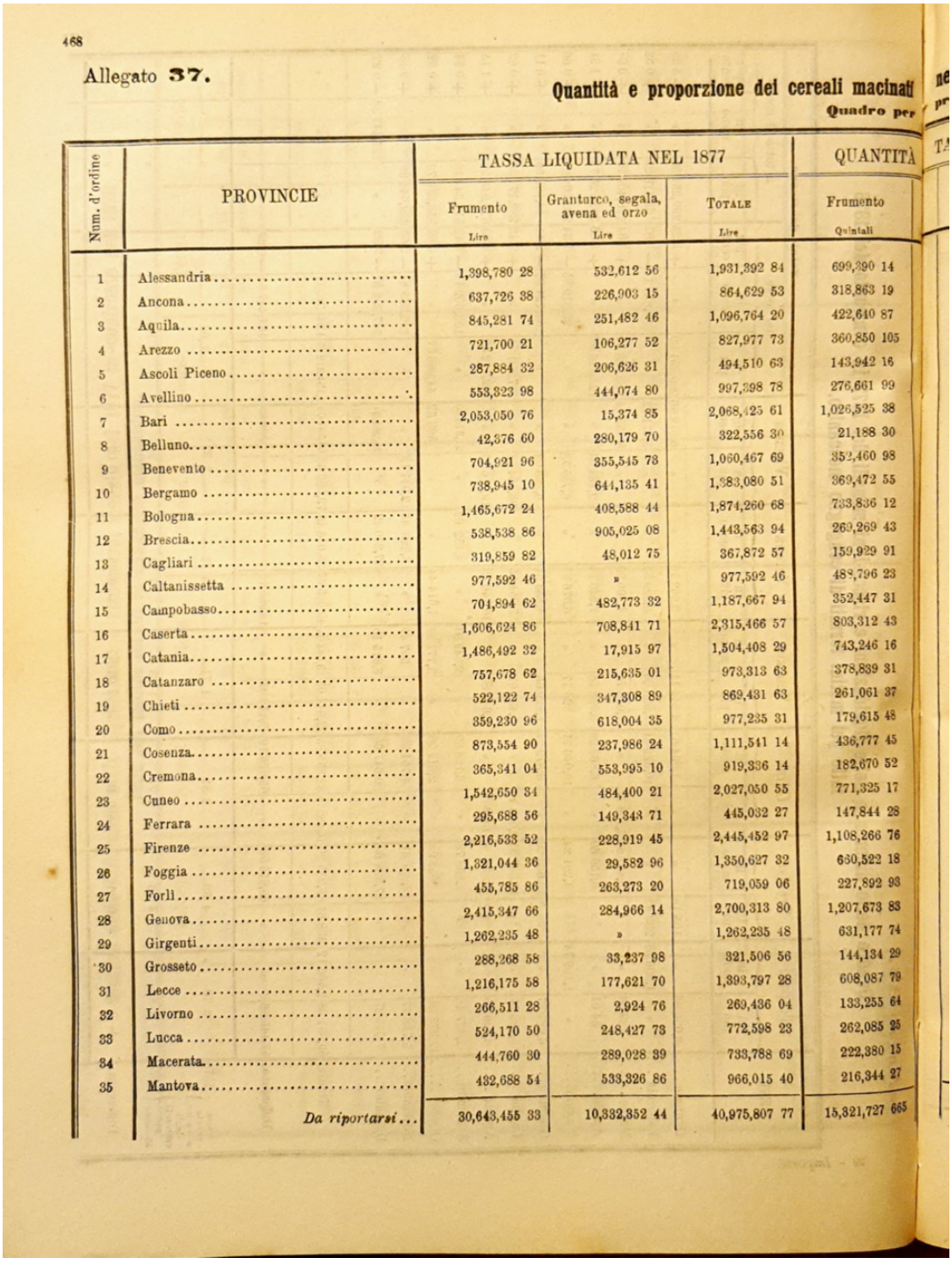
Table 2.25: Historical reports on grist tax - Part 2

Year 1877 – Allegato 37

A first example we discuss regards the "allegato 37" (attachment N. 37) to the "Relazione edita dalla Direzione generale delle imposte dirette nel 1877".

In figures 2.19 to 2.22 bitmaps the appearance of the two pages of allegato 37 is shown. They are photographs and not actual scans, because in the *Biblioteca Nilde Iotti della Camera dei deputati* where the documents are stored, there was not easy access to a digital scanner. However, the legibility of numbers is very good, so there are no or little issues of interpretation. Very important is the fact that the tables report on their bottom parts totals, which are the sums of the previous numbers, which are a useful check of data validity.

Allegato 37 is reproduced below in four sheets: this because in the source the full list of provinces is split in two partial lists, from Alessandria to Mantova and from Massa Carrara to Vicenza. Each of this list, in turn, spans across two pages, which were individually scanned, so we have four total sheets.



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Allegato **37.**

Quantità e proporzione dei cereali macinati

Quadro per

Num. d'ordine	PROVINCIE	TASSA LIQUIDATA NEL 1877			QUANTITÀ
		Frumento Lire	Granturco, segala, avena ed orzo Lire	Totale Lire	Frumento Quintali
1	Alessandria	1,398,780 28	532,612 56	1,931,392 84	699,390 14
2	Ancona	637,726 38	226,903 15	864,629 53	318,863 19
3	Aquila	845,281 74	251,482 46	1,096,764 20	422,640 87
4	Arezzo	721,700 21	106,277 52	827,977 73	360,850 105
5	Ascoli Piceno	287,884 32	206,626 31	494,510 63	143,942 16
6	Avellino	553,323 98	444,074 80	997,398 78	276,661 99
7	Bari	2,053,050 76	15,374 85	2,068,425 61	1,026,525 38
8	Belluno	42,376 60	280,179 70	322,556 30	21,188 30
9	Benevento	704,921 96	355,545 78	1,060,467 69	352,460 98
10	Bergamo	738,945 10	644,135 41	1,383,080 51	369,472 55
11	Bologna	1,465,672 24	408,588 44	1,874,260 68	733,836 12
12	Brescia	538,538 86	905,025 08	1,443,563 94	269,269 43
13	Cagliari	319,859 82	48,012 75	367,872 57	159,929 91
14	Caltanissetta	977,592 46	»	977,592 46	488,796 23
15	Campobasso	704,894 62	482,773 32	1,187,667 94	352,447 31
16	Caserta	1,606,624 86	708,841 71	2,315,466 57	803,312 43
17	Catania	1,486,492 32	17,915 97	1,504,408 29	743,246 16
18	Catanzaro	757,678 62	215,635 01	973,313 63	378,839 31
19	Chieti	522,122 74	347,308 89	869,431 63	261,061 37
20	Como	359,230 96	618,004 35	977,235 31	179,615 48
21	Cosenza	873,554 90	237,986 24	1,111,541 14	436,777 45
22	Cremona	365,341 04	553,995 10	919,336 14	182,670 52
23	Cuneo	1,542,650 34	484,400 21	2,027,050 55	771,325 17
24	Ferrara	295,688 56	149,343 71	445,032 27	147,844 28
25	Firenze	2,216,533 52	228,919 45	2,445,452 97	1,108,266 76
26	Foggia	1,321,044 36	29,582 96	1,350,627 32	660,522 18
27	Forlì	455,785 86	263,273 20	719,059 06	227,892 93
28	Genova	2,415,347 66	284,966 14	2,700,313 80	1,207,673 83
29	Girgenti	1,262,235 48	»	1,262,235 48	631,177 74
30	Grosseto	288,268 58	33,237 98	321,506 56	144,134 29
31	Lecce	1,216,175 58	177,621 70	1,393,797 28	608,087 79
32	Livorno	266,511 28	2,924 76	269,436 04	133,255 64
33	Lucca	524,170 50	248,427 73	772,598 23	262,085 25
34	Macerata	444,760 30	289,028 39	733,788 69	222,380 15
35	Mantova	432,688 54	533,326 86	966,015 40	216,344 27
	Da riportarsi...	30,643,455 33	10,332,352 44	40,975,807 77	15,321,727 665

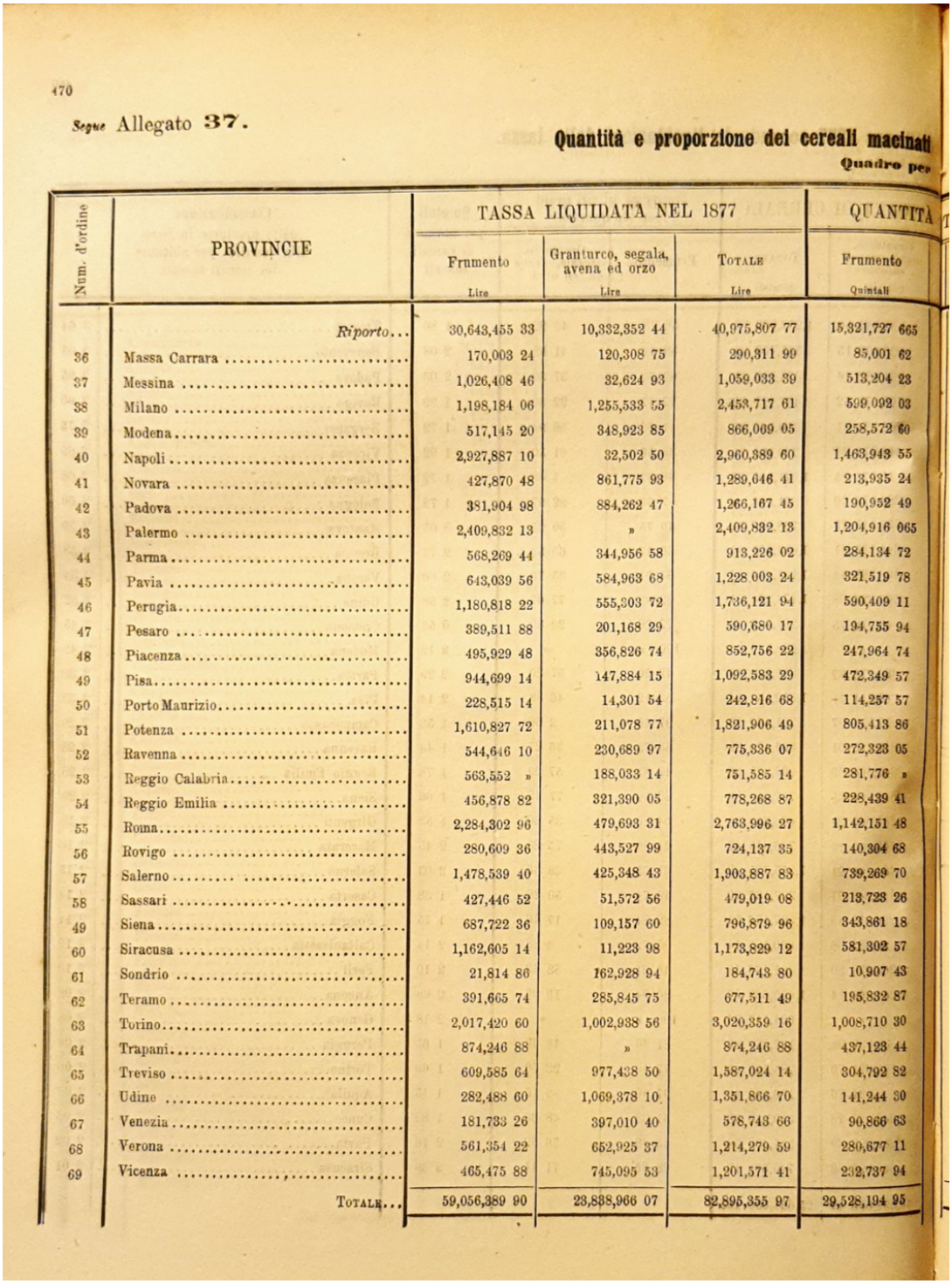
Figure 2.19: Year 1887 – Allegato 37 – Sheet 1/4

nell'anno 1877 secondo le liquidazioni della tassa.

provincie.

TASSATA DI CEREALI		Proporzione dei vari cereali per 100 quintali		Quintali per abitante di cereali tassati	Classificazione delle provincie in base alla quantità per abitante dei cereali tassati	
Granturco, segala, avena ed orzo Quintali	Totale Quintali	Frumento	Granturco, segala, avena ed orzo			
532,612 56	1,232,002 70	56 78	43 22	1 80	Treviso	3 64
226,903 15	545,766 34	58 42	41 58	2 08	Benevento	3 05
251,482 46	674,123 33	62 70	37 30	2 03	Padova	2 95
106,277 52	467,127 625	77 47	22 53	1 99	Rovigo	2 90
206,626 31	350,568 47	41 06	58 94	1 72	Bergamo	2 75
444,074 80	720,736 79	38 50	61 50	1 92	Vicenza	2 69
15,874 85	1,041,900 23	98 52	1 48	1 72	Piacenza	2 68
280,179 70	301,868 »	7 03	92 97	1 72	Bologna	2 60
355,545 73	708,006 71	49 75	50 25	3 05	Mantova	2 59
644,135 41	1,013,607 96	36 47	63 53	2 75	Brescia	2 58
408,588 44	1,141,424 56	64 21	35 79	2 60	Verona	2 54
905,025 08	1,174,294 51	22 93	77 07	2 58	Udine	2 52
48,012 75	207,942 66	77 20	22 80	0 53	Cremona	2 45
»	488,796 23	100 »	»	2 12	Modena	2 42
482,773 32	835,220 63	42 20	57 80	2 29	Parma	2 38
708,841 71	1,512,154 14	53 12	46 88	2 14	Pisa	2 33
17,915 97	761,162 13	97 40	2 60	1 53	Campobasso	2 29
215,635 01	594,474 32	63 73	36 27	1 44	Ravenna	2 28
347,368 89	608,370 26	42 91	57 09	1 78	Reggio Emilia	2 28
618,004 35	797,619 83	22 52	77 48	1 66	Siena	2 20
287,986 24	674,763 69	64 80	35 20	1 53	Girgenti	2 18
553,995 10	736,665 62	24 80	75 20	2 45	Macerata	2 16
484,400 21	1,255,725 38	61 65	38 35	2 03	Salerno	2 15
149,343 71	297,187 99	49 74	50 26	1 38	Caserta	2 14
228,919 45	1,337,186 21	82 84	17 16	1 75	Foggia	2 14
29,582 96	690,105 14	95 72	4 28	2 14	Caltanissetta	2 12
263,273 20	491,166 13	46 21	53 42	2 10	Forlì	2 10
284,966 14	1,492,639 97	80 94	19 06	2 08	Ancona	2 08
»	631,117 74	100 »	»	2 18	Genova	2 08
33,237 98	177,372 27	81 40	18 60	1 65	Perugia	2 08
177,621 70	785,709 49	77 40	22 60	1 60	Torino	2 06
2,924 76	196,180 40	97 90	2 10	1 15	Aquila	2 03
248,427 73	510,512 98	51 33	48 66	1 82	Cuneo	2 03
289,028 39	511,408 54	43 48	56 52	2 16	Pavia	2 02
533,326 86	749,671 13	28 86	71 14	2 59	Siracusa	2 01
10,332,352 44	25,654,080 105					

Figure 2.20: Year 1887 – Allegato 37 – Sheet 2/4



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Segue Allegato **37.**

Quantità e proporzione dei cereali macinati

Quadro per

Num. d'ordine	PROVINCIE	TASSA LIQUIDATA NEL 1877			QUANTITÀ
		Frumento Lire	Granturco, segala, avena ed orzo Lire	TOTALE Lire	Frumento Quintali
	Riporto...	30,643,455 33	10,332,352 44	40,975,807 77	15,321,727 665
36	Massa Carrara	170,003 24	120,308 75	290,311 99	85,001 62
37	Messina	1,026,408 46	32,624 93	1,059,033 39	513,204 23
38	Milano	1,198,184 06	1,255,533 55	2,453,717 61	599,092 03
39	Modena	517,145 20	348,923 85	866,069 05	258,572 60
40	Napoli	2,927,887 10	32,502 50	2,960,389 60	1,463,943 55
41	Novara	427,870 48	861,775 93	1,289,646 41	213,935 24
42	Padova	381,904 98	884,262 47	1,266,167 45	190,952 49
43	Palermo	2,409,832 13	»	2,409,832 13	1,204,916 065
44	Parma	568,269 44	344,956 58	913,226 02	284,134 72
45	Pavia	643,039 56	584,963 68	1,228 003 24	321,519 78
46	Perugia	1,180,818 22	555,303 72	1,736,121 94	590,409 11
47	Pesaro	389,511 88	201,168 29	590,680 17	194,755 94
48	Piacenza	495,929 48	356,826 74	852,756 22	247,964 74
49	Pisa	944,699 14	147,884 15	1,092,583 29	472,349 57
50	Porto Maurizio	228,515 14	14,301 54	242,816 68	114,257 57
51	Potenza	1,610,827 72	211,078 77	1,821,906 49	805,413 86
52	Ravenna	544,646 10	230,689 97	775,336 07	272,323 05
53	Reggio Calabria	563,552 »	188,033 14	751,585 14	281,776 »
54	Reggio Emilia	456,878 82	321,390 05	778,268 87	228,439 41
55	Roma	2,284,302 96	479,693 31	2,763,996 27	1,142,151 48
56	Rovigo	280,609 36	443,527 99	724,137 35	140,304 68
57	Salerno	1,478,539 40	425,348 43	1,903,887 83	739,269 70
58	Sassari	427,446 52	51,572 56	479,019 08	213,723 26
49	Siena	687,722 36	109,157 60	796,879 96	343,861 18
60	Siracusa	1,162,605 14	11,223 98	1,173,829 12	581,302 57
61	Sondrio	21,814 86	162,928 94	184,743 80	10,907 43
62	Teramo	391,665 74	285,845 75	677,511 49	195,832 87
63	Torino	2,017,420 60	1,002,938 56	3,020,359 16	1,008,710 30
64	Trapani	874,246 88	»	874,246 88	437,123 44
65	Treviso	609,585 64	977,438 50	1,587,024 14	304,792 82
66	Udine	282,488 60	1,069,378 10	1,351,866 70	141,244 30
67	Venezia	181,733 26	397,010 40	578,743 66	90,866 63
68	Verona	561,354 22	652,925 37	1,214,279 59	280,677 11
69	Vicenza	465,475 88	745,095 53	1,201,571 41	232,737 94
	TOTALE...	59,056,389 90	23,838,966 07	82,895,355 97	29,528,194 95

