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ORIGINAL PAPER

Assessing Italy's Severino Law: impacts on corruption control and inequality

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Abstract
The evaluation of public policies is an increasingly important issue that demands greater attention. This study examines the impact of the Severino Law (2012) on corruption control and inequality in Italy. Using a robust quantitative approach for the period 2002–2022, we apply difference-in-differences (DiD), the synthetic control method (SCM), and a multivariate adaptive regression splines (MARS) model. Our findings indicate that while the law significantly improved corruption control—albeit with a delayed effect—it did not reduce inequality as anticipated, which instead continued to rise. This outcome stands in contrast to the predictions of much of the empirical literature. The results suggest that the direct effects of corruption control on inequality can be highly idiosyncratic and do not operate in a linear or isolated manner. Rather, they depend on the extent to which corrupt behaviors are reduced and on the presence of complementary policies beyond anti-corruption reforms to effectively address structural inequality.

Keywords Corruption · Italian System · Inequality · Social capital

JEL Classification C73 · E71 · G18 · P16 · P43

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1 Introduction

Corruption in Italy has a sad long tradition (Ardeni and Gallegati 2024). Vilfredo Pareto in 1916 (Pareto 1916), wrote: "in Italy, the newly acquired wealth has its roots in public bids, railways and constructions, state-funded companies and custom protection […]. As a result, this order appears to experienced politicians as a lottery, which grants prizes, some larger and some smaller ones…".

Without deepening now the historical evolution that led to the promulgation of this law, which will be explored in the next section, few years before the approval of the Severino Law, the European Union, and in particular the GRECO group (2011)[1][2] showed that in Italy "corruption is deeply rooted in various areas of public administration, in civil society, as well as in the private sector. The payment of bribes seems common practice to obtain licenses and permits, public contracts, financing, to pass university exams, to practice the medical profession, to make agreements in the football world […] Corruption in Italy is a persuasive and systematic phenomenon that influences the society as a whole".

As a result of these pressures from the European community on the 4th government headed by Berlusconi, followed by his fall on November 2011, let the technical government that followed, led by Premier Mario Monti, launch the final provision with the so-called Anti-corruption Law or Severino Law by the proposing Minister (Law n. 190, year 2012) containing "Provisions for the prevention and repression of corruption and illegality in the public administration." With that law, the role of the National Anti-Corruption Authority (ANAC) for the evaluation of the anti-corruption policies and transparency in public administrations was reinforced and the role of the Head of Corruption Prevention (RPCT) was introduced within Italian local authorities.

This law was very innovative at that time. It acted on two strands of actions: tightening punishments for those convicted for corruption crimes and favoring situations that prevent the rise of corrupting activities in politics and in each public administration through the creation of a net of social capital and accountabilities, which—at least in the mean term—can contribute to the reduction of diffuse corruption by means of appropriate norms and duties specifically thought for the public administrations.

The novelty of the law, thus, was that it aims to prevent corruption through public administration, instead of solely focusing on punitive measures in the Criminal Code. The idea behind this new approach is that by promoting principles of good governance, ethics, transparency, and by training civil servants, public administrations will be able to prevent corruption (David and Lepore 2013).

[1] Report available at https://rm.coe.int/16806c6952

[2] There is indeed a strand of literature that assumes that certain level (possibly low) of corruption is good for development. Leff (1964), Organski (1969), and Acemoglu and Verdier (1998) claim that corruption, in some cases, acts as a piece-rate pay for bureaucrats inducing a more efficient provision of public services and a leeway for entrepreneurs to bypass inefficient regulations. As far as we can say, this view is a minority in the economic literature and moreover it holds only when the level of corruption is low.