Figure 2.21: Year 1887 – Allegato 37 – Sheet 3/4

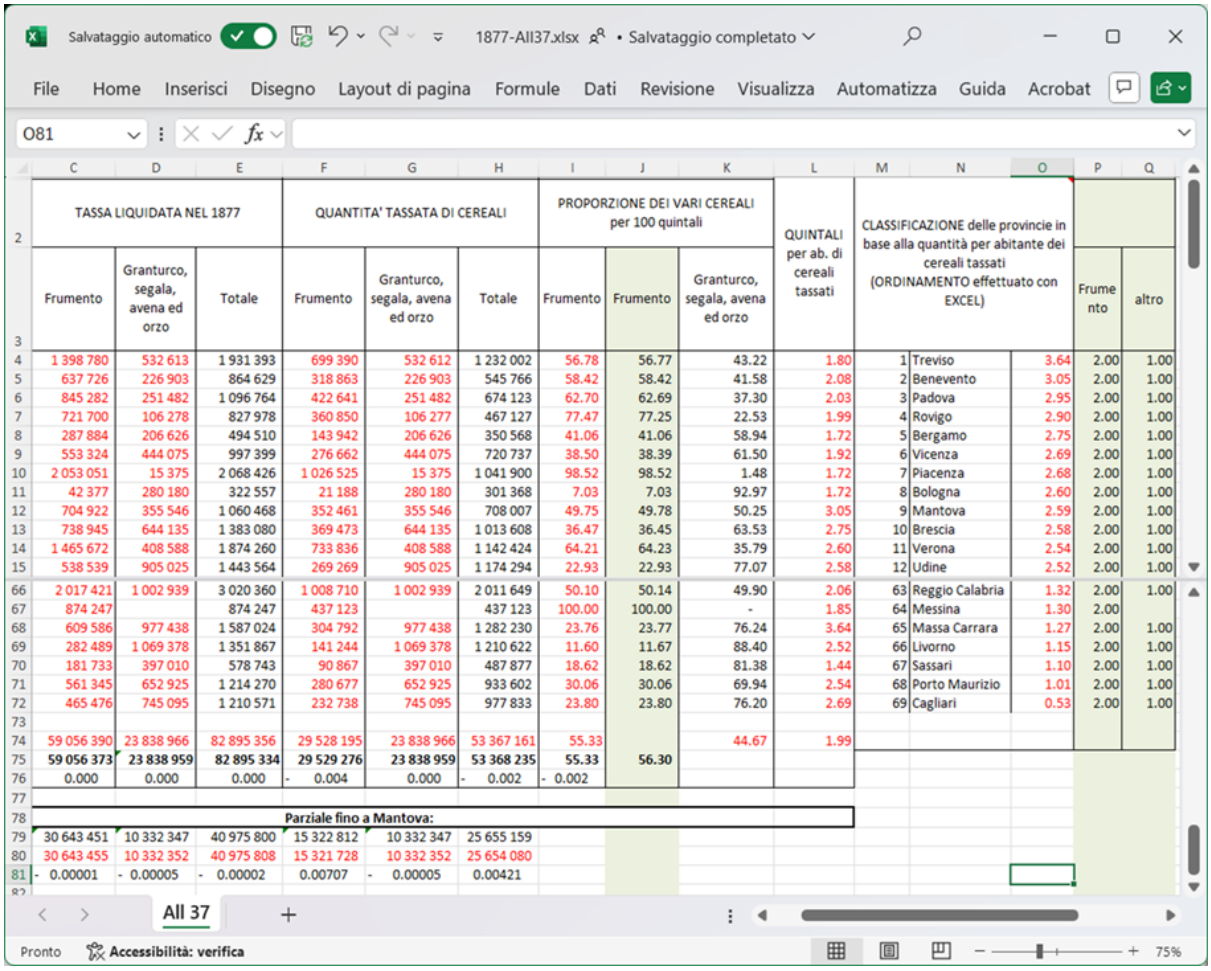
...ell'anno 1877 secondo le liquidazioni della tassa.

...provincie.

TASSATA DI CEREALI		Proporzioni dei vari cereali per 100 quintali		Quintali per abitante di cereali tassati	Classificazione delle provincie in base alla quantità per abitante dei cereali tassati	
Granturco, segala, avena ed orzo Quintali	TOTALE Quintali	Frumento	Granturco, segala, avena ed orzo			
10,332,352 44	25,654,080 105					
120,308 75	205,310 87	41 42	58 58	1 27	Arezzo	1 99
82,624 93	545,829 16	94 15	5 85	1 30	Potenza	1 99
1,255,533 55	1,854,625 58	32 30	67 70	1 85	Palermo	1 95
348,923 85	607,496 45	42 56	57 44	2 42	Teramo	1 95
82,502 50	1,496,446 05	97 85	2 15	1 65	Roma	1 94
861,775 93	1,075,711 17	20 »	80 »	1 72	Avellino	1 92
884,262 47	1,075,214 96	17 80	82 20	2 95	Pesaro	1 86
»	1,204,916 065	100 »	»	1 95	Milano	1 85
344,956 58	629,091 30	45 16	54 84	2 38	Trapani	1 85
584,963 68	906,483 46	35 48	64 52	2 02	Lucca	1 82
555,303 72	1,145,712 83	53 94	46 06	2 08	Alessandria	1 80
201,168 29	395,924 23	49 20	50 80	1 86	Chieti	1 78
356,826 74	604,791 48	40 99	59 01	2 68	Firenze	1 75
147,884 15	620,233 72	76 16	23 84	2 33	Ascoli	1 72
14,301 54	128,559 11	89 20	10 80	1 01	Bari	1 72
211,078 77	1,016,492 63	79 25	20 75	1 99	Belluno	1 72
230,689 97	503,913 02	54 15	45 85	2 28	Novara	1 72
188,033 14	469,809 14	60 02	39 98	1 32	Como	1 66
321,390 05	549,829 46	41 51	58 49	2 28	Grosseto	1 65
479,693 31	1,621,844 79	70 53	29 47	1 94	Napoli	1 65
443,527 99	583,832 67	24 »	76 »	2 90	Lecce	1 60
425,348 43	1,164,618 13	63 52	36 48	2 15	Sondrio	1 56
51,572 56	265,295 82	80 60	19 40	1 10	Catania	1 53
109,157 60	453,018 78	75 91	24 09	2 20	Cosenza	1 53
11,223 98	592,526 55	98 11	1 89	2 01	Catanzaro	1 44
162,928 94	173,836 37	5 90	94 10	1 56	Venezia	1 44
285,845 75	481,678 62	40 82	59 18	1 95	Ferrara	1 38
1,002,938 56	2,011,648 86	50 10	49 90	2 06	Reggio-Calabria	1 32
»	437,123 44	100 »	»	1 85	Messina	1 30
977,438 50	1,282,231 32	23 76	76 24	3 64	Massa Carrara	1 27
1,969,378 10	1,210,622 40	11 60	88 40	2 52	Livorno	1 15
397,010 40	487,877 03	18 62	81 38	1 44	Sassari	1 10
652,925 37	933,602 48	30 06	69 94	2 54	Porto Maurizio	1 01
745,095 53	977,833 47	23 80	76 20	2 69	Cagliari	0 53
23,838,966 07	53,367,161 02	55 83	44 67	1 99	REGNO ...	1 99

Figure 2.22: Year 1887 – Allegato 37 – Sheet 4/4

The produced excel file corresponding to this allegato has the appearance shown in the following picture (data between Brescia and Torino omitted for brevity):



	TASSA LIQUIDATA NEL 1877			QUANTITA' TASSATA DI CEREALI			PROPORZIONE DEI VARI CEREALI per 100 quintali			QUINTALI per ab. di cereali tassati	CLASSIFICAZIONE delle provincie in base alla quantità per abitante dei cereali tassati (ORDINAMENTO effettuato con EXCEL)				
	Frumento	Granturco, segala, avena ed orzo	Totale	Frumento	Granturco, segala, avena ed orzo	Totale	Frumento	Frumento	Granturco, segala, avena ed orzo					Frumento	altro
4	1 398 780	532 613	1 931 393	699 390	532 612	1 232 002	56.78	56.77	43.22	1.80	1	Treviso	3.64	2.00	1.00
5	637 726	226 903	864 629	318 863	226 903	545 766	58.42	58.42	41.58	2.08	2	Benevento	3.05	2.00	1.00
6	845 282	251 482	1 096 764	422 641	251 482	674 123	62.70	62.69	37.30	2.03	3	Padova	2.95	2.00	1.00
7	721 700	106 278	827 978	360 850	106 277	467 127	77.47	77.25	22.53	1.99	4	Rovigo	2.90	2.00	1.00
8	287 884	206 626	494 510	143 942	206 626	350 568	41.06	41.06	58.94	1.72	5	Bergamo	2.75	2.00	1.00
9	553 324	444 075	997 399	276 662	444 075	720 737	38.50	38.39	61.50	1.92	6	Vicenza	2.69	2.00	1.00
10	2 053 051	15 375	2 068 426	1 026 525	15 375	1 041 900	98.52	98.52	1.48	1.72	7	Piacenza	2.68	2.00	1.00
11	42 377	280 180	322 557	21 188	280 180	301 368	7.03	7.03	92.97	1.72	8	Bologna	2.60	2.00	1.00
12	704 922	355 546	1 060 468	352 461	355 546	708 007	49.75	49.78	50.25	3.05	9	Mantova	2.59	2.00	1.00
13	738 945	644 135	1 383 080	369 473	644 135	1 013 608	36.47	36.45	63.53	2.75	10	Brescia	2.58	2.00	1.00
14	1 465 672	408 588	1 874 260	733 836	408 588	1 142 424	64.21	64.23	35.79	2.60	11	Verona	2.54	2.00	1.00
15	538 539	905 025	1 443 564	269 269	905 025	1 174 294	22.93	22.93	77.07	2.58	12	Udine	2.52	2.00	1.00
66	2 017 421	1 002 939	3 020 360	1 008 710	1 002 939	2 011 649	50.10	50.14	49.90	2.06	63	Reggio Calabria	1.32	2.00	1.00
67	874 247		874 247	437 123		437 123	100.00	100.00	-	1.85	64	Messina	1.30	2.00	
68	609 586	977 438	1 587 024	304 792	977 438	1 282 230	23.76	23.77	76.24	3.64	65	Massa Carrara	1.27	2.00	1.00
69	282 489	1 069 378	1 351 867	141 244	1 069 378	1 210 622	11.60	11.67	88.40	2.52	66	Livorno	1.15	2.00	1.00
70	181 733	397 010	578 743	90 867	397 010	487 877	18.62	18.62	81.38	1.44	67	Sassari	1.10	2.00	1.00
71	561 345	652 925	1 214 270	280 677	652 925	933 602	30.06	30.06	69.94	2.54	68	Porto Maurizio	1.01	2.00	1.00
72	465 476	745 095	1 210 571	232 738	745 095	977 833	23.80	23.80	76.20	2.69	69	Cagliari	0.53	2.00	1.00
74	59 056 390	23 838 966	82 895 356	29 528 195	23 838 966	53 367 161	55.33		44.67	1.99					
75	59 056 373	23 838 959	82 895 334	29 529 276	23 838 959	53 368 235	55.33	56.30							
76	0.000	0.000	0.000	- 0.004	0.000	- 0.002	- 0.002								
78	Parziale fino a Mantova:														
79	30 643 451	10 332 347	40 975 800	15 322 812	10 332 347	25 655 159									
80	30 643 455	10 332 352	40 975 808	15 321 728	10 332 352	25 654 080									
81	- 0.00001	- 0.00005	- 0.00002	0.00707	- 0.00005	0.00421									

Figure 2.23: Excel representation of Allegato 37

For the maximum correspondence with the source, these excel tables have been written in Italian. Our translations of Italian terms are as shown in Fig. 2.26

A few notes on the methodology:

- All the original data retrieved from the historical documents are written in red, while data obtained from them by mathematical formulas are in black, for immediate recognition of the original values
- The headings are left in Italian for more immediate correspondence to the source
- All the sums available on the original documents are used for error checking. We see, for instance in row 76 that we have null or negligible errors everywhere except in columns I and L where still we have errors below 1%
- Since the source contains also partial sums for the first set of provinces, up to Mantova, a check on these partials has also been made (rows 79-81)
- When some data are expected to be a numerical function of others already shown, formulas are used for error checking, or enhanced analysis. In these cases, new columns have been added, and they have green background to show that they have

Italian	English	notes
Provincie	Provinces	
Tassa liquidata nel 1877	Tax paid in 1877	
Frumento	Wheat	
Granturco, segala, avena ed orzo	Corn, rye, oats and barley	
Totale	Total	
Quantità tassata di cereali	Quantity of cereals subject to tax	
Proporzione dei vari cereali per 100 quintali	Proportion of the various cereals (%)	Here he have a questionable header: the proportion is in percent, not per 100 quintals (1 quintal=100kg). It is understood that the source meant "quintals in a 100 quintal amount", but this is misleading. For max compliance, however, we have left the misleading header in our excel table
Quintali per ab. di cereali tassati	100-kg units per taxed inhabitant	In Italy one "quintale" (quintal) is a unit of measure consisting of 100 kg
Classificazione delle provincie in base alla quantità per abitante dei cereali tassati	Classification of provinces based on the quantity of taxed cereals per inhabitant	

Table 2.26: Italian - English heading translation part 1

not any counterpart on the source. For instance, the proportion of Frumento over all the cereals can be obtained by a formula.

- In some cases, the use of formulas was useful also to check what type of computations was made by the source. For instance, it was shown that, correctly, the value in cell 74I computed in the source not as the average of the above numbers, but, instead, the total quantity of wheat, divided by the total quantity of taxed cereals then multiplied by 100.
- The "Classification of provinces based on the quantity of taxed cereals per inhabitant" implied just jointly reordering columns B and L and this was done using the Excel reordering feature
- We now from literature analysis (and from Table 2.6 in this thesis) that the tax for these cereals had to be 2 and 1 Liras/(100 kg) for wheat and other cereals, respectively. Added columns P and Q check the coherency of tables data with these tariffs.

Year 1877 – Allegato 37

In some cases, cross-check of numbers have been performed also across different tables (i.e. allegati). This can be exemplified considering allegato 49 in document "Relazione edita dalla Direzione generale delle imposte dirette nel 1878".

Allegato 19.

Riassunto dei dati statistici intorno all'andamento

REGIONI ed UFFICI (1)	Numero medio dei palmenti forniti di congegno meccanico	Numero medio dei palmenti tassati in base al contatore	Centinaia di giri verificati nel 1877 — per palmento	Quota media per ogni cento giri di macina	Tassa liquidata per ciascun palmento col contatore	Tassa liquidata e venuta a carico degli esercenti nel 1876 — per abitante	Quintali di cereali tassati — per abitante	Tassa versata — per abitante	Spesa per 100 Servizio tecnico	Spesa per 100 Perizie e liti	Spesa per 100 Rimborsi per quote indebite od inesigibili
1	2	3	4	5	6	7	8	9	10	11	12
Piemonte	7,631	7,441	47,120	2.52	1,188.07	2.87	1.91	2.86	4. »	0.10	0.27
Liguria	3,288	2,591	35,350	2.80	990.03	3.37	1.81	3.40	4.20	0.15	0.40
Lombardia	6,967	6,856	58,701	1.96	1,149.35	2.82	2.15	2.81	4.10	0.14	0.13
Veneto	7,117	6,825	41,953	2.62	1,101.27	3.04	2.53	3.06	4.42	0.11	0.09
Emilia	7,443	6,325	31,535	3.80	1,198.11	3.35	2.21	3.37	4.65	0.14	0.04
Marche ed Umbria	3,349	2,958	23,362	6.56	1,532.16	3.10	1.99	3.08	5.61	0.26	0.17
Toscana	7,724	6,489	22,585	4.26	957.82	3.17	1.80	3.21	5.48	0.18	0.38
Lazio	882	826	50,416	5.57	2,808.91	3.40	1.98	3.43	3.34	0.02	0.07
Abruzzi e Molise	2,237	2,137	26,650	6.76	1,802.30	3.01	2.00	3.03	5.02	0.59	0.86
Campania	2,891	2,637	47,916	6.01	2,876.86	3.33	1.98	3.35	4.43	0.51	1.04
Puglie	2,637	2,254	29,167	5.73	1,671.88	3.50	1.83	3.52	4.57	0.26	0.33
Basilicata	1,126	1,031	31,092	6. »	1,865.77	3.78	2.02	3.72	5.40	0.26	0.66
Calabria	2,775	2,296	113,181	1.10	1,251.41	2.38	1.46	2.39	7.15	0.30	0.73
Sicilia	3,420	3,121	65,977	4.40	2,885.03	3.56	1.80	3.61	3.67	0.54	1.18
Sardegna	873	625	101,452	0.77	782.80	1.33	0.71	1.34	6.62	0.05	0.43
Ministero, Direz. e Intendenze	»	»	»	»	»	»	»	»	0.59	»	»
Totale	60,360	54,312	44,072	3.21	1,414.10	3.10	1.97	3.12	5.16	0.26	0.47
1877	60,322	54,545	46,873	3.04	1,424.56	3.09	1.99	3.10	5.23	0.39	0.32
1876	61,078	53,448	48,658	3.02	1,469.68	3.10	1.98	3.08	5.10	0.69	0.48
1875	61,783	55,845	49,634	2.68	1,332.90	2.89	1.85	2.86	5.49	0.57	0.31
1874	59,728	55,835	54,705	2.16	1,180.52	2.60	1.72	2.57	5.70	0.70	0.54
1873	59,609	53,766	57,566	1.93	1,110.62	2.35	»	2.40	5.05	0.55	0.62
1872	56,811	49,918	59,721	1.87	1,116.85	2.22	»	2.20	6.04	(2) »	
1871	49,902	40,454	64,916	1.57	1,024.20	1.78	»	1.66	7.11	(2) »	

(1) Si riporta per norma la ripartizione delle provincie nelle varie regioni:
Piemonte — Alessandria — Cuneo — Novara — Pavia — Torino.
Liguria — Genova — Porto Maurizio.
Lombardia — Bergamo — Brescia — Como — Cremona — Mantova — Milano — Sondrio.
Veneto — Belluno — Padova — Rovigo — Treviso — Udine — Venezia — Verona — Vicenza.
Emilia — Bologna — Ferrara — Forlì — Massa-Carrara — Modena — Parma — Piacenza — Ravenna — Reggio-Emilia.
Marche ed Umbria — Ancona — Ascoli-Piceno — Macerata — Perugia — Pesaro.
Toscana — Arezzo — Firenze — Grosseto — Livorno — Lucca — Pisa — Siena.
Lazio — Roma.
Abruzzi e Molise — Aquila — Campobasso — Chieti — Teramo.
Campania — Avellino — Benevento — Caserta — Napoli — Salerno.

Figure 2.24: Year 1878 – Allegato 49 – Sheet 1/2

ella tassa sul macinato nell'anno 1878.

e di tassa versata nel 1878					Spesa media del servizio tecnico per palmento fornito di congegno	Quote dal 1° ottobre 1874 a tutto dicembre 1878					Contravvenzioni accertate nel 1878	
Restituzioni per esportazione all'estero	Importazione di farine nella provincia romana	Aggi ai ricevitori ed esattori	Spese diverse	Totale		Contestate — per cento proposte	Per le quali non ebbe seguito la perizia o per irregolarità del ricorso, o per applicazione dell'art. 6 della legge o per transazione — per cento contestate	Definite mediante perizia — per cento contestate	Definite mediante giudizio in appello — per cento contestate	Pendenti — per cento contestate	Per 100 mulini	Per 100,000 abitanti
43	44	45	46	47	48	49	20	21	22	23	24	25
0.10		1.78	»	6.25	50.20	29.30	29. »	51.70	17.70	4.60	4.50	6. »
2. »	»	1.75	»	8.50	36.60	25.50	21. »	64.20	10. »	4.80	8. »	20. »
0.48	»	1.74	0.04	6.63	49.95	24.60	37.70	41.70	17.40	3.20	5. »	7. »
0.55	»	2.23	0.04	7.44	50.20	30.40	30.15	45.70	18.85	5.30	4. »	7.60
»	»	2.22	0.05	7.10	47.80	15.50	21. »	38. »	39. »	2. »	6. »	11. »
0.02	»	3.15	0.05	9.26	75.40	20.70	28.50	25.80	30.70	15. »	10. »	14. »
0.12	»	2.93	0.05	9.14	45.20	19.50	58.50	26.50	13.10	1.90	5. »	12. »
»	»	2.26	0.01	5.70	108.76	7.70	67.10	22.20	8.08	2.62	16. »	13. »
0.02	»	4.30	0.02	10.81	87.80	27.30	53.30	16.30	22.50	7.90	19. »	30. »
0.52	»	2.50	0.02	9.02	141.20	28.20	73.80	11.70	10.40	4.10	15. »	17. »
0.06	»	2.50	»	7.72	87. »	9.67	63.20	14. »	15.40	7.40	5. »	9.50
»	»	3.72	0.01	10.05	92.40	13.70	51.50	23.60	21.10	3.80	12. »	26. »
»	»	5.08	0.01	13.27	74.60	11.20	55.40	14.10	15.70	14.80	30. »	14. »
0.17	»	4.68	0.02	10.26	100.35	43.70	23.40	26. »	47. »	3.60	19. »	29. »
0.02	»	6.62	0.02	13.76	64.80	5.04	31. »	19. »	7.04	51.96	1. 50	76. »
»	»	»	»	0.59	»	»	»	»	»	»	»	»
0.28	»	2.81	0.01	8.99	71.40	23.60	37.50	34.40	23.30	4.80	6.50	18 »
0.28	»	3.68	0.01	9.91	72.02	24.70	32.49	34.73	23.55	9.23	7. »	20. »
0.30	0.10	3.53	0.01	10.21	68.78	27.35	29.70	35.78	21.07	46.75	7. »	19. »
0.42	0.06	3.56	0.17	10.58	68.68	29.30	15.90	(3) 28.13	9.22	13.45	9. »	26. »
0.37	0.22	3.40	0.77	11.70	65.76	18 63	»	57 65 (4) / 60 31 (5)	14 18 / 11 24	2.40 (6)	25.77	12. » 33. »
0.40	0.16	3.38	0.64	10.80	55.32	19 14	»			1.85	26.60	13. » 38. »
0.68		3.38	(2) 1.32	11.42	62.76	19 80	»	63 60 (4) / 64 60 (5)	2 60 / 1 70	0.50 (6) / »	33.30	15. » 42. »
0.50		1.46	(2) 1.50	10.57	63.36	22 30	»				33.70	13. » 48. »

Puglie — Bari — Foggia — Lecce.
Basilicata — Potenza.
Calabria — Catanzaro — Cosenza — Reggio-Calabria.
Sicilia — Caltanissetta — Catania — Girgenti — Messina — Palermo — Siracusa — Trapani.
Sardegna — Cagliari — Sassari.

(2) Per gli anni 1871-1872 le spese di perizie e liti sono conglomerate nelle spese diverse.
(3) Queste cifre si riferiscono al periodo dell'impianto della tassa alla fine di ciascun anno.
(4) Quote definite mediante perizia amministrativa.
(5) Quote definite dall'Autorità giudiziaria in prima istanza,
(6) Idem idem in grado d'appello.

Figure 2.25: Year 1878 – Allegato 49 – Sheet 2/2

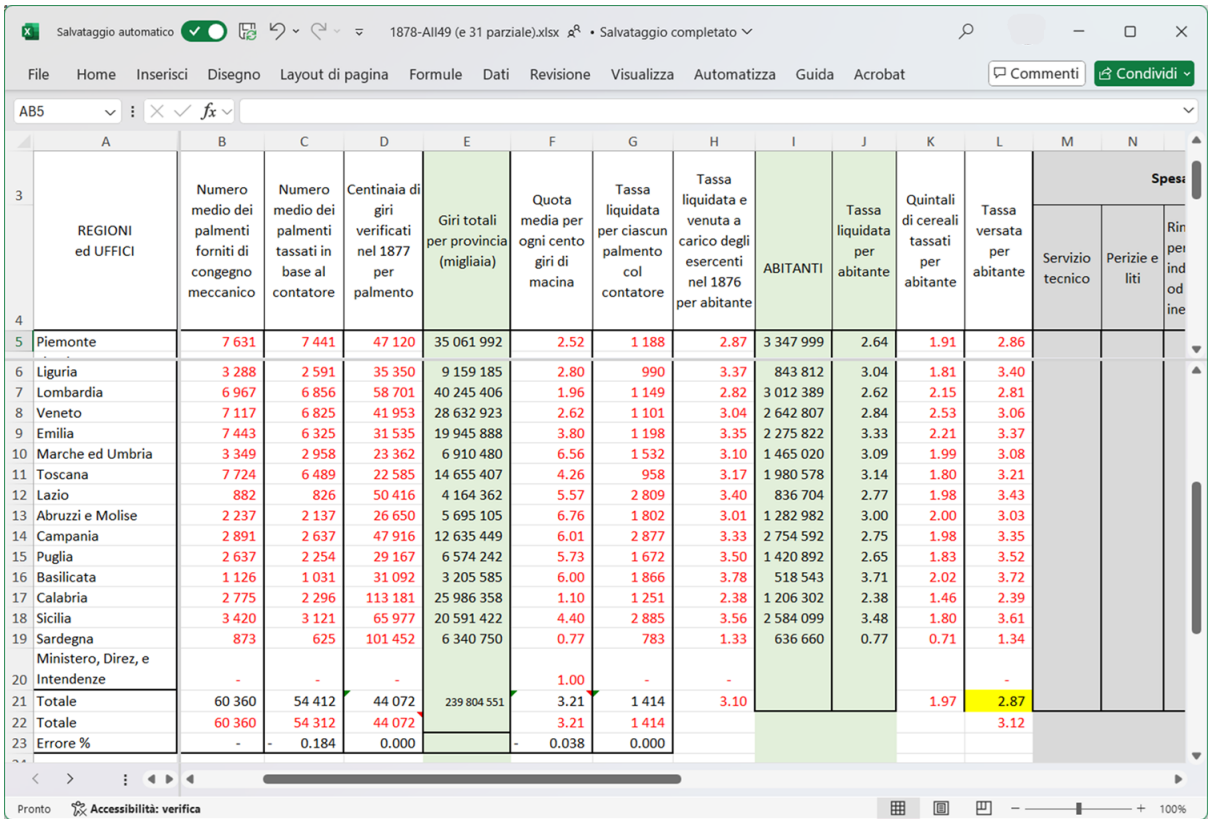
Such a table contains some data that are not of interest of this thesis, and therefore have not been digitalised: the corresponding columns are shown greyed. Nevertheless, for completeness, in the Table 2.27 the full table header item set is translated. In the table, with green background also translation of additional headers of columns that have been added in the produced spreadsheet, to perform cross checks.

Italian	English
REGIONI ed UFFICI	Regions and offices
Numero medio dei palmenti forniti di congegno meccanico	Average number of millstones equipped with mechanical device
Numero medio dei palmenti tassati in base al contatore	Average number of millstones taxed per meter
Centinaia di giri verificati nel 1877 per palmento	Hundreds of revolutions verified in 1877 per millstone
Giri totali per provincia (migliaia)*	Total revolutions per Province (thousands)*
Quota media per ogni cento giri di macina	Average amount per hundred mill revolutions
Tassa liquidata per ciascun palmento col contatore*	Tax paid for each millstone with meter
Tassa liquidata e venuta a carico degli esercenti nel 1876 per abitante*	Tax paid and paid by shopkeepers in 1876 per inhabitant
ABITANTI	Inhabitants
Tassa liquidata per abitante	Tax paid per inhabitant
Quintali di cereali tassati per abitante	Quintals of cereals taxed per inhabitant
Tassa versata per abitante*	Tax paid per inhabitant
Spesa per 1100 Lire di tassa versata nel 1878	Expense for 1100 lira of tax paid in 1878
Servizio tecnico	Technical service
Perizie e titi	Appraisals and disputes
Rimborsi per quote indebite od inesigibili	Refunds for undue or uncollectable amounts
Restituzioni per esportazione all'estero	Refunds for export abroad
Importazione di farine nella provincia romana	Importation of flour in the Roman province
Aggi ai ricevitori ed esattori	Commissions to receivers and collectors
Spese diverse	Diverse expenses
Totale	Total
Spesa media del servizio tecnico per palmento fornito di congegno	Average cost of technical service per mill equipped with device
Quote dal 1° ottobre 1874 a tutto dicembre 1878	Quotes from October 1, 1874 to December 31, 1878
Contestate per cento proposte	Contested for one hundred proposals
Per le quali non ebbe seguito la perizia o per irregolarità del ricorso o per applicazione dell'art. 6 della legge o per transazione - per cento contestate	For which no appraisal followed either due to irregularity of the appeal or due to application of art. 6 of the law or due to transaction - per hundred contested[36]
Definite mediante perizia per cento contestate	Defined by appraisal per cent disputed
Definite mediante giudizio in appello per cento contestate	Defined by appeal per cent contested
Pendenti per cento contestate	Pending Per one hundred disputes
Contravvenzioni accertate nel 1878	Contraventions found in 1878
Per 100 mulini	For 100 mills
Per 100,000 abitanti	For 100,000 inhabitants

Table 2.27: Italian - English heading translation part 2

The excel table produced had for completeness all the headers, but only the numbers of interest for this thesis were transcribed (and the corresponding cell's background greyed). As in the previous cases, columns having green background have been added, not existing in the source, but useful for understanding better the meaning of the gathered data.

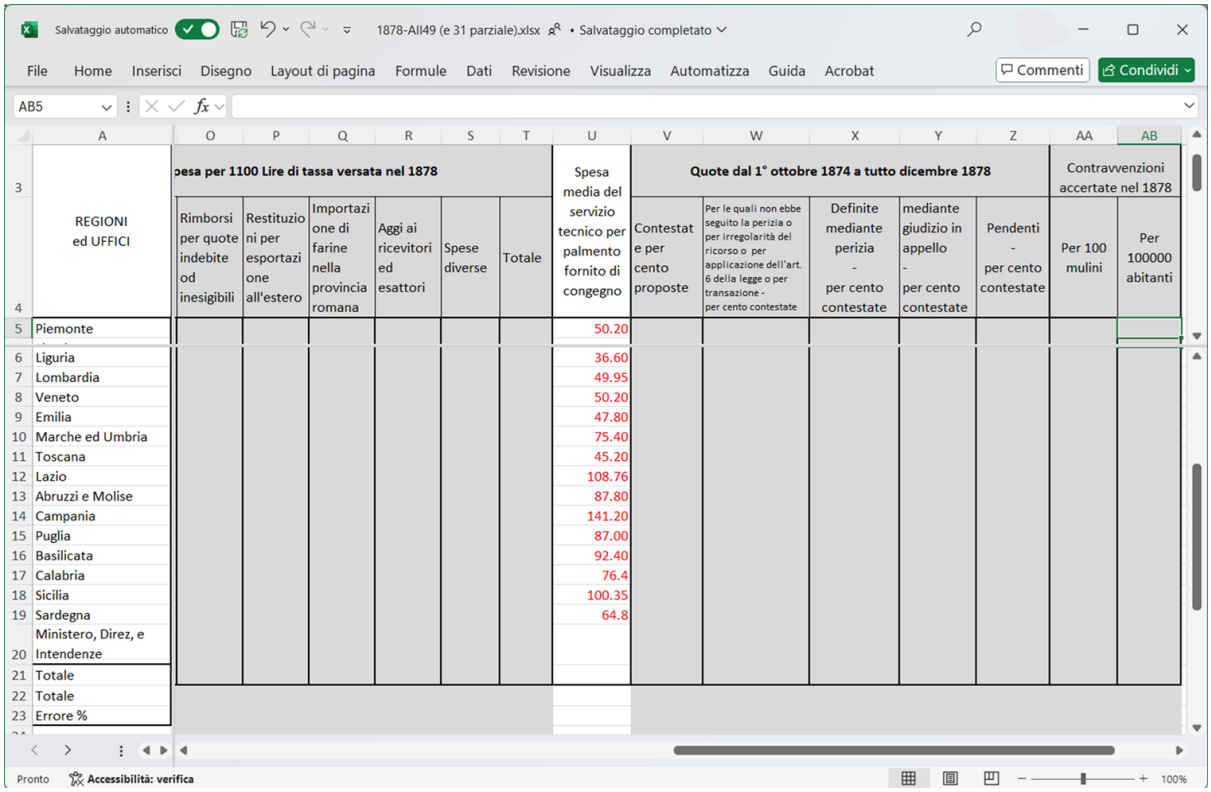
To make it well visible in the width of the page, the obtained excel table is shown below in Fig. 2.26 and 2.27, all of which sharing the first (heading) column.



	REGIONI ed UFFICI	Numero medio dei palmenti forniti di congegno meccanico	Numero medio dei palmenti tassati in base al contatore	Centinaia di giri verificati nel 1877 per palmento	Giri totali per provincia (migliaia)	Quota media per ogni cento giri di macina	Tassa liquidata per ciascun palmento col contatore	Tassa liquidata e venuta a carico degli esercenti nel 1876 per abitante	ABITANTI	Tassa liquidata per abitante	Quintali di cereali tassati per abitante	Tassa versata per abitante	Spesa: Servizio tecnico	Spesa: Perizie e liti	Spesa: Rin per ind od ine
5	Piemonte	7 631	7 441	47 120	35 061 992	2.52	1 188	2.87	3 347 999	2.64	1.91	2.86			
6	Liguria	3 288	2 591	35 350	9 159 185	2.80	990	3.37	843 812	3.04	1.81	3.40			
7	Lombardia	6 967	6 856	58 701	40 245 406	1.96	1 149	2.82	3 012 389	2.62	2.15	2.81			
8	Veneto	7 117	6 825	41 953	28 632 923	2.62	1 101	3.04	2 642 807	2.84	2.53	3.06			
9	Emilia	7 443	6 325	31 535	19 945 888	3.80	1 198	3.35	2 275 822	3.33	2.21	3.37			
10	Marche ed Umbria	3 349	2 958	23 362	6 910 480	6.56	1 532	3.10	1 465 020	3.09	1.99	3.08			
11	Toscana	7 724	6 489	22 585	14 655 407	4.26	958	3.17	1 980 578	3.14	1.80	3.21			
12	Lazio	882	826	50 416	4 164 362	5.57	2 809	3.40	836 704	2.77	1.98	3.43			
13	Abruzzi e Molise	2 237	2 137	26 650	5 695 105	6.76	1 802	3.01	1 282 982	3.00	2.00	3.03			
14	Campania	2 891	2 637	47 916	12 635 449	6.01	2 877	3.33	2 754 592	2.75	1.98	3.35			
15	Puglia	2 637	2 254	29 167	6 574 242	5.73	1 672	3.50	1 420 892	2.65	1.83	3.52			
16	Basilicata	1 126	1 031	31 092	3 205 585	6.00	1 866	3.78	518 543	3.71	2.02	3.72			
17	Calabria	2 775	2 296	113 181	25 986 358	1.10	1 251	2.38	1 206 302	2.38	1.46	2.39			
18	Sicilia	3 420	3 121	65 977	20 591 422	4.40	2 885	3.56	2 584 099	3.48	1.80	3.61			
19	Sardegna	873	625	101 452	6 340 750	0.77	783	1.33	636 660	0.77	0.71	1.34			
20	Ministero, Direz, e Intendenze	-	-	-		1.00	-	-				-			
21	Totale	60 360	54 412	44 072	239 804 551	3.21	1 414	3.10			1.97	2.87			
22	Totale	60 360	54 312	44 072		3.21	1 414					3.12			
23	Errore %	-	- 0.184	0.000		- 0.038	0.000								

Figure 2.26: Year 1878 – Digitalised Allegato 49 – Sheet 1/2

[36]The source does not clarify the difference between "Tassa liquidata" and "Tassa versata". Both are somehow tax paid. See the first dot in the below notes on the methodology.



	REGIONI ed UFFICI	esa per 1100 Lire di tassa versata nel 1878						Spesa media del servizio tecnico per palmento fornito di congegno	Quote dal 1° ottobre 1874 a tutto dicembre 1878					Contravvenzioni accertate nel 1878	
		Rimborsi per quote indebite od inesigibili	Restituzioni per esportazione all'estero	Importazione di farine nella provincia romana	Aggi ai ricevitori ed esattori	Spese diverse	Totale		Contestate per cento proposte	Per le quali non ebbe seguito la perizia o per irregolarità del ricorso o per applicazione dell'art. 6 della legge o per transazione - per cento contestate	Definite mediante perizia - per cento contestate	mediante giudizio in appello - per cento contestate	Pendenti - per cento contestate	Per 100 mulini	Per 100000 abitanti
5	Piemonte							50.20							
6	Liguria							36.60							
7	Lombardia							49.95							
8	Veneto							50.20							
9	Emilia							47.80							
10	Marche ed Umbria							75.40							
11	Toscana							45.20							
12	Lazio							108.76							
13	Abruzzi e Molise							87.80							
14	Campania							141.20							
15	Puglia							87.00							
16	Basilicata							92.40							
17	Calabria							76.4							
18	Sicilia							100.35							
19	Sardegna							64.8							
20	Ministero, Direz, e Intendenze														
21	Totale														
22	Totale														
23	Errore %														

Figure 2.27: Year 1878 – Digitalised Allegato 49 – Sheet 2/2

A few notes on the methodology of the digitalisation:

- The table contains the expressions "Tassa liquidata" and "Tassa versata". The difference is not clearly stated but we believe that "tassa liquidata" indicates the amount of tax that has been determined, while "tassa versata" is the tax that has been actually paid by the taxpayer to the state. To have consistent data, therefore, column J has been added, having a clear meaning, i.e. the "tassa liquidata" for each inhabitant
- To generate column J data of inhabitants of different regions consistent with that table had to be retrieved. Fortunately, in the same document containing Allegato 49 information on the population of different provinces was available (allegato 31.) These are shown in Fig. 2.28 where also the lists of provinces included in each region is shown. This is important, since this composition changed often over the years in the XIX century. The lists shown in the figure were taken from the information shown in the bottom part of allegato 49.