This law indeed establishes two levels of identification of potential risks for corruption: a central level, administered by the National Anti-Corruption Agency (ANAC), which adopts the National Anti-Corruption Program (NAP), and a peripherical one, administered by each single public administration through the redaction and observation of a three-years programs for Transparency and the Prevention of Corruption (TPCP). Both the ANAC and each single public administration write down a 3-year "rolling" program, since each year the program is updated for the next three years. The purpose of the NAP is to identify "the main risks of corruption and the associated remedies (…) in relation to the dimension and different sectors of activity in which the public entities operate" (Parisi 2018), in order to guide and support public sector bodies and the other parties to which the anticorruption legislation is applied in the preparation of the Three-year Plan for the Prevention of Corruption and Transparency. The program contains recommendations; given that it also includes illustrative guidelines, there remains a need to contextualize the risks and remedies (the so-called measures) in relation to the specific organizational context of each entity. The method used therefore, supplemented by the two rolling and cascading actions, enables the creation of a continuous cycle of control, learning and application of personalized, made to measure instruments for prevention. In other countries, such obligation for the public administrations does not exist, being the prevention of corruption handled mainly through the general law and the guidelines of the competent authorities.

Before the Severino Law, the ineligibility requirement had originally been introduced only in reference to regional and local elective offices and resulted from a conviction exclusively for crimes connected to organized crime. It was therefore a measure primarily aimed at preventing the infiltration of mafia crimes into institutions, inspired by the prevailing aims of protecting public order and safety, alongside the need to safeguard the free determination of elective bodies, the proper functioning and transparency of the public administration. The "Severino Law" has not only extended the application of the measures to national and European parliamentarians but has also expanded the range of obstructive crimes, including those committed against the public administration. The expansion of the subjective and objective scope of application of the discipline, in short, has coincided with the accentuation of the profiles connected to the safeguarding of the good work and the honorability of public offices, in order to allow the satisfaction of the "permanent needs of contrasting the widespread illegality in the public administration."

Briefly, this law established:

- The redaction, for each public administration, of a three-year anti-corruption plan, where the areas at major risk are identified and the corresponding actions to minimize the events of corruption defined. This obligation is compulsory and due each year, with a yearly update of the plan. This obligation is preventive to any act of corruption, and has the goal to act on the minimization of the risk through appropriate actions.
- The introduction of the figure of Responsible of the Anti-corruption measure (RPCT) in each Italian public institution.

- The obligation of rotation of public managers employed in sectors that are at high risk of corruption.
- The obligation of transparency and traceability of the public activity.
- The impossibility for a person convicted of corruption crimes of presenting himself as a candidate for public elections. This impossibility is unavoidable, even if the conviction has not become final and binding. The judge, therefore, has not discretionality in deciding whether to apply this additional penalty to the convicted of such crimes.
- The loss of the role of member of the parliament or public manager for those convicted after the election or designation, and, as before, this holds immediately even if the sentence is not final.
- The creation of a new ethic code for public employees and the protection of the public employee that reports corruption crimes.
- The institution of un-conferment and incompatibility regimes in the public administration.
- The strengthening of the National Anticorruption Authority's supervision of public procurements.

With the introduction of these obligations, as the anti-corruption plan for each public administration, and the creation of the Responsible of the Anti-corruption measures (RPCT), along with the rotation of public managers employed in sectors at high risk of corruption and the tightening of punishments for those convicted for corruption crimes had the goal of creating the social capital which is necessary to the progressive eradication of corruption in the public administration.

No other country in the European Monetary Union had a law similar to this one at that time. France, for example, at the end of year 2016 (therefore, four years later than the enactment of the Severino Law) approved the Sapin II law, according to which an anticorruption agency (AFA) was created, and obligations of identifying areas of particular risk for corruption and appropriate actions for reducing such risk for firms with a minimum of 500 employees and euro 100 millions of sales were introduced. Such obligation, which holds for private companies, does not hold for the Public Administration and the figure of the responsible for the Anti-corruption measures does not exists in French public institutions. According to this law, which, we recall, was subsequent to the Severino's and targeted only to private firms, the possibility of an additional penalty of ineligibility for people convicted of corruption may be applied, but not compulsorily, as it is up to the judge to decide and motivate why he believes it is necessary case by case. Spain and Germany's anti-corruption laws offer the possibility of an additional penalty of ineligibility for those convicted of corruption to be levied by the prosecutor based on his own evaluation.