	A	B
1	Provincia	Popolazione
2	Alessandria	683 361
3	Ancona	262 349
4	Aquila	332 784
5	Arezzo	234 645
6	Ascoli	203 004
7	Avellino	375 691
8	Bari	604 540
9	Belluno	175 282
10	Benevento	232 008
11	Bergamo	368 152
12	Bologna	439 232
13	Brescia	456 023
14	Cagliari	393 208
15	Caltanissetta	230 066
16	Campobasso	364 208
17	Caserta	697 403
18	Catania	495 415
19	Catanzaro	412 226
20	Chieti	339 986
21	Como	477 642
22	Cosenza	440 468
23	Cremona	300 595
24	Cuneo.	618 232
25	Ferrara	215 369
26	Firenze	766 821
27	Foggia	322 758
28	Forlì	234 090
29	Genova	716 759
30	Girgenti	289 018
31	Grosseto	107 457
32	Lecce	493 594
33	Livorno	118 851
34	Lucca	280 399
35	Macerata	236 994
36	Mantova	288 942

	A	B
1	Provincia	Popolazione
37	Massa Carrara	161 944
38	Messina	420 649
39	Milano	1 009 794
40	Modena	273 231
41	Napoli	907 752
42	Novara	624 985
43	Padova	364 430
44	Palermo	617 678
45	Parma	264 381
46	Pavia	448 435
47	Perugia	549 601
48	Pesaro Urbino	213 072
49	Piacenza	225 775
50	Pisa	265 959
51	Porto Maurizio	127 053
52	Potenza	518 543
53	Ravenna	221 115
54	Reggio Calabria	353 608
55	Reggio Emilia	240 685
56	Roma	836 704
57	Rovigo	200 835
58	Salerno	541 738
59	Sassari	243 452
60	Siena	206 446
61	Siracusa	294 885
62	Sondrio	111 241
63	Teramo	246 004
64	Torino	972 986
65	Trapani	236 388
66	Treviso	352 538
67	Udine	481 586
68	Venezia	337 538
69	Verona	367 437
70	Vicenza	363 161
71		26 809 201

Regione	Popolazione	
Piemonte	3 347 999	*Alessandria, Cuneo, Novara, Pavia, Torino*
Liguria	843 812	*Genova, Porto Maurizio*
Lombardia	3 012 389	*Bergamo, Brescia, Como, Cremona, Mantova, Milano, Sondrio*
Veneto	2 642 807	*Belluno, Padova, Rovigo, Treviso, Udine, Venezia, Verona, Vicenza*
Emilia	2 275 822	*Bologna, Ferrama, Forlì, Massa carrara, Modena, Parma, Piacenza*
Marche ed Umbria	1 465 020	*Ancona, Ascoli Piceno, Macerata, Perugia, Pesaro*
Toscana	1 980 578	*Arezzo, Firenzze, Grosseto, Livorno, Lucca, Pisa, Siena*
Lazio	836 704	*Roma*
Abruzzi e Molise	1 282 982	*Aquila, Campobasso, Chieti, Teramo*
Campania	2 754 592	*Avellino, Benevento, Caserta, Napoli, Salerno*
Puglia	1 420 892	*Bari, Foggia, Lecce*
Basilicata	518 543	*Potenza*
Calabria	1 206 302	*Catanzaro, Cosenza, Reggio Calabria*
Sicilia	2 584 099	*Caltanissetta, Catania, Girgenti, Messina, Palermo, Siracusa, Trapani*
Sardegna	636 660	*Cagliari, Sassari*
TOT	**26 809 201**	

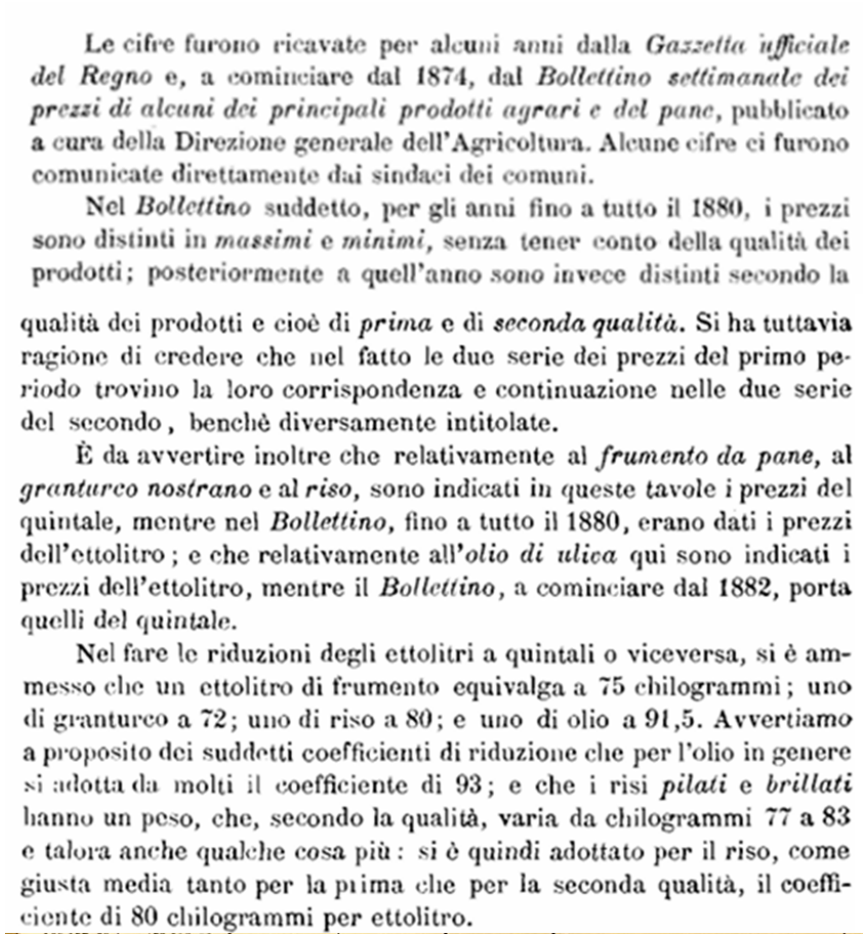
Figure 2.28: Population data and regional composition from Allegato 31

Data on Prices: "movimento dei prezzi su alcuni generi alimentari"

The market evaluation of cereal prices, in the years 1862 to 1884 can be made starting from the document: "Movimento dei Prezzi di alcuni generi alimentari dal 1862 al 1884" (Movement of Prices of some foodstuffs from 1862 to 1884), produced by the "Direzione Generale della Statistica" (General directorate of statistics), and published in Rome by the "Eredi Botta" (Botta heirs) printing house, in the year 1885.

The data in this document have been digitized and verified for the consistency of the numbers obtained according to what is discussed below.

The data reported in the digitized tables generated for this thesis must necessarily be evaluated in relation to the brief accompanying note reported at the beginning of the aforementioned document, and reported for the reader's convenience in an anastatic copy below (Fig. 2.29, along with our translation.



Le cifre furono ricavate per alcuni anni dalla *Gazzetta ufficiale del Regno* e, a cominciare dal 1874, dal *Bollettino settimanale dei prezzi di alcuni dei principali prodotti agrari e del pane*, pubblicato a cura della Direzione generale dell'Agricoltura. Alcune cifre ci furono comunicate direttamente dai sindaci dei comuni.

Nel *Bollettino* suddetto, per gli anni fino a tutto il 1880, i prezzi sono distinti in *massimi* e *minimi*, senza tener conto della qualità dei prodotti; posteriormente a quell'anno sono invece distinti secondo la qualità dei prodotti e cioè di *prima* e di *seconda qualità*. Si ha tuttavia ragione di credere che nel fatto le due serie dei prezzi del primo periodo trovino la loro corrispondenza e continuazione nelle due serie del secondo, benchè diversamente intitolate.

È da avvertire inoltre che relativamente al *frumento da pane*, al *granturco nostrano* e al *riso*, sono indicati in queste tavole i prezzi del quintale, mentre nel *Bollettino*, fino a tutto il 1880, erano dati i prezzi dell'ettolitro; e che relativamente all'*olio di ulica* qui sono indicati i prezzi dell'ettolitro, mentre il *Bollettino*, a cominciare dal 1882, porta quelli del quintale.

Nel fare le riduzioni degli ettolitri a quintali o viceversa, si è ammesso che un ettolitro di frumento equivalga a 75 chilogrammi; uno di granturco a 72; uno di riso a 80; e uno di olio a 91,5. Avvertiamo a proposito dei suddetti coefficienti di riduzione che per l'olio in genere si adotta da molti il coefficiente di 93; e che i risi *pilati* e *brillati* hanno un peso, che, secondo la qualità, varia da chilogrammi 77 a 83 e talora anche qualche cosa più: si è quindi adottato per il riso, come giusta media tanto per la prima che per la seconda qualità, il coefficiente di 80 chilogrammi per ettolitro.

Figure 2.29: Anastatic copy

Our translation:

The figures were taken for some years from the Official Gazette of the Kingdom and, beginning in 1874, from the bollettino settimanale dei prezzi di alcuni dei principali prodotti agrari e del pane *(weekly bulletin of prices for some of the main agricultural products and bread), published by the General Directorate of Agriculture. Some figures were communicated to us directly by the mayors of the municipalities.*

In the aforementioned Bulletin, for the years up to and including 1880, prices are divided into maximum and minimum values, without taking into account the quality of the products; after that year, they are instead divided according to the quality of the products, namely first and second quality. However, there is reason to believe that the two price series from the first period correspond and are continued in the two series from the second, although with different titles.

It should also be noted that for bread wheat, local corn, and rice, these tables indicate prices per quintal, while the Bollettino, up until 1880, gave prices

per hectolitre; and that for olive oil, these tables indicate prices per hectolitre, while the bullettin, starting in 1882, gave prices per quintal.

In making the reductions of hectolitres to quintals or vice versa, it has been assumed that one hectolitre of wheat is equivalent to 75 kilograms; one of corn to 72; one of rice to 80; and one of oil to 91.5. We note with regard to the aforementioned reduction coefficients that for oil in general the coefficient of 93 is adopted by many; and that husked and polished rice (risi pilati e brillati) has a weight that, depending on the quality, varies from 77 to 83 kilograms and sometimes even a little more: therefore, for rice, as a fair average for both the first and second quality, the coefficient of 80 kilograms per hectolitre has been adopted.

An example of the available tables with prices is shown below, containing prices per quintal (100 kg) for the first-quality wheat on the market of Bari. In the first column we have the months (Gennaio to Dicembre stands for January to December; "mesi" stands for months, "media annual" for annual average).

Mercato di

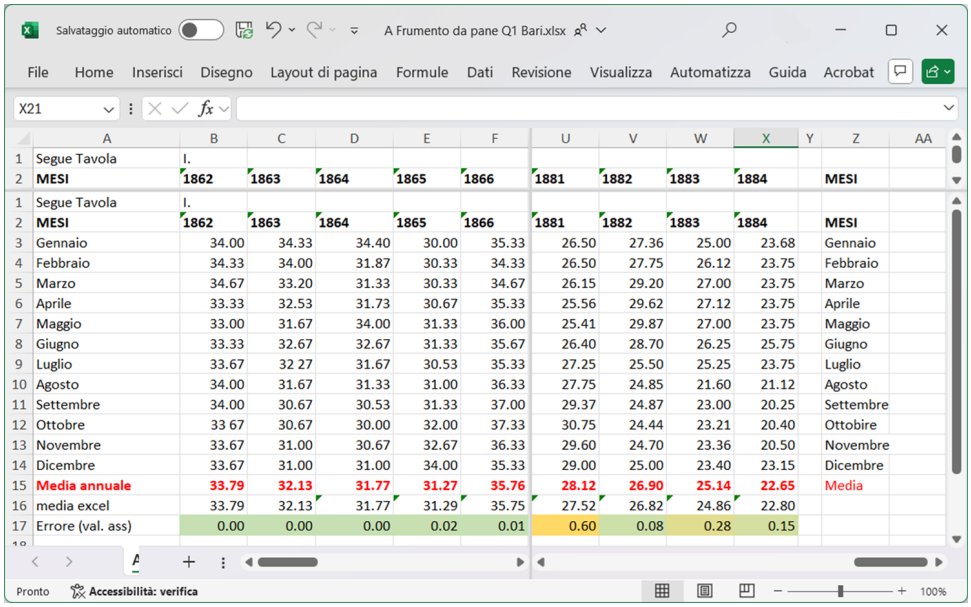
Gennaio . . .	34.00	34.33	34.40	30.00	35.33	36.00	34.33	31.33	32.00	32.67	32.33
Febbraio . .	34.33	34.00	31.87	30.33	34.33	35.33	33.67	30.93	31.33	32 27	32.67
Marzo	34.67	33.20	31.33	30.33	34.67	35.67	35.07	29.87	30.93	32.00	31.47
Aprile	33.33	32.53	31.73	30.67	35.33	35.33	36.00	29.87	31.33	30.13	31.33
Maggio . . .	33.00	31.67	34.00	31.33	36.00	34.53	36.67	29.33	32.00	29.33	31.00
Giugno . . .	33.33	32.67	32.67	31.33	35.67	33.60	35.00	30.40	30.89	29.60	30.33
Luglio	33.67	32 27	31.67	30.53	35.33	33.33	32.93	29.20	31.31	29.20	30.00
Agosto . . .	34.00	31.67	31.33	31.00	36.33	33.20	28.20	30.27	31.45	29.33	29.73
Settembre . .	34.00	30.67	30.53	31.33	37.00	33.33	28.67	29.87	28.08	30.08	29.33
Ottobre . . .	33 67	30.67	30.00	32.00	37.33	32.67	29.73	30.93	28.67	30.67	30.00
Novembre . .	33.67	31.00	30.67	32.67	36.33	33.00	31.33	32.00	30.72	30.93	33.87
Dicembre . .	33.67	31.00	31.00	34.00	35.33	33.33	31.33	32.67	32.83	32.00	30.93
Media annuale	33.79	32.13	31.77	31.27	35.76	34.11	32.75	30.56	30.96	30.67	30.87

Figure 2.30: Prices on the Bari market over the years, for 1st quality bread wheat - Sheet 1/2

1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883	1884	MESI
Bari (1).												
33.33	42.47	30.29	26.23	33 15	34.67	33.07	38.93	26.50	27.36	25.00	23.68	Gennaio.
32.67	43.91	29.19	27.92	33.87	34.29	31.13	38.93	26.50	27.75	26.12	23.75	Febbraio.
34.00	43.35	29.01	29.59	34.27	34.40	32.20	38.93	26.15	29.20	27.00	23.75	Marzo.
34.67	44.19	28.87	28.68	32.40	35.60	36.13	36.00	25.56	29.62	27.12	23.75	Aprile.
34.67	44.48	29.29	28.69	30.67	35.57	36.00	35.55	25.41	29.87	27.00	23.75	Maggio.
35.33	39.96	28.51	28.71	28.00	32.93	36.27	35.33	26.40	28.70	26.25	25.75	Giugno.
33.87	35.93	29.96	28.11	29.00	32.23	32.75	34.67	27.25	25.50	25.25	23.75	Luglio.
33.20	30.85	29.21	26.73	31.40	32.11	30.40	34.00	27.75	24.85	24.60	21.12	Agosto.
33.67	32.48	26 65	26.65	32.49	32.07	30.40	34.00	29.37	24.87	23.00	20.25	Settembre.
35.73	31.65	28.12	27 95	34.53	36.19	35.73	35.07	30.75	24.44	23.21	20.40	Ottobre.
36.00	31.13	26.41	30.03	37.33	37.33	38.13	36.67	29.60	24.70	23.36	20.50	Novembre.
36.67	29.57	26.67	31.73	37.33	29.87	38.93	36.11	29.00	25.00	23.40	23.15	Dicembre.
34.49	37.53	**28.44**	**28.41**	32.95	33.37	34.31	36.21	28.12	26.90	25.14	22.65	*Media.*

Figure 2.31: Prices on the Bari market over the years, for 1st quality bread wheat - Sheet 2/2

The digitalisation of these table in an excel file we made has the aspect shown below (central years omitted).



	A	B	C	D	E	F	U	V	W	X	Z
1	Segue Tavola	I.									
2	**MESI**	**1862**	**1863**	**1864**	**1865**	**1866**	**1881**	**1882**	**1883**	**1884**	**MESI**
3	Gennaio	34.00	34.33	34.40	30.00	35.33	26.50	27.36	25.00	23.68	Gennaio
4	Febbraio	34.33	34.00	31.87	30.33	34.33	26.50	27.75	26.12	23.75	Febbraio
5	Marzo	34.67	33.20	31.33	30.33	34.67	26.15	29.20	27.00	23.75	Marzo
6	Aprile	33.33	32.53	31.73	30.67	35.33	25.56	29.62	27.12	23.75	Aprile
7	Maggio	33.00	31.67	34.00	31.33	36.00	25.41	29.87	27.00	23.75	Maggio
8	Giugno	33.33	32.67	32.67	31.33	35.67	26.40	28.70	26.25	25.75	Giugno
9	Luglio	33.67	32 27	31.67	30.53	35.33	27.25	25.50	25.25	23.75	Luglio
10	Agosto	34.00	31.67	31.33	31.00	36.33	27.75	24.85	21.60	21.12	Agosto
11	Settembre	34.00	30.67	30.53	31.33	37.00	29.37	24.87	23.00	20.25	Settembre
12	Ottobre	33 67	30.67	30.00	32.00	37.33	30.75	24.44	23.21	20.40	Ottobire
13	Novembre	33.67	31.00	30.67	32.67	36.33	29.60	24.70	23.36	20.50	Novembre
14	Dicembre	33.67	31.00	31.00	34.00	35.33	29.00	25.00	23.40	23.15	Dicembre
15	**Media annuale**	**33.79**	**32.13**	**31.77**	**31.27**	**35.76**	**28.12**	**26.90**	**25.14**	**22.65**	Media
16	media excel	33.79	32.13	31.77	31.29	35.75	27.52	26.82	24.86	22.80	
17	Errore (val. ass)	0.00	0.00	0.00	0.02	0.01	0.60	0.08	0.28	0.15	

Figure 2.32: Picture showing how the data are digitalised and arranged in a table, with error computation

The data to be analysed are huge: tables like the one shown above must be repeated for each province, each quality (first and second), each of the four cereals (wheat, corn,

bread, rice).

Once all of the tables are written, a complete dataset comprehensive excel file was created.

To have an idea of the general quality obtained from the digitalisation of all these tables, a general error tables were created for each cereal and each quality. The general appearance of these error tables is that shown below for the case of first quality wheat.

Frumento Q1	Ascoli	Avellino	Bari	Bergamc	Brescia	Carmagnola	Catanzaro	Firenze	Foggia	Foligno	Forlì	Genova	Livorno	Maddalon	Modena	Napoli	Padova	Parma	Roma	Udine	Vercelli	Verona
1862	0.00	0.00	0.00	0.83	0.01	0.00	0.00	0.00	0.00	0.10	0.00	0.05	0.01	0.02	0.00	0.00	0.02	0.00	0.10	0.00	0.01	0.02
1863	0.00	0.00	0.00	0.03	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.25	0.09	0.00	0.06	0.00	0.00	0.00
1864	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.01	0.00	0.00	0.01	0.06	0.21	0.08	0.00	0.08	0.25	0.00	0.24	0.00	0.03	0.03
1865	0.00	0.00	0.02	0.00	0.01	0.00	0.42	0.01	0.00	0.00	0.00	0.03	0.12	0.00	0.00	0.25	2.54	0.01	0.15	0.00	0.00	0.00
1866	0.00	0.08	0.01	0.00	0.01	0.01	0.27	0.00	0.01	0.00	0.00	0.05	0.03	0.00	0.00	0.04	0.00	0.01	0.01	0.00	0.10	0.00
1867	0.43	0.07	0.00	0.49	0.00	0.13	1.32	0.00	0.01	0.09	0.01	0.03	0.01	0.03	0.00	0.24	0.46	0.00	0.13	0.13	0.31	0.00
1868	0.01	0.07	0.01	0.81	0.01	0.02	0.01	0.00	0.00	0.01	0.15	0.54	0.25	0.00	0.05	0.25	0.31	0.00	0.58	0.13	0.52	0.00
1869	0.25	0.00	0.22	0.05	0.01	0.01	0.01	0.00	0.00	0.02	0.07	0.02	0.06	0.06	0.80	0.00	0.46	0.00	0.09	0.17	0.07	0.01
1870	0.12	0.06	0.00	0.08	0.00	0.12	0.00	0.00	0.00	0.11	0.04	0.05	0.03	0.04	0.24	0.00	0.05	0.00	0.70	0.03	1.98	0.00
1871	0.04	0.01	0.13	1.11	0.01	0.01	0.00	0.03	0.00	0.02	0.03	0.27	0.00	0.14	0.01	0.00	0.01	0.00	0.08	0.03	0.03	0.01
1872	0.01	0.00	0.21	0.57	0.04	0.01	0.01	0.07	0.03	0.14	0.01	0.04	0.01	0.07	0.05	0.20	0.04	0.00	0.00	0.06	0.07	0.00
1873	0.01	0.00	0.01	0.07	0.00	0.00	0.01	0.01	0.00	1.11	0.01	0.71	0.67	0.10	0.02	0.00	0.16	0.00	0.07	0.35	0.11	0.00
1874	0.22	0.15	0.13	0.03	0.01	0.65	0.00	0.00	0.02	0.08	0.00	9.52	0.03	0.01	0.07	1.09	0.01	0.28	0.10	0.00	0.01	0.01
1875	0.02	0.19	0.23	0.18	0.01	0.06	0.00	0.01	0.00	0.02	0.03	0.04	0.05	0.00	0.00	0.15	0.06	0.00	0.03	0.02	0.00	0.01
1876	0.48	0.04	0.05	0.01	0.00	0.03	0.01	0.00	0.17	0.24	0.02	0.23	0.03	0.14	0.14	0.03	0.00	0.06	0.23	0.02	0.01	0.09
1877	0.20	0.20	0.08	0.17	0.00	0.13	0.01	0.00	0.00	0.07	0.02	0.02	1.34	0.03	0.00	0.11	0.02	0.06	0.27	0.07	0.08	0.00
1878	1.07	0.09	0.15	0.43	0.03	0.02	0.00	0.02	0.25	0.01	0.05	0.29	0.10	0.06	0.01	0.06	2.58	0.00	0.02	0.07	0.16	0.02
1879	0.03	0.13	0.05	0.04	0.52	0.07	0.07	0.07	0.24	0.02	0.04	0.13	0.04	0.03	0.00	0.66	0.22	0.05	0.08	0.17	0.01	0.19
1880	0.05	0.06	0.28	0.07	0.05	0.09	0.14	0.18	0.14	0.30	0.02	0.07	0.05	0.00	0.07	0.04	0.04	0.03	0.15	0.07	0.43	0.10
1881	0.09	0.02	0.60	0.03	0.01	0.00	0.00	0.03	0.33	1.73	0.01	0.01	0.02	0.14	0.01	0.01	0.12	0.02	0.04	0.00	0.00	0.03
1882	0.00	0.02	0.08	0.00	0.08	0.00	0.04	0.04	0.00	0.01	0.01	0.00	0.02	0.01	0.00	0.20	0.01	0.42	0.50	0.04	0.04	0.07
1883	0.03	0.00	0.28	0.00	0.02	0.30	0.19	0.01	0.25	0.00	0.00	0.37	0.02	0.00	0.01	0.11	0.01	0.02	0.00	0.00	0.02	0.01
1884	0.01	0.05	0.15	0.04	0.12	0.00	0.18	0.03	0.00	0.01	0.06	0.00	0.03	0.01	0.01	0.00	0.01	0.00	0.42	0.15	0.14	0.03

Figure 2.33: Synoptic table of absolute errors obtained with digitalization of 1st quality wheat

The errors are obtained as the absolute value of the difference of the calculated annual means with those obtained through the numerical mathematical mean of the monthly values present in the source.

The clearly anomalous data for Genoa in 1874 has been highlighted in red. It has been hypothesized that this error is due to an error in transcribing the annual total, which in the source amounts to 28.63 Lit/q, while the annual average calculated on the basis of the values found month by month is equal to 38.15 Lit/q. If the transcriber had intended to write 38.62, the error would have been set at the much more reasonable value of 0.48 Lit/q.

All the data in the image above, except that written in red and considered totally anomalous, have been subjected to conditional formatting in a colour range that allows the data with the largest absolute errors to be immediately and visually identified: as earlier, green corresponds to the lowest errors, yellow to the highest ones, with different intensities.

Another way to evaluate errors is to display percentage errors, instead of absolute ones. This calculation was performed by comparing the absolute errors to the averages present in the source, considered as the "true" value. The synoptic table of percentage errors is obtained, shown below.

Frumento Q1	Ascoli	Avellino	Bari	Bergam	Brescia	Carmagnola	Catanzaro	Firenze	Foggia	Foligno	Forlì	Genova	Livorno	Maddalon	Modena	Napoli	Padova	Parma	Roma	Udine	Vercelli	Verona
1862	0.00	0.02	0.01	2.97	0.04	0.01	0.01	0.00	0.01	0.00	0.01	0.16	0.02	0.06	0.01	0.01	0.08	0.01	0.34	0.01	0.02	0.07
1863	0.00	0.01	0.01	0.12	0.02	0.01	0.03	0.01	0.01	0.00	0.01	0.11	0.00	0.01	0.00	0.95	0.37	0.01	0.20	0.00	0.02	0.00
1864	0.00	0.01	0.01	0.01	0.06	0.03	0.01	0.01	0.00	0.00	0.03	0.22	0.87	0.33	0.01	0.34	1.06	0.01	0.89	0.01	0.13	0.11
1865	0.00	0.02	0.07	0.00	0.03	0.02	1.31	0.05	0.01	0.00	0.01	0.13	0.48	0.01	0.01	1.08	13.36	0.04	0.53	0.02	0.01	0.00
1866	0.00	0.26	0.03	0.01	0.02	0.05	0.70	0.01	0.02	0.00	0.01	0.15	0.10	0.01	0.01	0.13	0.01	0.02	0.04	0.01	0.40	0.00
1867	0.00	0.07	0.00	0.49	0.00	0.13	1.32	0.00	0.01	0.09	0.01	0.03	0.01	0.03	0.00	0.24	0.46	0.00	0.13	0.13	0.31	0.00
1868	0.00	0.07	0.01	0.81	0.01	0.02	0.01	0.00	0.00	0.01	0.15	0.54	0.25	0.00	0.05	0.25	0.31	0.00	0.58	0.13	0.52	0.00
1869	0.00	0.00	0.22	0.05	0.01	0.01	0.01	0.00	0.00	0.02	0.07	0.02	0.06	0.06	0.80	0.00	0.46	0.00	0.09	0.17	0.07	0.01
1870	0.00	0.06	0.00	0.08	0.00	0.12	0.00	0.00	0.00	0.11	0.04	0.05	0.03	0.04	0.24	0.00	0.05	0.00	0.70	0.03	1.98	0.00
1871	0.00	0.01	0.13	1.11	0.01	0.01	0.00	0.03	0.00	0.02	0.03	0.27	0.00	0.14	0.01	0.00	0.01	0.00	0.08	0.03	0.03	0.01
1872	0.00	0.00	0.21	0.57	0.04	0.01	0.01	0.07	0.03	0.14	0.01	0.04	0.01	0.07	0.05	0.20	0.04	0.00	0.00	0.06	0.07	0.00
1873	0.00	0.00	0.01	0.07	0.00	0.00	0.01	0.01	0.00	1.11	0.01	0.71	0.67	0.10	0.02	0.00	0.16	0.00	0.07	0.35	0.11	0.00
1874	0.00	0.15	0.13	0.03	0.01	0.65	0.00	0.00	0.02	0.08	0.00	9.52	0.03	0.01	0.07	1.09	0.01	0.28	0.10	0.00	0.01	0.01
1875	0.00	0.19	0.23	0.18	0.01	0.06	0.00	0.01	0.00	0.02	0.03	0.04	0.05	0.00	0.00	0.15	0.06	0.00	0.03	0.02	0.00	0.01
1876	0.00	2.37	2.26	2.23	2.35	2.20	2.26	3.14	1.94	0.42	2.23	2.53	3.30	2.19	2.44	2.82	2.00	2.32	1.91	2.29	2.16	2.19
1877	0.00	0.20	0.08	0.17	0.00	0.13	0.01	0.00	0.00	0.07	0.02	0.02	1.34	0.03	0.00	0.11	0.02	0.06	0.27	0.07	0.08	0.00
1878	0.00	0.09	0.15	0.43	0.03	0.02	0.00	0.02	0.25	0.01	0.05	0.29	0.10	0.06	0.01	0.06	2.58	0.00	0.02	0.07	0.16	0.02
1879	0.00	0.13	0.05	0.04	0.52	0.07	0.07	0.07	0.24	0.02	0.04	0.13	0.04	0.03	0.00	0.66	0.22	0.05	0.08	0.17	0.01	0.19
1880	0.00	0.06	0.28	0.07	0.05	0.09	0.14	0.18	0.14	0.30	0.02	0.07	0.05	0.00	0.07	0.04	0.04	0.03	0.15	0.07	0.43	0.10
1881	0.00	0.02	0.60	0.03	0.01	0.00	0.00	0.03	0.33	1.73	0.01	0.01	0.02	0.14	0.01	0.01	0.12	0.02	0.04	0.00	0.00	0.03
1882	0.00	0.02	0.60	0.03	0.01	0.00	0.00	0.03	0.33	1.73	0.01	0.01	0.02	0.14	0.01	0.01	0.12	0.02	0.04	0.00	0.00	0.03
1883	0.00	0.00	0.28	0.00	0.02	0.30	0.19	0.01	0.25	0.00	0.00	0.37	0.02	0.00	0.01	0.11	0.01	0.02	0.00	0.00	0.02	0.01
1884	0.00	0.05	0.15	0.04	0.12	0.00	0.18	0.03	0.00	0.01	0.06	0.00	0.03	0.01	0.01	0.00	0.01	0.00	0.42	0.15	0.14	0.03

Figure 2.34: Synoptic table of the percentage errors obtained with digitization in the case of first quality wheat

The errors are obtained by dividing the absolute values obtained as discussed in the legend of the previous table, by the annual averages (calculated from the monthly values of the source) and multiplying the result of the division by 100.

This further analysis provides a different and complementary perception, compared to the previous one, of the overall picture of the errors that have been obtained from the annual averages and that have an impact on the uncertainties in the data read from the source.

In particular, this has allowed us to highlight that:

- The absolute error corresponding to Padua in 1865, although not the highest among the absolute errors subject to conditional formatting in the previous table, is particularly significant in percentage terms, obviously due to the fact that compared to other cases it is divided by a lower number
- A particularly significant percentage error is highlighted for the 1876 vintage.

Moreover, except for the two anomalous cases highlighted in red in the table, all the errors are contained within a few percentage units, and very many are around the tenth of percent or less.

This suggests an acceptable quality of the results obtained.

Appendix II - Web scraping *Tabelle mercuriali* in the *Gazzetta Ufficiale* using AI

To reconstruct the impact of the flour tax in post-unification Italy, it was necessary to identify historical sources documenting official prices and fiscal measures. The *Gazzetta Ufficiale del Regno d'Italia*, which served as the official repository of laws, decrees, and

administrative notices from 1861 onward, was a primary candidate. This section details the procedure for systematically collecting and filtering issues of the *Gazzetta* to find publications reporting flour prices or relevant fiscal data.

Availability and Structure of Official Publications

The digital archive of the *Gazzetta Ufficiale* accessible on the official website[37] provides scanned issues in PDF format, divided into various series and subcategories. Of particular interest are the *Fogli Ordinari* from 1861 to 1894. These documents, however, are only partially digitized for early years, often incomplete, and with limited metadata. Also, the publication frequency is irregular and not strictly weekly.

Although some issues include statistical tables on commodity prices, including flour, this information is neither indexed nor available in structured format. Thus, a manual inspection of thousands of PDFs would have been unfeasible, motivating the use of automated information extraction techniques.

Automated Scraping of Issues

To automate retrieval, we implemented a custom scraper in Python using a library called Selenium[38]. The script navigates the search interface, selects the desired year, triggers the search, and collects download links to PDFs. The scraper iteratively processes years from 1861 to 1894

Information Extraction from Unstructured Data

The core challenge was to determine whether each gazzetta contained relevant price data. The extraction task is complicated by several factors: (i) the documents are scanned images without embedded text, (ii) formatting is non-standard, and (iii) there is significant visual variation between issues. We set up the task as what is commonly called "Classification task" in the field of Machine Learning. We look for a method that, given a pdf of a *Gazzetta* needs to return "yes" if the pdf contains a Mercuriali table, and "no" otherwise. We tested several methods of increasing sophistication and computational complexity: keyword-based Optical Character Recognition (OCR), CLIP-based (an artificial intelligence model that can be used for classification) and Vision-Language-Model based.

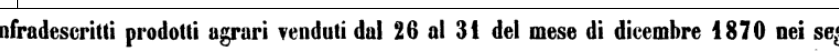
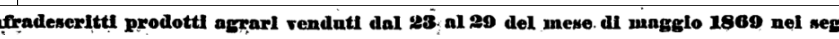
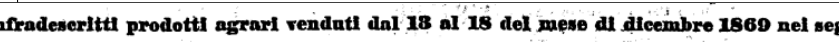
[37] `https://www.gazzettaufficiale.it/`
[38] `https://selenium-python.readthedocs.io`

Keyword-based search (native OCR)

By visual inspection, we notice that the structure, both textual and visual, of the tables we are searching for is consistent: it always is a large table, full-page, always contains the following title: *Prezzi degli infradescritti prodotti agrari venduti dal START_DAY al END_DAY del mese di dicembre YEAR nei seguenti mercati.* and a text in the top right corner saying *TABELLA DELLE MERCURIALI, NUM X*. The most straightforward method to find out whether a Gazzetta contains such table, is to look for some of those words, e.g. "infradescritti prodotti agrari" or "mercuriali". Unfortunately, since we are dealing with scanned documents, the text is not always crisp.

The search functionality on pdfs (which can be done manually or programmatically) uses a native basic Optical Character Recognition (OCR). OCR is a technology used to convert images of printed or handwritten text into machine-readable strings. It is widely employed in document digitization pipelines to enable keyword search, indexing, and structured data extraction (Liang, Hull, & Srihari, 2008; Smith, 2007). Nevertheless, given its generic nature and the high variance in the crispness of the text, it often fails to spot the correct pdfs. In table 2.28 we show three examples of the automatically extracted text from pdfs.

Table 2.28: Native OCR outputs on example images.

Example 1	
	
Prezzi degli infradescritti prodotti agrari venduti dal 26 al 31 del mese di dicembre 1870 nei seguenti mercati.	
Example 2	
	
Prezzi deg1I Intk•añeseritti prodotti agt•arl venduti dal Sil al 29 del mese. di maggio 1800 nel segnenti merenti.	
Example 3	
	
Prezzi degli Intk•añeseritti prodotti agrarl vendati dal 18 aÙÊ det aese di dlåe e 1860 nel segmenti m reati.	

CLIP Zero-Shot Classification

CLIP (Contrastive Language–Image Pretraining) is a multimodal neural architecture introduced by OpenAI (Radford et al., 2021). It is trained on a large corpus of image–text pairs to align image and text embeddings in a shared semantic space. CLIP can thus be used to assess the similarity between an image and a textual label without task-specific fine-tuning (this is commonly called "zero-shot" classification). Each PDF page, converted into an image, was compared to labels such as `‘‘numbers"`, and `‘‘text"`.

A simplified visual schema of CLIP's architecture is shown below, highlighting its dual-encoder framework:

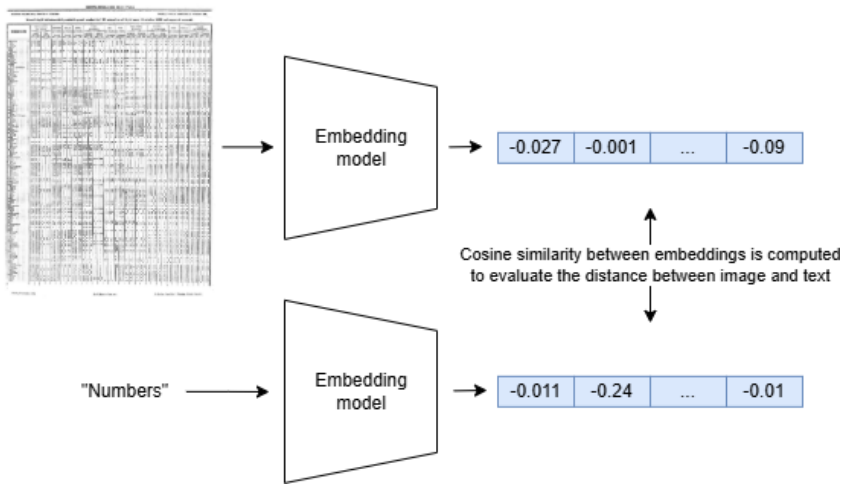


Figure 2.35: CLIP uses encoders for images and text. The cosine similarity between their embeddings provides a relevance score used to choose which pdfs to retain.

CLIP offered a good balance between efficiency and semantic relevance.

Vision-Language Models (VLMs)

Finally, we tested a Vision-Language Model (VLM) (Du, Li, Yang, and Lin; 2022) on our classification task. VLMs are the technology behind most of the commonly used Artificial Intelligence chatbots such as ChatGPT and Claude, and are able to take both images and text as input, reason on it, and produce text [39]. These models are computationally expensive but very accurate in many tasks. We submit each page of each gazzetta to a VLM asking the model whether the page contains a Mercuriali table.

Below we report the prompt used to classify each page and check whether a "Tabella dei mercuriali" was present.

Classification prompt

Does this page contain a large numeric table that is a 'Tabella dei mercuriali'? The title of the page should be something like: 'Prezzi degli infradescritti prodotti agrari venduti dal ... al ... nei seguenti mercati' Answer only with 'yes' or 'no'.

The chosen model is `GPT-o4-mini` (OpenAI, 2025), considered one of the most cost-effective vision language models at the time of writing.

[39] They are often called simply 'Large Language Models', since they are mainly trained to produce text, but Vision-Language models is a more accurate term when dealing with models able to take images as input, together with text.

Evaluation Results (method choice)

To choose the extraction method, we run a small-scale benchmarking procedure on a set of documents. These are the key steps followed for the evaluation:

1. Use the scraping script to gather a set of 40 gazzette
2. Accurately curate a set of labeled samples. We anually analyze the 40 gazzette retrieved to gather 10 positive samples (i.e. issues containing the mercuriali tables) and 10 negative samples (hereinafter, "labeled set")
3. Run each method on the labeled set to compute performance metrics

Once this was done, we were able to make an educated choice on the method to be used on a larger scale, to retrieve many more issues containing the Mercuriali tables. We report in 2.29 the results of the evaluation on the labeled set. We also include a random baseline, to represent a lower-bound on performance.