The fact that this law came into force exactly at the end of year 2012 in Italy (which we may think to it as a breakpoint), without that any other country implemented a similar policy, creates the conditions to study its effects using quasi-experimental econometric techniques.

After the literature review and having detailed the historical evolution that led to the promulgation of this law, we try to measure its effects from a purely statistical and econometric point of view. To the best of our knowledge, this paper is the only

one that tries to evaluate the impact of this law on these indexes, namely, corruption control and inequality. Once this effect has been estimated, we want to investigate the causal impact of corruption on inequality. Given the positive effect this law has had on controlling corruption, we intend to determine if these effects can translate to the population by reducing inequality levels and thus improving citizens' well-being. To test for this causal relationship in Italy, we use a non-linear and semiparametric approach estimating a Multi Adaptative Regression Splines (MARS) model. This type of models endogenously determines the nonlinearity thresholds of each determinant and can also endogenously identify if any traditional determinants of inequality are not significant for Italy. The results show that corruption control was not effective in reducing inequality in Italy. Consequently, we can conclude that the Severino Law has significantly improved the quality of Government, but not the quality of life of the citizens and we wonder whether other mechanisms are in place that better explain the dynamics of inequality.

The paper is organized as follows. Section 2 present the literature review. Section 3 introduces the main facts that have led to the promulgation of the law dating back to the 1960s. Section 4 presents some stylized facts about corruption and inequality in Italy. Section 5 introduces the statistical methods and the main results, while Section 6 concludes.

2 Literature review

There is an almost unanimous consensus in the economic literature about the fact that corruption is detrimental for the economic activities and the society's welfare[3]: Corruption is known to undermine confidence in public institutions, distorts economic competition, with special regard to public contracts, causes an increase in average costs and delays for the provision of infrastructures, favors the poor quality of public works, and constitutes an unbearable economic weight for a country that have been in a deep economic crisis since 2008. Other consequences of corruption which are frequently reported in the economic literature are a lower propensity to invest by the private sector, a lower amount and quality of public infrastructures and services provided, a lower effectiveness of public investments, because government investments are directed toward less productive projects and a reduction of human capital formation (Mauro 1995; Murphy et al. 1993). From a social point of view, corruption is also associated to an increase in economic inequality because of its impact on income distribution, social spending, access to essential services and the political instability that it generates (Accinelli and Carrera 2012; Alfano et al. 2023; Alesina and Perotti 1996; Accinelli et al. 2023; Mo 2001; Mo 2000; Gründler and Potrafke 2019; Perotti 1994).

[3] There is indeed a strand of literature that assumes that certain level (possibly low) of corruption is good for development. Leff (1964), Organski (1969), and Acemoglu and Verdier (1998) claim that corruption, in some cases, acts as a piece-rate pay for bureaucrats inducing a more efficient provision of public services and a leeway for entrepreneurs to bypass inefficient regulations. As far as we can say, this view is a minority in the economic literature, and moreover, it holds only when the level of corruption is low.

A robust body of empirical work has demonstrated that corruption tends to exacerbate income and wealth disparities. Tanzi (1998) argued that corruption acts as a regressive tax that disproportionately affects lower-income individuals while redirecting resources toward the elites, thereby undermining equity. Similarly, Mauro (1998) showed that corrupt environments are associated with lower public spending on education and health, which are essential economic equalizers.

More recent econometric analyses have reinforced this linkage using advanced panel and cross-sectional data. Gründler and Potrafke (2019), employing a global panel dataset, find that better control of corruption significantly reduces income inequality. Beyaert et al. (2023a, 2023b) take a non-linear modeling approach and uncover heterogeneity in the corruption–inequality nexus depending on institutional quality and economic development levels. Durlauf et al. (2001) further propose that corruption indirectly affects inequality by distorting the parameters of the economic growth process, thereby modifying the transmission channels of income distribution.

Deaton (2013) provides another relevant perspective by arguing that improvements in aggregate income levels should ideally lead to reductions in inequality, yet this mechanism often breaks down in corrupt systems. This breakdown, in turn, reinforces the need to analyze the institutional determinants of inequality rather than relying solely on macroeconomic aggregates.

Uslaner (2008, 2015) emphasized the bidirectional relationship between inequality and corruption, suggesting that unequal societies foster environments of low trust where corruption thrives, while corrupt systems, in turn, reinforce existing inequities. The theoretical underpinning of this argument is based on social capital theory and distributive justice frameworks, where the erosion of institutional fairness leads to reduced redistribution and weakened public service delivery.

Considering the nature of this law and its peculiar way to increase awareness of public officials, managers and politicians on the social and personal consequences of corrupt behaviors through the creation of the so-called social capital, our study may be framed in the economic and sociological literature on the debate of the relation between social capital formation and the level of corruption. Through the obligation of the redaction and observation of the anti-corruption plans (which, we recall, it is a unique obligation in Europe when we talk about the Public Administrations), the identification of responsibilities and penalties for those who do not align with the prescriptions of the plan, this law has effectively helped contributing to increase the social capital in Italy which is at the foundation for creating an anti-corruption culture.[4] Despite the difficulties in measuring the levels of social capital in a society and the levels of corruption, which, by nature, is a hidden activity, there is an important body of evidence linking negatively indicators of social capital (and trust) and corruption (Pena López and Sánchez Santos 2014; La Porta et al. 1996; Bjørnskov

[4] There are indeed several types of social capital which are object of investigations by scholars. Social capital might be indeed classified into two groups: bridging social capital and bonding social capital. Wachs et al. (2019) claim that they have different effects on corruption levels, being bridging social capital effective in reducing corruption while bonding social capital is associated to higher levels of corruption. In our study, we will assume that the Severino Law had an impact on what is commonly known as bridging social capital.

2011) or linking lack of trust to higher levels of corruption due to the diminished sense of doing something "immoral," which leads to a perception of higher corruption (Xin and Rudel 2004) in the society and thus a higher prevalence of corruption (Bardhan 2017; Robert and Arnab 2013).

However, the causality direction between corruption and social capital (or trust) remains largely debated. Corruption indeed has also been viewed as a cause for the erosion of social capital (Anderson and Tverdova 2003; Chang and Chu 2006; Della Porta 2000). This view draws support from the impact of political scandals on trust (Bowler and Karp 2004), and by relating confidence in institutions entrusted to control corruption to interpersonal trust (Rothstein and Stolle n.d.). Other scholars indeed have interpreted the relation as one of mutually reinforcing causality (see for instance Uslaner 2002; Morris and Klesner 2010). Our paper wants to contribute to the literature in two directions: due to the fact that this law constitutes an exogenous intervention aimed at increasing the level of awareness and anti-corruption morale among citizens, public officials, and politicians, we want to contribute to test whether there is a causal relationship from social capital (due to this intervention) to corruption and inequality, and to estimate their magnitude in Italy. So, the fact that this law somehow contributed to the formation of an anti-corruption culture in a unique way within the public administrations in Italy constitutes an excellent quasi-experiment worth of investigating. Moreover, being the level of corruption and any possible indicator of social capital potentially endogenous, the promulgation of this law constitutes an excellent tool for the identification strategy of the effect of an increase in social capital on corruption.