Detector	**Accuracy**	**Precision**	**Recall**	**AvgTimePerFile**
Random	0.40	0.40	0.40	0.00
OCR	0.65	0.62	0.80	1.21
CLIP	0.65	0.64	0.70	5.41
VLM	0.95	0.91	1.00	20.21

Table 2.29: Performance of different detectors on binary classification of PDFs as containing or not Mercuriali tables. Accuracy is the proportion of correctly classified samples over the total number of samples, Precision is the proportion of detected positives that are correct, Recall is the proportion of actual positives detected out of all positives, and AvgTimePerFile is the average processing time in seconds per file.

The most accurate method, as expected, was the VLM, being the most sophisticated and smart model. When prompted to say whether each page contained a Mercuriali table or not, it was able to answer correctly 95% of the times. Nevertheless, it was largely the slowest method, considering its computational complexity. OCR and CLIP performances were close, with CLIP obtaining a slightly higher precision, and OCR achieving a higher recall.

In the current setting, in which we plan on running the pipeline on a much larger set of documents to gather many Mercuriali tables, precision is more important than recall. Indeed, we care that the found gazette do contain the wanted data (otherwise they are useless in this context). Giving up some recall means that we will not catch all the relevant gazzette available. This is the reason why we choose CLIP to be used on the large-scale set of gazzette. Moreover, CLIP is known to "generalize" better than OCR, meaning that its performance does not suffer as much when the format of the document changes. On the other hand, VLMs, even if accurate, would take much more resources to analyze all the gazzette available. Future work could address the recall problem, either

by leveraging VLMs at a large scale, or by fine-tuning a CLIP model on a set of labeled data.

Results (large-scale inference)

Through the scraping and processing pipeline, 105 documents containing the Mercuriali tables were obtained, published in the issues of the *Gazzetta Ufficiale* in the years 1869, 1870 and 1871.

Issuance Year	Number of Issues Identified
1869	45
1870	57
1871	3

Table 2.30: Number of relevant issues identified per year

Several factors may account for the substantial variation in the number of relevant issues found across years:

- **False negatives:** Although possible, this explanation is unlikely based on the manual evaluation of both positive and negative samples.
- **Format changes:** The structure of the *mercuriali* tables may have changed significantly over time, reducing the pipeline's ability to detect them.
- **Discontinuation of publication:** The most plausible explanation is a decline in the frequency with which the *mercuriali* tables were published i the *Gazzetta Ufficiale*.

For the remaining years between 1861 and 1874 not shown in 2.30, the pipeline returned a high number of false positives. Through manual inspection, most of these issues were found to contain tables unrelated to the target data.

Post-Processing and Filtering

Each positive match was logged with metadata (date, issue number, page), and the corresponding PDF was retained. Non-matching PDFs were discarded to reduce storage. All matching PDFs were manually reviewed for validation.

The resulting dataset constitutes a significant contribution, providing, for the first time, a novel reconstruction of data that were 'trapped' in unstructured sources, among many Gazzetta issues.

Chapter 3
A plan for green jobs and sustainable mobility: a scenario analysis[1]

Abstract

This paper, promoted by the associations of the Alleanza Clima Lavoro, aims to simulate the economic, social, and environmental impact of a policy mix known as the "Piano per il lavoro verde e la mobilità sostenibile" which focuses on promoting the electrification of mobility in Italy and the decarbonization of the transport sector. The simulations were carried out using the Eurogreen macroeconomic model, a system dynamics-based tool specifically calibrated for the Italian context. The scenario analysis also considered additional hypotheses, such as reducing sectoral working hours and increasing exports of sustainable mobility products. The results show that, while the Plan promotes emission reduction and job growth, additional policies will be necessary to mitigate the negative social impacts of the ecological transition. Lastly, we compare our results with the forecast of Italy's 2024 National Integrated Energy and Climate Plan highlighting a superior emissions performance, while providing a clearer source of financing for the interventions.

The paper therefore highlights the importance of a systemic and integrated approach to address the challenges of transitioning towards a more sustainable and equitable future, with particular attention to socio-economic dynamics.

Keywords: *ecological transition, just transition, automotive sector, system dynamics, scenario analysis, macroeconomic model.*

JEL Classification: *Q58, E61, O44, C63, H23, R48*

[1] *This chapter is based on a study co-authored with Simone D'Alessandro, Marta Bonetti and David Cano-Ortiz from the University of Pisa. Such study and has been published as "Un piano per il lavoro verde e la mobilità sostenibile. Analisi di Scenario" in "Economia e società regionale", FrancoAngeli, issue 2024/2, pages 25-40.*

3.1 Introduction

The complexity of the so-called Just Transition, intended as an equitable distribution of the negative and positive effects of the ecological transition, requires the creation of spaces for collaboration and production of knowledge capable of valorising and making different actors interact in the definition of public policies. By combining environmental, economic and social parameters in a unified platform, integrated macroeconomic simulation models can be configured as tools to support multi-actor decision-making processes, aimed at jointly exploring the design of actions to support change, offering guidance through the complexities of the transition, in the direction of a more equitable and sustainable future.

This article describes the outcomes of the joint research path between the Italian "Alleanza Clima e Lavoro" (climate and work alliance) and a group of researchers from the University of Pisa, who used the Eurogreen simulation model to explore the economic, environmental and social effects of the simultaneous implementation of a mix of policies aimed at speeding up the process of electrification of mobility (so-called "Plan for Green Work and Sustainable Mobility").

While current literature is limited to studying the sectoral effects of policies, the proposed model, thanks to the system dynamics tools, has allowed us to highlight the systemic effects and mutual interactions, offering the possibility of evaluating their consistency and desirability.

The simulations carried out have also highlighted the limits of green growth-only policies in reducing the negative social effects of the transition and the need for interventions aimed at reducing income inequality, testing the effects of reducing working hours at the same salary.

The article is structured as follows: after the presentation of the Plan (Section 3.2), the effects of the hypothesis of cancellation of Environmentally Harmful Subsidies (EHS) aimed at finding the resources necessary for the implementation of the Plan are described (Section 3.3), then the Eurogreen simulation model is introduced (Section 3.4), to then illustrate the results in the case in which no policy changes occur (Section 3.5) or on the contrary the subsidies are eliminated and the Plan is implemented (Section 3.6), finally the effects of two additional scenarios are presented: the reduction of working hours and specialization in exports (Section 3.7). The study is then contextualized within the national policy framework through a comparison with the 2024 update of Italy's Integrated National Energy and Climate Plan (Section 3.8).

3.2 The Plan for Green Work and Sustainable Mobility: The Alliance's Proposals

The Alleanza Clima Lavoro [2] is a permanent table of discussion and common proposal between trade unions, environmentalists and civil society organizations, promoted, among others, by Italian trade unions FIOM and CGIL, and the Sbilanciamoci association. Established in 2020, the Alliance aims to promote the just transition to sustainable and electric mobility in Italy and the goal of climate neutrality by 2050 in line with the European Green Deal. In this perspective, a set of policy proposals has been developed aimed at combining decarbonization objectives, employment protection, and the fight against inequalities. The proposals developed by the organizations that make up the Alliance can be reclassified into three macro categories, as illustrated in Table 3.1:

- Stimuli to the demand for private electric cars and just mobility (Cluster I);
- Investments in charging infrastructure (Cluster II);
- Development of public transport (Cluster III).

Below is a summary of the proposed interventions and the methods of implementation within the simulation model; the set of all these proposals, multiple but synergistic, makes up the "Plan for green work and sustainable mobility" (hereinafter referred to as "PGWSM" or "the Plan") .

Cluster I - Stimuli to the demand for private electric cars and just mobility

The proposals of the first cluster concern the electrification of the car fleet as established by the Italian PNIEC (Piano Nazionale Integrato per l'Energia e il Clima, i.e., National Integrated Plan for Energy and Climate - PNIEC (Mise-MATTM-MIT, 2020), aim to stimulate internal demand for electric mobility and are go into three main directions:

i) Support for the transition to electric mobility for low-income families.
ii) Support for the transition to electric mobility of the company vehicle fleets.
iii) Support for the transition to shared electric mobility.

The first direction includes a set of proposals aimed at ensuring access to the purchase and use of electric vehicles also for low-income families, through innovative formulas such as "social leasing" on the French model, or an improvement of the current system of incentives for electric cars able to make their purchase more advantageous than that of internal combustion vehicles, as described for example in D'Alessandro et al. (2023, pp. 15-17).

[2] https://sbilanciamoci.info/alleanza-clima-lavoro/chi-siamo/

The second direction groups together proposals on incentives for companies to encourage a rapid replacement of their vehicle fleet with new electric vehicles and an increase in the use of zero-emission vehicles also for rented vehicles. The proposals also aim to stimulate the growth of a second-hand electric car market, which up to now has been too limited in size in Italy and which could instead provide a further and significant incentive to purchase also by less well-off families (T&E, 2022).

The third direction finally includes proposals aimed at encouraging new mobility models based on the sharing of means or transport services between multiple people (sharing mobility and the so-called MaaS ("Mobility as a Service") still not very widespread in the Italian landscape.

Cluster II - Investments in charging infrastructure

The second cluster collects proposals related to infrastructure issues. The idea behind these interventions is that the technical-logistical obstacles linked to electric mobility are a strong obstacle to its diffusion; in particular, recent studies (the most recent is Element Energy 2021) show how most people in Europe do not need ultra-fast charging stations to allow them to travel long distances within the day. This means that the necessary investments are not expensive and ultra-fast charging stations, but rather a widespread network of slow charging stations with low usage costs.

Including similar interventions within a macrosimulation model is not easy as it depends a lot on the assumptions that one decides to make regarding the effects on consumption and on the structure of the energy grid. In the analysis and simulations conducted later using the Eurogreen model, it was therefore decided not to assume exogenous variations in the electricity mix and to consider investments in charging points as a push for consumers to abandon internal combustion vehicles and switch to electric ones.

Cluster III – Development of public transport

The transformation of public transport to improve sustainability plays a central role in the decarbonisation of the entire mobility system. The main proposal considered in the development of the PGWSM, and included in the third cluster, involves increasing the allocation of the National Transport Fund by 7 billion euros, with the aim of reducing private traffic by 10% in 5 years.

In order to encourage the replacement of the fleet currently in use, other proposals have been included in the PGWSM, such as that of including the rental of electric buses for the use of the funds of the National Plan for Sustainable Mobility, which would thus be increased by six hundred million euros per year, and the elimination of system charges for electricity from RES for the charging of electric buses.

Table 3.1: *The proposals of the Climate Work Alliance reclassified for the Eurogreen macro-simulation model.*

Cluster I – Demand for EVs	**Cluster II – Infrastructure**	**Cluster III – Public Transport**
1. Financing of on-demand transport for areas with weak demand	**1.** Dedicated investments related to the modernization of the infrastructure	**1.** Increase the allocation of the Italian *Fondo Nazionale Trasporti* (National Transport Fund)
2. Social leasing: renting an electric vehicle at prices and conditions accessible to all to combat *mobility poverty*	**2.** Introduction of an electric *certificates of release in consumption*,* which equates the incentive currently reserved for drip fuels also to renewable electricity	**2.** Forecast of a time horizon for the transition from historical expenditure to standard costs in the financing of TPL, with a reorganization of services
3. Review of company car taxation (bonus-malus, 100% deduction) to stimulate the adoption of greater shares of EVs in company fleets and create, over time, a second-hand market for lower income brackets	**3.** Continuation of incentives for the purchase or rental of charging systems for businesses (without supplying charging to third parties)	**3.** Forecast of a driving license bonus to match supply and demand for work in public transport
4. Tax breaks on fringe benefit company cars	**4.** Continuation of incentives for domestic charging stations (*wallboxes*)	**4.** Insertion of the rental case alongside the purchase of electric buses for the use of funds from the Italian *Piano Nazionale per la Mobilità Sostenibile* (National Plan for Sustainable Mobility)
5. 10% VAT for zero-emission car sharing	**5.** Promote the spread of low-power charging points (<3.7 kW) without reserved parking slots in residential areas in cities with more than 100,000 inhabitants	**5.** Eliminate system charges for electricity (if from RES) serving electric bus depots
6. Increase in funds for road haulage companies for zero-emission commercial vehicles, including rental vehicles	**6.** Introduction of electricity from RES useful for reaching the mandatory targets of the obligated subjects in the certificates of release in consumption system	

Source: our own elaboration.
*This is the translation of the Italian "CIC - Certificati di Immissione al Consumo". Those regulatory certificates that attest to the introduction of sustainable biofuels into the national distribution system and are issued by GSE (Gestore dei Servizi Energetici - Italian Energy Services Manager). Each individual CIC certificate attests to the introduction of a quantity of biofuels equal to 10 Gigacalories and they are a market-driven tool to oblige transport fuel retailers to sell a minimum amount of biofuel annually, calculated as a percentage of the energy content of the transport fuel sold in the relevant year; in addition, producers of advanced biomethane and other advanced biofuels receive €375 per CIC by the state. Some of the proposals of the Alleanza want to use the same system for the market of electric vehicles.

3.3 Environmentally harmful subsidies as a resource

The implementation of the intervention proposals included in the three clusters of the Plan described above requires the use of significant resources. The latter, rather than being found through the use of general taxation, could come from the removal of some Environmentally Harmful Subsidies (the so-called "EHS"), generating a sort of "double dividend"[3] in terms of environmental impact.

EHS are subsidies well defined within the Italian tax system. Article 68 of Law 221/2015 (the so-called "Collegato Ambientale"), in fact, has charged the Ministry of the Environment and Protection of Land and Sea, now the Ministry of the Environment and Energy Security (Italian acronym: MASE), with preparing a "Catalogue of environmentally harmful subsidies and environmentally favourable subsidies".

The latest Catalogue (MASE, 2022) identifies 168 measures with potentially significant environmental effects, for a total of 52.5 billion euros, classified into three categories: Environmentally Harmful Subsidies (EHS), Environmentally Friendly Subsidies (EFS) and Environmentally Uncertain Subsidies (EUS). In detail, the following emerged (2021 values): EHS equal to 22.4 billion euros, EFS equal to 18.6 billion and subsidies of uncertain classification (EUS) for 11.5 billion. Given that EHS influence various sectors of the economy, it was decided to limit ourselves to considering those linked to the automotive sector: in this way the policies (i.e. the Sustainable Mobility Plan) and its financing are related to the same sector and this makes the simulation exercise cleaner and the results easier to interpret.

According to the latest edition of the study Stop Sussidi Ambientalmente Dannosi by Legambiente (Eroe and Della Bruna, 2023, p. 24), the total of EHS linked to the transport sector (adding direct and indirect ones) amounts to approximately 13.5 billion euros in 2022: this is the amount we used in the simulations carried out with the Eurogreen model.

The resources obtained will be divided as follows:

i) 2 billion euros for Cluster I;
ii) 3.5 billion euros for Cluster II;
iii) 8 billion euros for Cluster III;

This is therefore the quantitative composition of the PGWSM. The calibration of the share of the total budget for each sector was carried out using the studies of the Ministry of

[3]The "double dividend" hypothesis is a concept in microeconomics that imagines a dual role for environmental taxes: on the one hand, they allow for an improvement in environmental conditions due to changes in the behaviour of individuals; on the other, they allow for the generation of revenue for state coffers that could be used for various policies to improve well-being (the most classic being a reduction in pre-existing taxes). The context considered presents a situation similar to the double dividend since state spending to support polluting companies is reduced and, at the same time, the recovered resources are used to finance policies in favour of the ecological transition.

Infrastructure and Sustainable Mobility (MIMS, 2022) on the distribution of the financing of Mission 3 of the PNRR,[4] with a variation regarding the demand for new vehicles for public transport and therefore for the automotive sector.

3.4 The Eurogreen model

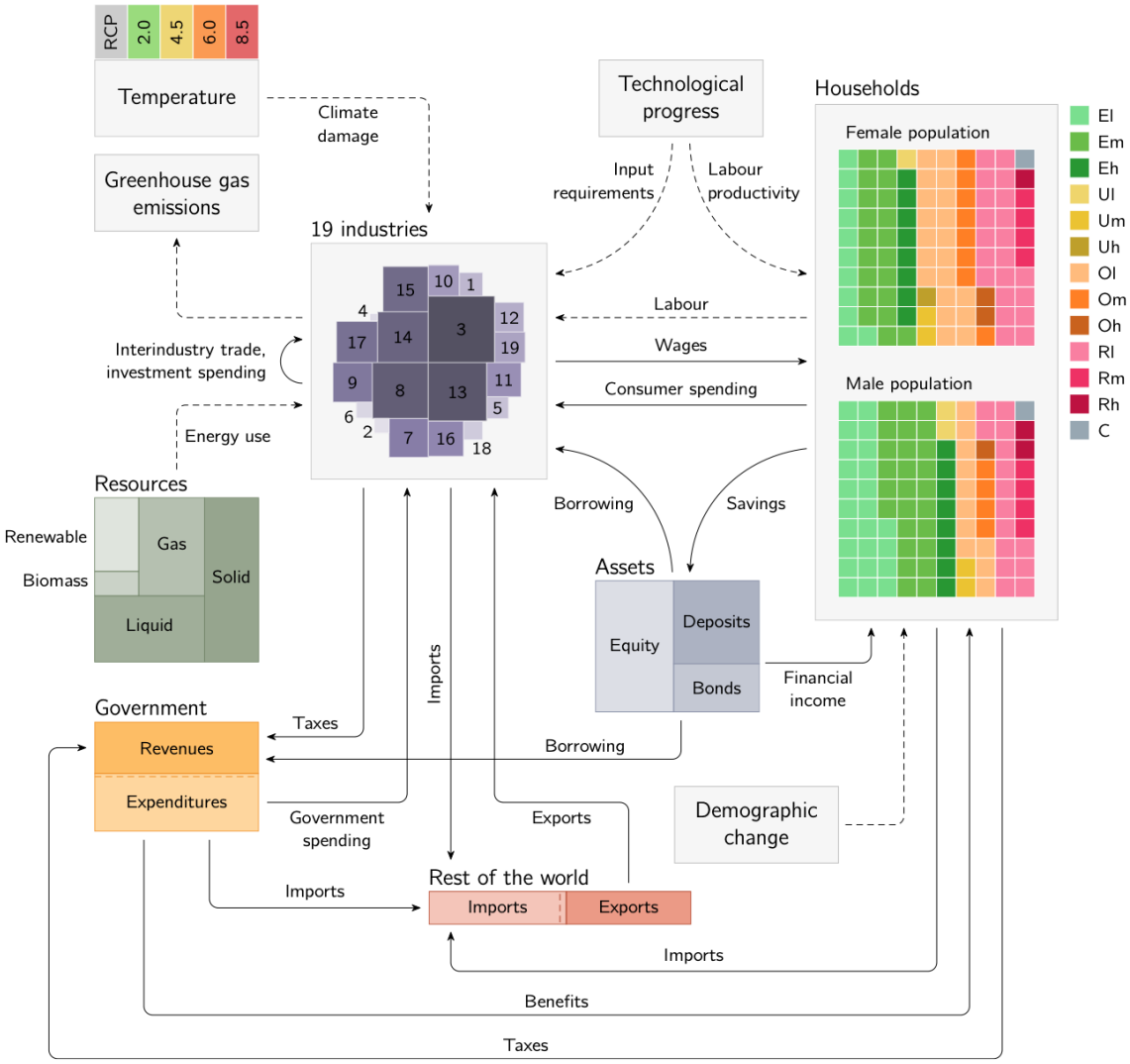
The analysis related to the implementation of the Plan for Green Work and Sustainable Mobility is based, as mentioned, on the use of Eurogreen, a dynamic macro-simulation model developed since 2018 by a team from the Department of Economics and Management of the University of Pisa and already applied to the cases of France (D'Alessandro et al., 2020; Cieplinski et al., 2021a) and Italy (Cieplinski et al., 2021b; Cieplinski et al., 2023).