A large fraction of articles that we cited in this section used survey data (therefore, individual data), to measure the effect of trust or social capital on the level of perceived corruption and/or vice versa (La Porta et al. 1996; Bjørnskov 2011; Anderson and Tverdova 2003). Despite these studies may help understand effectively the relationships between those two variables, it is often difficult to establish a causal relationship between a macroeconomic intervention and the observed result. There might be indeed confounding factors that affect both the intervention and the result, making it difficult to determine whether the intervention was the main driver of the change. Even if those surveys were repeated over time, the population interviewed is not the same in all waves and the perception may change across samples even without an intervention. Moreover, these kinds of data have rarely been measured for long time, since their collection is quite expensive; therefore, measuring an impact is quite difficult.

Other scholars use instead cross-country data to measure the effect of social capital on corruption (Xin and Rudel 2004). A discrete number of scholars would argue that it is impossible to measure the incidence of corruption across nations because the legal and cultural context surrounding corrupt behaviors varies between countries (Rose-Ackerman 1997). If a behavior in one country is considered corrupt, in another could be perfectly legal and widely accepted. As an example, consider that in the USA, pharmaceutical firms promote their drugs by providing physicians with Monetary and in-kind payments. In year 2020, payments to US physicians, including meals, gifts, consulting fees, and travel expenses, totaled $2 billion (Newham

and Valente 2024). Such a practice is severely banned in Italy, and considered a corrupt behavior, as stated in article 31 of physicians' behavioral code.

Our study, therefore, encompasses all these problems by studying the effect of an intervention through time in a single country, with the advantage that the notion of corruption has remained substantially the same through the study time. What changed, instead, was the level of corruption which we attribute to the exogenous implementation of the law, therefore protecting us form a possible confounding factor that associates a variation of the definition of corruption with a variation of the level of corruption.

3 A historical overview

The Severino Law is the outcome of a particular historical context in Italy characterized by a widespread corruption across all areas and economic contexts, such that the other EU countries required corrective actions to limit the damage that this illegal activity was creating to Italy and EU itself.

Dating back to the 1960s, corruption was largely confined to the country's ruling elite. From then, it became a common behavior, spread across all social strata and involving an even larger number of low- and middle-income politicians and bureaucrats (Castro 2021; Paoli 2001). It is pretty clear that it has been fostered by the complexity of the legal system and bureaucratic rules, the pervasive presence of organized crime, especially in the south, and an insufficient level of social capital in the country which somehow made this behavior socially "accepted," as it was the habit of evading taxes (Angelis et al. 2020; Attanasi et al. 2024; Paoli 2001). In year 1991, however, the joint effect of the *Mani pulite* scandals that finally uncovered that widespread habit of accepting (or asking for) bribes to convey the results of public procurement[5] and the risk of state bankruptcy following the expulsion of the Italian Lira from European Monetary System (EMS) in 1992,[6] fostered a popular revolt against the traditional parties expressed in their collapse at the polls in two important referenda in 1993[7] which bring the population to claim the need to More political stability and accountability even at the cost of some representativeness. This moment in the Italian history defines the end of the first Republic and the begin of the second, which was characterized by the advent of Silvio Berlusconi as a protagonist of the Italian political arena for about 20 years, despite not continuously. His "descent into the field," as he was used to define, was highly controversial: Silvio Berlusconi presented himself as a successful entrepreneur with a huge

[5] Corruption permeated basically all the public activities, with particular regards to the public chemical industry, public works, private building sector and welfare institutions (Morlino and Tarchi 2026).

[6] The risk of bankruptcy was caused by a massive capital flight and the consequence inability of the Italian currency to keep its exchange rate above the minimum threshold of fluctuations accepted for being included in the EMS.

[7] The two referenda which we are referring to are the abolition of the rules concerning the electoral system of the Italian Senate in order to introduce the single-member majoritarian electoral system and the abolition of public funding to parties.

wealth which—in part—was due to the public concessions regarding TVs. Supporters of Berlusconi believed that this extraordinary wealth was a guarantee of honesty. Opponents, instead, claimed that Berlusconi initiated his activity in politics to save his firms and himself.[8]

What is sure is that his success was mainly due to the "anti-political effect" that Berlusconi represented to the bellies of the Italian people. The movement of rejection of politics in Italy had a secular tradition and he managed to embrace it successfully with the undisputed media power he had at that time. Officially, he declared himself a liberal man, but his choices about the internal politics kept himself close to the preordained conservatism that was typical of the previous Italian order bloc.[9]

In building his political party, Berlusconi entrusted himself with the worst ruling class, especially in the south of Italy, of clientelist nature and often very close to the organized crime, as he was used to do before the election with his business activity (Felice 2013). Corruption allegations of Berlusconi have been at the agenda of the Italian political activity, most of them concluded with acquittal due to the expiry of the legal limitation period (which himself contributed to shorten dramatically during his mandates).

From the point of view of the quality of institutions, meaning, political and judicial institutions, the advent of the "reformer" and "liberal" Silvio Berlusconi has been what we define *Italian leopardism transformation*, meaning, that "everything must change for nothing to change," to cite Giuseppe Tomasi di Lampedusa (Barker 2010). Political reforms undertaken by Berlusconi have been far away from what Italy needed at that time: an industrial reform aimed at increasing productivity totally absent, with a strict preference toward those policies aimed at protecting rents and consolidated privileges, like the abolition of the inheritance tax, the flat tax on rental houses, and the abolition of the property tax on houses, and—of course—policies aimed at reducing the penalties for economic crimes like false accounting and reducing the legal limitation period for getting a judgement for several crimes, flaunted as if this were a guarantee of efficiency and effectiveness for the Italian judicial system.

This *inertia* or—depending on how one wants to see it—these counterproductive policies undertaken by Berlusconi's Government ended in 2013 when Italy faced a new political crisis epitomized by the advent of the "technical government" chaired by Mario Monti (November 2011–April 2013), and by an electoral round in 2013 in which a newly formed anti-system party (Il Movimento 5 Stelle, or "Five Stars Movement") turned out as the first single most voted political party in the Chamber of Deputies, leading to a hung Parliament.

[8] According to Marcello dell'Utri, interviewed in by A. Galdo, Fininvest had 5 thousand billion of debts. At that time, in 1994, he said, the CEO of Fininvest, Franco Tato', did not see other solutions than to declare bankrupcy. With time, he added, without the decision to engage in politics, Berlusconi would not have been able to save himself and he would have ended up like Angelo Rizzoli who, with the investigations about P2, was jailed and lost his firm.

[9] This bloc was made up of a coalition of five political parties, (the so-called *pentapartito*), of which Bettino Craxi was president before Berlusconi's election.

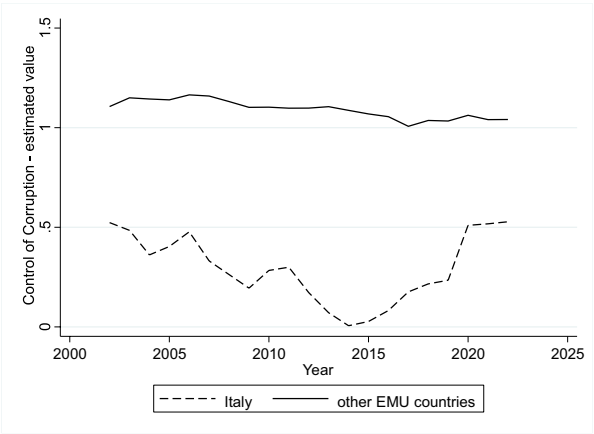

Fig. 1 Estimated value of the index "Control of Corruption." Source: own elaboration (data from WGI World Bank)

It has been during Monti's Government that the need to reform public institutions with an ad-hoc law aimed at preventing corruption phenomena and tightening penalties for those convicted of corruption has emerged, and was finalized with the promulgation of law 190/2012, the so-called Severino Law, as the name of the Minster of Justice who was the main author. The necessity of an ad hoc discipline against corruption raised from some investigations made by the European Union and the OECD which estimated a cost of corruption in Italy of about 60 million per year, equal to about 3.8% of GDP, against 1% for other European Countries. After the 2008's great recession, this data was unacceptable from any economic, social, and political point of view. Twelve years after the promulgation of this law, that is, at the time this paper was written, our goal is to establish the impact that this measure has had on corruption control, tax collection, and inequality in Italy.