Figure 3.1 shows the model overview, with the main variables and their relationships. The approach followed for the development of Eurogreen allows to produce a representation based on real data of the Italian economy coming from numerous official statistical sources (e.g. Eurostat, ISTAT, WIOD) that takes into account numerous feedback loops, while detecting the impacts of certain measures on a set of key indicators of an economic, social and environmental nature.

The simulations carried out do not claim to represent forecasts on the impacts of the various actions considered: however, the scenario analysis allows to develop a consistent narrative based on a methodology consolidated in the literature that, with transparency, highlights the assumptions underlying the results. Nevertheless, the scenarios and the directions of the variations between the parameters are sufficiently robust even with respect to significant variations of the parameters themselves: even if they do not allow for reliability on specific numbers, they make the qualitative results and the conclusions reliable. Further details regarding the operation of the model are provided in the Technical Appendix 3.11.

[4]PNRR stands for *Piano Nazionale di Ripresa e Resilienza*, a plan implementing in Italy Next-generation EU European plan.

Figure 3.1: Overview of the Eurogreen model



Source: Campigotto et al. (2024).
Solid and dashed arrows represent monetary and non-monetary flows respectively. Households, Industries, Resources, Assets, Government and Rest of the World boxes summarize the results of the simulation of the first period. The abbreviations in the Households box describe the following groups: E=employed; U=unemployed; O=out of the workforce; R=retired; l=low-skilled; m=medium-skilled; h=highly-skilled; C=capitalists.

3.5 The reference scenario ("Baseline") for the development of the Green Work and Sustainable Mobility Plan: The consequences of inaction

In order to assess the impacts of the Green Work and Sustainable Mobility Plan through the application of the Eurogreen model, it is first necessary to develop a reference scenario, called the "baseline" scenario: this allows us to highlight the cost of inaction assuming

that there are no changes in policies compared to those already in place in Italy in 2023. Figure 3.2 shows the dynamics of the main macroeconomic and environmental variables (Table a) and distributional variables (Table b) in Italy in the period 2021-2050.

The simulations describe an Italy characterized by low growth (average annual rate of about 0.5% reaching an increase of about 10% compared to 2021 at the end of the simulation period) and emissions falling but not enough to reach what is foreseen by international agreements, i.e., a reduction of 55% in 2030 compared to 1990 and total decarbonization in 2050 (see, for example, European Commission, 2021).

Average labour productivity, a measure closely related to GDP, grows at an average annual rate of just over 0.5% due to the ongoing digitalization and automation processes that are implemented by the production sector; this also explains the contraction in employment. These effects have very important distributive consequences (Fig. 3.2b): the ratio between the labour compensation and the current monetary output (the so-called labour share) shows a continuation of the negative trend of recent decades.

Inequality in disposable income, as shown by the Gini index in Fig. 3.2b, also increases significantly: this is due to the impact of innovation processes within the labour market. The polarization of wages between highly skilled jobs, often complementary to innovations, and wages in low- and medium-skilled jobs, which are often replaced by innovation processes, increases.

At the macroeconomic level, therefore, the "Baseline" reference scenario shows for Italy a mega-trend characterized by an innovation process that produces a stronger increase in labour productivity than in recent years, accompanied by a worsening of the conditions of workers both in terms of jobs and distribution variables.

Figure 3.3, instead, illustrates the trend of the main specific indicators of the Italian automotive sector for the same "Baseline" scenario. High productivity and slightly decreasing demand explain a fall in employment of about 50,000 thousand units and a consequent reduction in the share of automotive employment compared to the entire manufacturing sector. This scenario therefore highlights an extremely high cost of inaction for the automotive sector which has a negative impact especially on jobs.

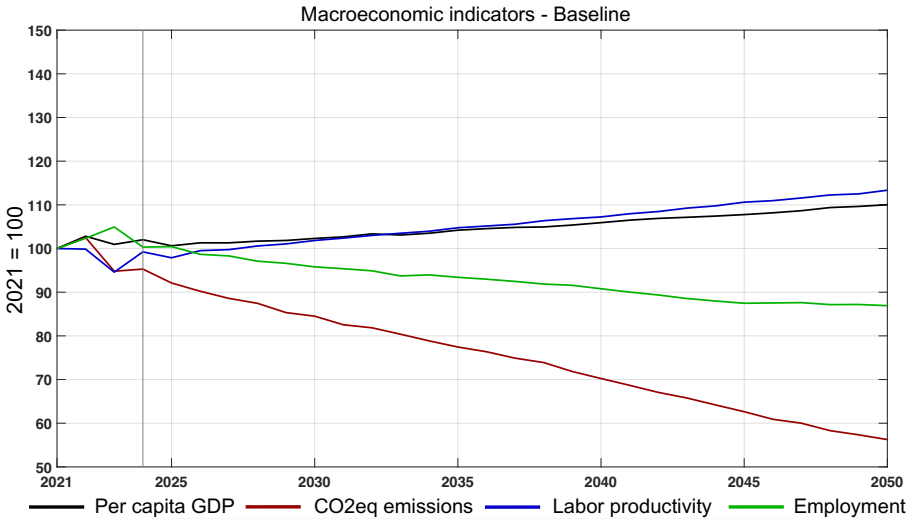
3.6 Scenario analysis

Once the Baseline scenario was built, the Plan was implemented in two steps:

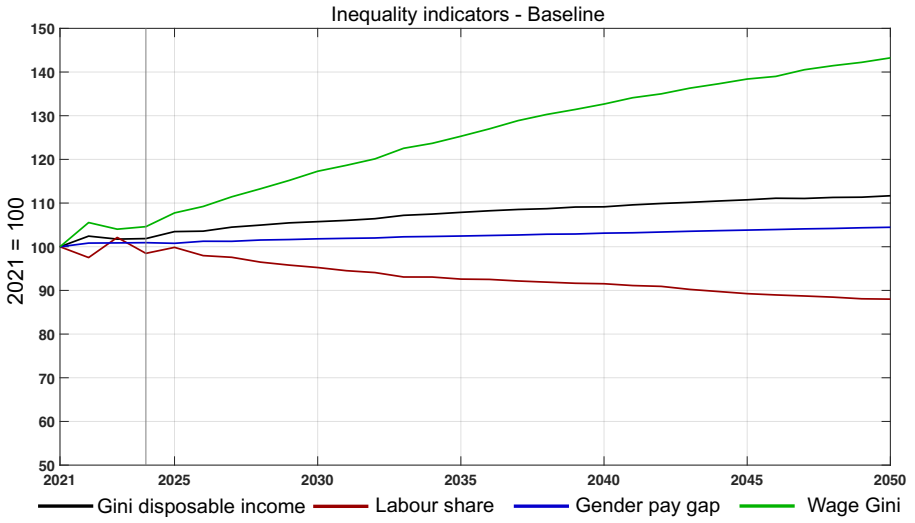
1. "No EHS" – the "Baseline" scenario was modified by eliminating the EHS s active in the automotive sector (without the freed resources being used in any way);
2. "PGWSM" – The PGWSM policies financed by 13.5 billion euros were activated on the scenario called "No EHS".

Step 1 is preparatory to the scenario analysis of the Plan and does not require further

Figure 3.2: Trends of macroeconomic and inequality indicators in the "Baseline" scenario



(a) Macroeconomic indicators

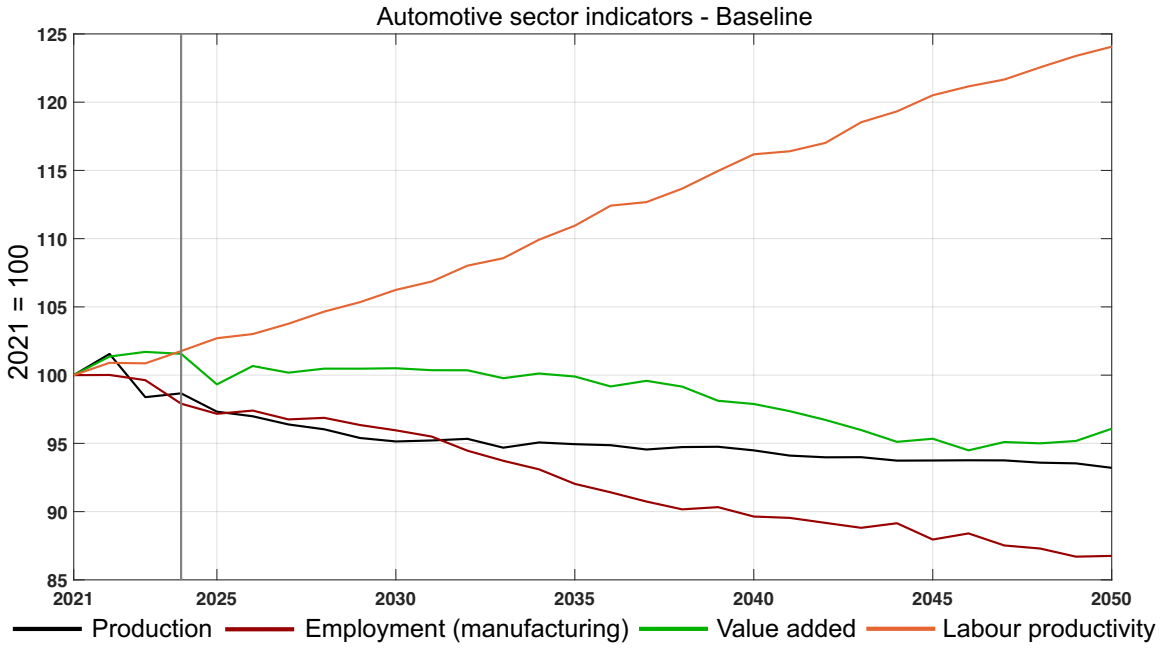


(b) Inequality indicators

Source: our own elaboration obtained through the application of the Eurogreen model.
Each curve represents the average value of 200 simulations for each scenario.

study; suffice it to say that the removal of the EHSs for transport alone generates a strongly negative impact in Italy, especially with regard to employment, in addition to

Figure 3.3: Automotive sector performance in the "Baseline" scenario. The value of each indicator is normalized to 100 in 2021.



Source: our own elaboration obtained through the application of the Eurogreen model.
Each curve represents the average value of 200 simulations for each scenario.

a regressive effect on low-income families dictated by the increase in the price of fossil fuels. The only positive impact is a limited reduction in CO_2 emissions.[5]

The Plan changes the development trajectory

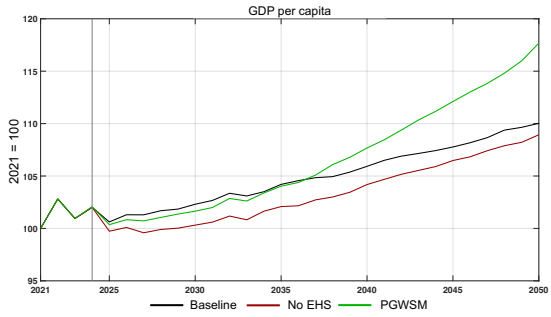
The results of the simulations regarding the Plan for Green Work and Sustainable Mobility, previously described in its individual components, are represented in Figure 3.4.

The most interesting finding of the simulation analysis is the realization that the implementation of the measures that make up the "PGWSM" scenario leads, in the long term, not only to offsetting the loss of employment that characterizes the "No EHS" scenario, but also to achieving – starting around 2035 – significantly better results than those of the "Baseline". Paradoxically, if we limit the comparison to the automotive sector only, the effects of the PGWSM are less impressive: both the level of production and the added value of the sector see an improvement of around 5% when the Plan is

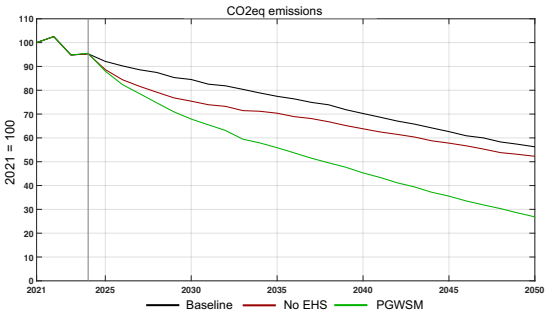
[5]When we talk about "CO_2 emissions" we are actually talking about CO_{2eq} emissions. This means that the model takes into account the different polluting gases and just to give a summary measure they are all converted into CO_{2eq} emissions.

active (of Figure 3.5a and 3.5b). This paradox is indicative of a strong systemic effect of the Plan and a limited sectoral effect: an uncommon result in policy studies.

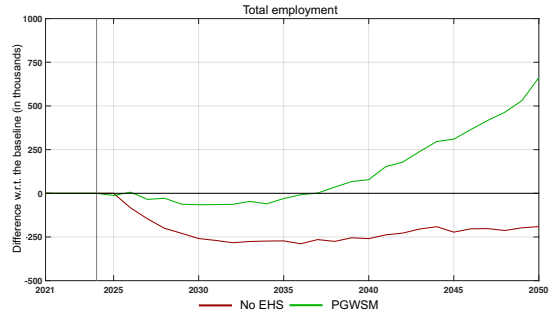
Figure 3.4: Trend comparisons between Baseline, No EHS and PGWSM. The vertical line at 2024 indicates the date of implementation of the measures of the two alternative scenarios. In (a) and (b) the values are normalized to 100 at 2021. In (c), (d), (e) and (f) the differences between the two alternative scenarios and the Baseline are represented.



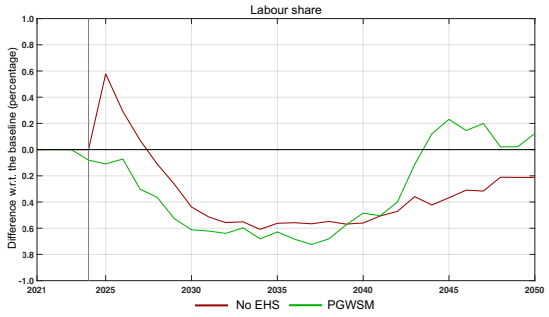
(a) GDP per capita



(b) CO_2-eq emissions

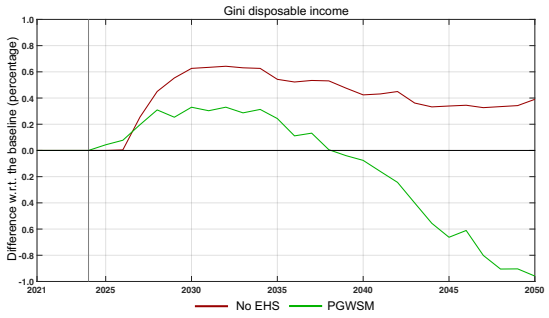


(c) Total employment



(d) Labour share

(e) Wage Gini coefficient



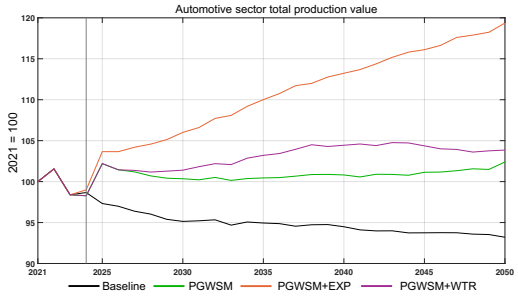
(f) Disposable income Gini coefficient

Source: our own elaboration obtained through the application of the Eurogreen model.
Each curve represents the average value of 200 simulations for each scenario.

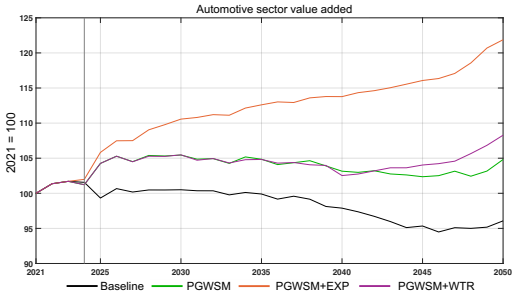
3.7 Two additional scenarios: reduction of working hours and specialization in export

The not particularly positive results for the sector just presented depend on some assumptions underlying the scenario analysis: in particular, in the PGWSM scenario, no assumption was added relating to a different competitiveness of new national products in the automotive sector; one could in fact expect that a rapid development of the sector could develop new skills and guarantee a reduction in the technological gap of the sector compared to international competitors.

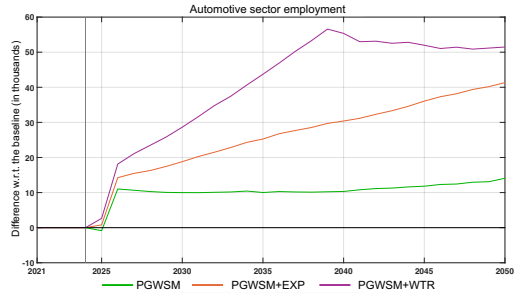
Figure 3.5: Comparison of trends of four indicators of the automotive sector in Baseline, PGWSM, PGWSM+EXP and PGWSM+WTR scenarios. All values normalised to 100 at 2021.



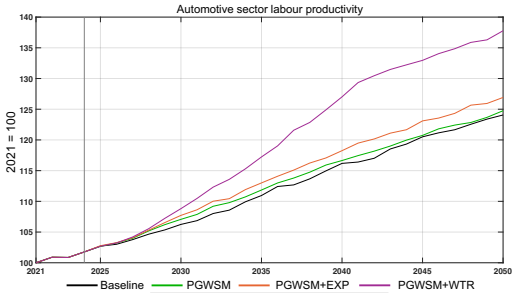
(a) Total automotive sector production



(b) Automotive sector value added



(c) Automotive sector employment



(d) Labour productivity in the automotive sector

Source: our own elaboration obtained through the application of the Eurogreen model.
Each curve represents the average value of 200 simulations for each scenario.

It is also important to underline that both in the "Baseline" and "PGWSM" scenarios, the employment and wage dynamics do not produce variations in the hours worked, which therefore remain constant over time. In this perspective, it was considered interesting

to also explore the scenarios related to the removal of these two assumptions. In the first, called "PGWSM + EXP", it is assumed that the transformation of the automotive sector for the production of electric vehicles for both private and public mobility increases the competitiveness of the sector, ensuring an additional increase in exports of 1.5% per year for the entire simulation period. The second alternative scenario, called "PGWSM + WTR", instead considers a reduction in working hours at the same wage in the automotive sector at a rate of 1.5% per year for 15 years, reaching an overall reduction of around 25% by 2039. Unlike other interventions included in the PGWSM, it was decided to model the reduction in working hours with a gradual implementation to represent a progressive penetration into the workforce of companies.[6]

Figure 3.5 shows the effects of these two additional scenarios. In "PGWSM + EXP", the increase in exports leads to an increase of about 20% in both the level of production (Fig. 3.5a) and the value added (Fig. 3.5b), to radically change the dynamics of these variables compared to the previous scenarios.

The scenario "PGWSM + EXP" highlights that, if the transformation of the industrial sector for sustainable mobility manages to increase the competitiveness of the country's automotive production, then it is possible to ensure high levels of employment and adequately and convincingly support the development of the sector.

In the scenario "PGWSM + WTR", on the other hand, a particular increase in jobs in the sector is observed compared to all the other scenarios considered. The gradual reduction in working hours induces an overall increase compared to the 'baseline' of more than 50 thousand units (Fig. 3.4c).

The maximum increase, in 2039, corresponds to the achievement of a 25% reduction in working hours; after that date the innovation process tends to slightly reduce the demand for labour. This scenario therefore highlights that the adoption of innovative labour policies can promote synergies between the creation of "green" jobs and the transition to sustainable mobility.

3.8 Comparison with the 2024 update of PNIEC

Our study was conducted when the governmental reference document was the 2020 version of the Italian Integrated National Energy and Climate Plan (see 3.2); however, in 2024 a new version of PNIEC has been published.[7]. Since such document study scenarios are similar to ours, we believe that it is useful to compare the results of our study with the

[6]It is also assumed that the increase in hourly wages to keep the monthly salary unchanged will be covered half by the State and half by businesses. From the point of view of the public budget, the cost of this measure is very low, also because the reduction in new unemployed linked to the implementation of the measure significantly reduces the cost of social safety nets, starting with unemployment benefits.

[7]The 2024 version is the most recent version of PNIEC published

ones published in the PNIEC. Indeed, this comparison helps contextualize our results within the evolving national strategy and highlights key similarities and divergences in assumptions, modelling frameworks, and expected outcomes.

3.8.1 PNIEC actions in the automotive sector and energy poverty

The analysis of PNIEC 2024 automotive measures requires contextualizing their significance within Italy's broader climate commitments.

The document explicitly emphasises the crucial role of the transport sector in achieving European climate objectives, and it states that "the transport sector remains crucial to achieving the new and more ambitious Effort Sharing Regulation[8] objective"[9] and that "the path to be taken will therefore require an extreme effort, particularly regarding the reduction of consumption and emissions in sectors linked to Effort Sharing Regulation commitments, that is in sectors such as transport".[10]

In particular, it is important to notice that a ministerial document as PNIEC states that, to achieve the climate goals, "transport demand reduction is a key element for sector decarbonization"[11] and it requires comprehensive policies that include modal shift and the promotion of alternative transport modes.

PNIEC does not focus much on the inequalities issues connected to the designed environmental policies, except for one section: the reflections on energy poverty. This concept, that comes from EU regulations, is quite large and is more connected to the price increase of electricity and gas than to the automotive sector ("The main specific measure for energy poverty reduction in Italy is part of the category of instruments aimed at reducing household energy spending: these are electricity and natural gas social bonuses, aimed at families in economic hardship");[12] nethertheless, it recognizes that "the transition path toward a sustainable energy system requires paying particular attention to the most vulnerable end customers"[13] and that the government even established a

[8]The Effort Sharing Regulation (ESR) is a key EU climate policy instrument that sets binding national greenhouse gas emission reduction targets for EU Member States. Its goal is to ensure that the EU collectively meets its climate commitments by reducing emissions in sectors not covered by the EU's Emissions Trading System (ETS).

[9]Our translation. Original Italian text: "il settore dei trasporti rimane cruciale per il conseguimento del nuovo e più ambizioso obiettivo ESR"

[10]Our translation. Original Italian text: "il percorso da compiere richiederà dunque uno sforzo estremo, in particolar modo per quanto attiene la riduzione dei consumi e delle emissioni nei settori legati agli impegni dell'Effort Sharing Regulation (ESR), cioè in settori quali trasporti"

[11]Our translation. Original Italian text: "la riduzione della domanda di trasporto è un elemento chiave per la decarbonizzazione del settore"

[12]Our translation. Original Italian text: "La principale misura specifica di contrasto alla povertà energetica in Italia fa parte della tipologia di strumenti destinati alla riduzione della spesa energetica delle famiglie: si tratta dei bonus sociali elettrico e gas naturale, rivolti alle famiglie in condizioni di disagio economico."

[13]Our translation. Original Italian text: "il percorso di transizione verso un sistema energetico sostenibile richiede di prestare attenzione particolare ai clienti finali più vulnerabili."

national observatory on energy poverty (Osservatorio Nazionale sulla Povertà Energetica - ONPE, Dlgs. 131/2022) to monitor the phenomenon and develop a reduction strategy.

Table 3.2 presents the comprehensive overview of the automotive measures of PNIEC 2024, their current implementation status, and associated funding mechanisms.

3.8.2 Compatibility analysis: PNIEC actions and PGWSM

The PNIEC and PGWSM show substantial convergence in their core objectives:

- both of them prioritize vehicle electrification as a primary decarbonization strategy, with PNIEC targeting 6.6 million electric vehicles by 2030 and PGWSM allocating €2 billion specifically for electric mobility demand stimulation;
- both reserve funds to sustain transport development, with PNIEC dedicating €3.885 billion for TPL fleet renewal and €5.45 billion annually for the National Transport Fund, and PGWSM allocates €8 billion for public transport development;
- both promote expansions of the charging infrastructure, with PNIEC's €713.1 million PNRR allocation for this purpose and with PGWSM's €3.5 billion investment in Cluster II infrastructure projects;
- both plans pursue social equity in the transition, since PNIEC contains energy poverty measures and PGWSM's emphasises the so-called "just mobility" and supports low-income families.

However, there are also significant differences.

The largest divergence resides in their funding philosophy: if PNIEC relies on traditional public funding mechanisms, national budgets, and EU resources (PNRR), PGWSM, instead, foresees financing through the elimination of Environmentally Harmful Subsidies.

So, this difference reflects different basic approaches, one relying on public spending, the other on resources taken from existing fiscal frameworks.

The temporal implementation strategies also differ significantly. In fact, PNIEC measures are distributed across various timeframes, some of which are already active (like Ecobonus), while others are still in their planning phases. In contrast, PGWSM proposes a comprehensive, simultaneous implementation of all measures starting from 2024.

Finally, PNIEC's sectoral approach contrasts with PGWSM's integrated macroeconomic one, which accounts for intersectoral feedback effects and dynamic economic adjustments.

Table 3.2: PNIEC 2024 Automotive Measures: Targets, Status, and Funding

Action Area	**Italian Policy Name**	**PNIEC Target / Current Status**	**Funding**
Vehicle Electrification	Obiettivo di diffusione dei veicoli elettrici	Target: 6.6 million EVs by 2030. BEVs in circulation (Mar 2023): 183,467	Not disaggregated; included in overall transport investments
Ecobonus Incentives	Ecobonus per veicoli privati	Incentives up to €11,000. DPCM 20/05/2024: €200M used in 1 day	€1.148B (2021), €630M/year (2022–23), €640M (2024)
Public Fleet Electrification	Rinnovo parco PA	Mandatory shares: 30% (2022) → 85% (2030); implementation status not reported	National + PNRR co-funding; not detailed
Commercial Van Renewal	Rinnovo veicoli merci	Last measure in 2018 (€33.6M); no new allocation or results	€33.6M (2018); no update
Charging Infrastructure (Public)	Infrastrutture di ricarica pubblica	Target: +21,255 fast/superfast points. Installed (2023): 41,173	PNRR: €359.9M (highways) + €353.2M (cities) = €713.1M
Private Charging Infrastructure	Ricarica privata	Wallbox support for households and firms; part of Superbonus and SME schemes	National fund: €90M (Legge 126/2020)
Company Car Taxation	Tassazione auto aziendali	Tax base from 25% (60g CO_2/km) to 60% (190g); active rule	Fiscal measure (no cost)
Reduced VAT	IVA agevolata 4% per disabili	4% VAT on EV/hybrid cars for people with disabilities	Tax expenditure; no dedicated fund
TPL Fleet Renewal	Rinnovo mezzi TPL	Replace diesel buses with electric/clean models	€3.885B (2019–33); includes €1.915B PNRR + €500M national
Ban on Polluting Buses	Divieto progressivo bus inquinanti	Diesel bus bans from 2025 onward; full exclusion by 2030	Covered via TPL fleet renewal funding
Modal Shift to Public Transport	Shift modale verso TPL	Modal shift via investment, service improvements	Fondo Nazionale Trasporti: €5.45B/year (2024)
Sustainable Mobility Fund	Fondo per la Mobilità Sostenibile	Multi-sector fund (2023–34) for fleets, infrastructure, mobility systems	€1.9B (2023–2034)
Povertà Energetica	Misure contro la povertà energetica	Bonus sociali elettrico e gas (sconto in bolletta); reddito energetico per famiglie a basso reddito (fino al 100% per FV); incentivi per comunità energetiche; diagnosi energetiche gratuite; Osservatorio nazionale operativo dal 2022	Fondo nazionale reddito energetico: €200M (dal 2022); bonus sociali coprono fino al 30% (elettrico) e 15% (gas) della spesa media; Conto Termico: €9.2M su edilizia sociale tra 2021–2022

Source: our own elaboration on PNIEC 2024 update

3.8.3 Comparing PNIEC and Eurogreen

Structural and Methodological Differences

The macroeconomic projections in PNIEC 2024 are based on a standard input–output (I/O) model developed by GSE, which uses fixed coefficients from ISTAT's national accounts to estimate the sectoral value added and employment effects of energy investment scenarios. These energy scenarios, in turn, are generated by the TIMES-RSE model, a bottom-up optimization model that finds the least-cost energy pathway to reach decarbonization targets. The TIMES model provides investment needs across sectors, which are treated as exogenous final demand shocks in the I/O framework. This method captures direct and indirect economic effects but remains linear, static in coefficients, and aggregate in the treatment of households and labour markets.

In contrast, the Eurogreen model integrates a system dynamics approach into an IO-based macroeconomic model, which means that the outcomes of each period feed into the next. The model's equations update annually and exhibits stock-flow consistency and endogenous technical change: its input–output coefficients and productivity levels are not fixed, but evolve in response to innovation and policies.

Emission forecast comparison between PNIEC and Eurogreen

PNIEC does not show any employment data specific to the automotive sector, therefore we focus our forecast comparison on the polluting emissions.

The baseline scenario, both in PNIEC 2024 and Eurogreen, represent the "business as usual" or the "inaction", i.e. it is assumed that the organization of the Italian economy stays the same compared to the reference year.[14] Following PNIEC's model, the baseline scenario envisages only 12.5% a reduction of ESR sector emissions by 2030 vs 2021. Instead, in the 2030 simulated in Eurogreen baseline scenario, we see CO_{2eq} emissions declining approximately 15% vs 2021 levels. In both cases we are far from reaching 55% reduction target (compared to 1990 levels) by 2030 and net zero emissions by 2050.

Let's now compare the policy scenarios. PNIEC's updated policy scenario obtains a reduction in ESR sector emissions of 23.2%[15] emission reduction in ESR sector by 2030. The Eurogreen PGWSM scenario demonstrates superior emissions performance, with CO_{2eq} emissions declining of 32% of 2021 levels by 2030.

For the next period 2030-2050, Eurogreen PGWSM scenario estimate a further gradual reduction of CO_{2eq} emissions reaching, in 2050, the final value of 28% of the 2021 level. Unfortunately we cannot compare this result with PNIEC because its estimates do not go over 2030.

[14] The reference year for both models is 2024.
[15] Still compared to 2021.

These reductions are very challenging for the industry, but are still insufficient to reach climate neutrality in 2050. So, even the most comprehensive policy integration modelled requires additional measures beyond 2030 to achieve full decarbonization

3.9 Conclusions

The path of the transition towards a new development model and a fair society that respects planetary limits passes through the guarantee of the right to sustainable mobility. The transport sector has thus far contributed insufficiently to the decarbonisation objectives (ICCT, 2021). According to the EEA (2023), after the 2020 anomaly, in 2021 emissions from the transport sector rose again above 100 million tonnes of CO_{2eq}.

The analysis presented starts from the proposals of the environmental and trade union organisations that adhere to the Alleanza Clima Lavoro, so to speak, systematizing an ambitious Plan for green work and sustainable mobility ("Piano per il lavoro verde e la mobilità sostenibile") for Italy and showing its effects. The Plan includes a series of measures and interventions aimed at radically transforming private mobility and public transport in the country, focusing decisively on electrification, creating "good" employment.

To verify the consistency of the Plan for Green Work and Sustainable Mobility, the Eurogreen dynamic macro-simulation model calibrated on Italy was applied. It allows processing of the main macroeconomic, distributive, energy use, and emissions-related variables, managing to evaluate the systemic effects of the policies thanks to the feedback effects present between the various elements of the model. Eurogreen is in fact built to evaluate, through the analysis of alternative scenarios, the impact of certain public measures on the social, economic, and environmental dimensions.

The costs of the Plan are entirely covered by the elimination of Environmentally Harmful Subsidies currently active in the automotive sector, an estimated total of 13.5 billion euros.

The adoption of the Plan guarantees an increase in jobs from 2035 compared to the reference scenario, reaching an increase of approximately 700 thousand units in 2050. This is a significant figure, which also corroborates what has been stated in numerous scientific studies and research (see, for example, Ilo, 2015; Haberl et al., 2020; Jackman et al., 2021): the electrification of energy consumption and, more generally, the ecological transition, are an opportunity, and not a threat, for employment.

The Eurogreen model also highlights some problems related to the implementation of the Plan in the short term, in particular with regard to employment levels in the automotive sector. To overcome these negative effects, it is appropriate to adopt innovative social policy measures. The reduction of working hours at the same salary was considered, constructed as a gradual decrease up to an overall reduction of 25% in 15 years. The results

that emerged are more than encouraging, since the reduction of working hours is able to increase the number of employees in the sector by over 50 thousand units compared to the reference scenario. A result strengthened by a substantial synchronous increase in labour productivity.

Lastly, a further scenario hypothesis was considered: the Italian automotive sector, due to its transformation and specialization in electric vehicles, increases the volume of its exports at an exogenous and additional rate of 1.5% per year. In this scenario, the slight increase in export demand considered is able to increase the production levels of the sector by approximately 11 billion euros, with a consequent increase in employment of approximately 25,000 units.

The comparison with the 2024 update of the Italian Integrated National Energy and Climate Plan (PNIEC) validates our findings and demonstrates their policy-making relevance. The substantial convergence between PNIEC 2024 and PGWSM in the core objectives, both prioritizing vehicle electrification and public transport development, confirms the strategic soundness of our approach.

In particular, PNIEC explicitly recognizes that "the transport sector remains crucial for achieving the new and more ambitious Effort Sharing Regulation objective", validating our study's focus on comprehensive transport sector transformation. The forecast comparison reveals that our PGWSM scenario achieves superior emissions performance, with CO_{2eq} emissions declining of approximately 15% of the 2021 levels by 2030, outperforming PNIEC's projected 12.5% reduction trajectory. However, even this enhanced performance falls short of the net zero-emissions target by 2050, indicating that additional measures beyond those modelled will be necessary to achieve full decarbonization.

In conclusion, the transition to sustainable and electric mobility is an essential step toward achieving the decarbonization objectives. The results of the simulations and analyses presented demonstrate that, with a clear vision and adequate resources and tools, the desired transition can take place in a fair and effective way, based on the implementation of specific industrial, social, and employment policy measures that ensure sustainable development of the country and offer a concrete response to one of the key principles of the European Green Deal: leaving no one behind.

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3.11 Technical Appendix

In the Eurogreen model, aggregate demand determines the level of output and is composed of exports and government spending, household consumption spending and investment. Household consumption depends on disposable income, the marginal propensity to consume dependent on income and prices. Consumption is allocated between 16 different goods depending on changes in relative prices (including both private transport and public transport spending). Disposable income is determined by government transfers, income from work and financial income, social contributions and income taxes.

These variables vary according to skills, gender and employment status (employed, unemployed, out of the labour force and retired), with 24 different population groups, allowing for an in-depth analysis of distributional issues. These 24 groups are then recombined to generate 100 household types divided by quintile and region. Since household behaviour depends on income, prices and different territorial situations, the model cap-

tures the feedback effects that derive from changes in distribution, employment status and prices that in turn may derive from causes such as technological progress, wage increases or the introduction of incentive or disincentive policies. Many of the proposals of the Green Work and Sustainable Mobility Plan aim precisely to change household choices.

Employment varies according to skills and gender and is determined as a function of sectoral labour productivity, production in the previous period and weekly working hours. The composition of labour demand by skill reflects historical trends specific to the sector, while the composition by gender depends on the difference between female and male unemployment rates within each skill group. Pensions and unemployment benefits are paid in proportion to wages, which in turn are influenced by labour productivity, inflation and group-specific employment rates. Financial income consists of dividends on shares and interest on government bonds.

Industries adjust their desired investments based on the difference between actual and normal capacity utilization, seeking to produce at the normal rate of capacity utilization. However, investment spending is constrained by profits net of debt repayment and taxes, which determine the maximum investment each industry can finance. Another feature of the model is that financing conditions are negatively affected by the industry's leverage. The level of production is obtained by multiplying domestic final demand by the inverse Leontief matrix and is constrained by fixed capital and capital productivity.

The version used for the analysis modifies the original Eurogreen framework of 19 sectors[16] by introducing a specific Automotive sector and a splitting the Energy sector into Electricity and Gas and Heat, bringing the input-output sectors to 21. The technical input-output coefficients change endogenously over time with technological progress. The innovation process can be summarized as follows. In each period, one or more new technologies can be discovered with a certain probability. Innovations can be labour-saving, intermediate-input saving, or both. The probability of a new technology being discovered depends on the cost of labour and intermediate factors.

Once a technology is discovered, the amount of technological progress in each sector is randomly determined by normal distributions calibrated on historical data. Finally, each sector chooses (based on cost minimization criteria) whether to adopt a new technology and, if so, which one. This version of the model allows production efficiency to be improved even in the absence of new innovations, thanks to the progressive diffusion of the latest available technology.

Technological progress also affects energy demand, increasing energy efficiency. Energy flows are linked to real internal monetary flows, with energy demand coefficients for production specific to each cell of the input-output matrix and sector-specific coefficients for household consumption. Energy demand is met by five energy sources (solid, liquid,

[16]They have been chosen following the European classification "NACE Rev 2".

gas, biomass and renewables) according to industry- and household-specific shares that change over time.

GHG emissions are then determined, once again, using sector- and household-specific energy source-to-emissions conversion factors. This approach allows energy demand and emissions to respond to changes in the quantity and composition of inputs required for production. At the same time, changes in the energy mix determine both a change in emissions and the level of production of sectors. Note that this emissions accounting only considers emissions from energy products and does not consider emissions not related to energy production.

The version of the Eurogreen model used here also includes a climate damage function, defined as the fraction of change in production compared to that which would occur in the absence of global warming. Temperature projections are exogenous and based on representative concentration paths (RCPs). The climate damage functional form is based on Desmet et al. (2015), with modifications to account for extreme weather events.

The government collects social contributions, value added taxes, carbon taxes (if any), and taxes on labour, financial income, and corporations. It also makes transfers to households, subsidies to businesses, and purchases goods and services. Prices are determined as a mark-up on unit production costs. Population dynamics are exogenous and depend on demographic projections. Data on the main variables between 2010 and 2019-2020 were used to calibrate the key parameters of the model and proceed with its validation. In addition, to replicate the effects of the Covid-19 pandemic, an exogenous shock to private consumption, investment, exports, and imports was included in 2020 and 2021.