4 Stylized facts and main statistics

Looking at raw data, Italy is one among the developed countries where citizens' perception of corruption is at the highest levels. According to the Corruption Perception Index (in the following, CPI) released by Transparency International, in year 1995 Italy had a score of about 30, worse than Mexico and Colombia. In year 2011, this score was 39 (9 points higher). In year 2023, Italy had a score of 56.[10] During the period 1995–2011, that is, in 16 years, Italy managed to decrease the perception of corruption of only 9 points, while in the subsequent 12 years, the improvement was definitely higher (17 points, from 39 to 56 points).

[10] Transparency's Corruption Perception Index ranks the least corrupted country with a score of 100, and the Most corrupted with a score of 0. So, the higher the score, the least corrupt the country.

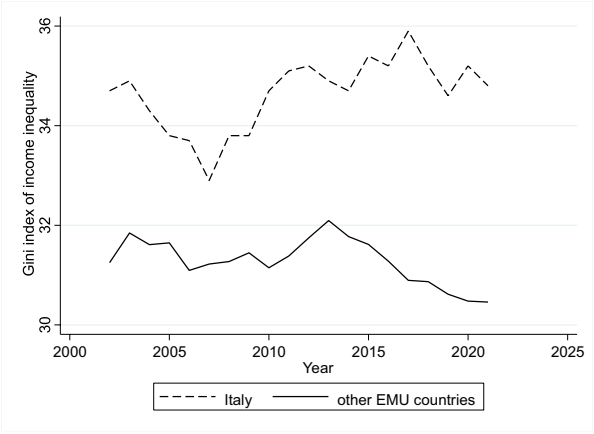

Fig. 2 Gini index of income inequality. Source: own elaboration (data from Eurostat)

The index of control of corruption released by World Bank (World Development Indicators dataset[11]) in Figure 1 shows that corruption increased with a steady trend up to 2012, with a peak in year 2014, and subsequently increased. This is shown in Figure 1 with a decrease of the index for Italy until 2014, and then an increase. This index is indeed constructed by the World Bank to capture corruption on a scale of −2.5 to +2.5, where the higher the index, the less the corruption level. This index averaged for the other EMU countries[12] is substantially steady across the whole period and systematically higher than in Italy, showing a structural lower level of corruption in Europe than in Italy

Income inequality, as represented by Gini index[13] shows an approximate steady level across all the study period, with a minimum level in year 2007 (see Fig. 2). The level of mean inequality in the other EMU countries shows an approximate steady level up to year 2013, and a decrease thereafter.

As anticipated in the previous section, in this paper our goal is to measure the effect of the Severino Law on these two indexes, namely, control of corruption and income inequality. The data used in the analysis (see Table 1) are:

- Control of corruption (estimate). The data source for this indicator is World Bank, World Development Indicators dataset (variable code CC.EST). This indicator ranges between − 2.5 and + 2.5, the lower the indicator, the higher the corruption level (Kaufmann, Kraay and Mastruzzi 2010).
- Gini Index of Income inequality (equivalized disposable income) extracted from Eurostat (variable code tessi190).

[11] The index considered in this paper is from World Bank, World development indicators and has code CC.EST.

[12] Austria, Belgium, Croatia, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovak Republic, Slovenia, Spain.

[13] The source of this index is World Bank, World Development Indicators (index code SI.POV.GINI).

Table 1 Summary statistics of the main explanatory variables for Italy and the other EMU countries. Period 2002–2022

Italy					
Variable	Mean	Median	Standard deviation	Maximum	Minimum
Gini index	32	32	1.375	33	29
Control of corruption	0	0	0.193	1	0
GDPpc	42,158	42,065	1863,155	45,357	38,947
Population	58,626,296.0	58,841,789.0	1,405,515,92	60,789,140	56,844,303
Unemployment rate	10.0	10.0	1935	13	6
Trade openess	53.0	54.0	7082	76	43
Financial index	80.023	81.453	9.575	93.571	61.820
Tax revenues as % of GDP	41	41	1.440	43	39
Other EMU countries					
Variable	Mean	Median	Standard deviation	Maximum	Minimum
Gini index	29.719	29.300	3.844	38.9	20.9
GDPpc	43,893.58	40,268.11	20,209.48	120,647.8	15,157.62
Population	1.77E + 07	5,454,147	2.46E + 07	8.41E + 07	395,969
Unemployment rate	8.651	7.55	4.439	27.47	2.55
Trade openess	131.234	117.483	74.201	388.120	45.418
Control of corruption	1.102	1.079	0.666	2.454	− 0.190
Financial index	91.868	90.990	12.159	113.891	70.921
Tax revenues as % of GDP	35.719	35.542	5.558	46.356	19.906

Source: own elaboration

- Tax revenues as % of GDP. From Eurostat, total receipts from taxes and social contribution after deduction of general government and UE institutions as a percentage of GDP (variable code gov 10a taxag).
- Gross Domestic Product per capita at constant US$, 2015 extracted from World Bank (variable code NY.GDP.PCAP.KD).
- Population are all residents regardless of legal status or citizenship from World Bank (variable code SP.POP.TOTL).
- Unemployment as a percentage of population in labor force extracted from Eurostat (variable code une rt a).
- Trade is extracted from the World Bank and is defined as the sum of exports and imports of goods and services measured as a share of gross domestic product (variable code NE.TRD.GNFS.ZS).
- Financial index defined as domestic credit to the private sector as a percentage of GDP extracted from World Bank as a proxy of financial development. (variable code FS.AST.PRVT.GD.ZS).

5 Statistical methodology and results

The evaluation of public policies, such as those implemented by the Italian government to combat the growing corruption at the dawn of the nineteenth century, has drawn on a variety of methodological approaches—including qualitative analyses, mixed-method strategies, and quantitative techniques. Within the latter, the concept of counterfactual analysis becomes essential. In order to correctly assess the impact of a public policy, it is necessary to estimate what would have happened in its absence and compare that hypothetical trajectory to the observed one (Imbens and Rubin 2015; Gertler et al. 2016). This framework relies on several quantitative tools, among which the two methods used in this study to evaluate the effects of the Severino Law are the most widely recognized in the literature.

The first approach involves the use of a difference-in-differences (DiD) estimator to identify average treatment effects by comparing pre- and post-policy differences between treated and control groups. The second method employs the synthetic control method (SCM), originally developed by Abadie and Gardeazabal (2003), and later refined in subsequent work (Abadie et al. 2010; Abadie 2021). As a third step, and in order to understand the mechanism linking corrupt behavior in the public sector to a country's level of inequality, this study applies the MARS (multivariate adaptive regression splines) estimation technique. This allows for the exploration of a potentially non-linear causal relationship between corruption control and inequality in the Italian context.

5.1 Difference-in-differences estimatations

The difference-in-differences (DiD) methodology is a robust econometric tool widely used to estimate causal effects in observational studies. By comparing changes in outcomes over time between a treatment group and a control group, this quasi-experimental approach controls for unobserved heterogeneity that could otherwise bias results, distinguishing it from other analytical techniques (Angrist and Pischke 2009). A fundamental assumption of DiD is the parallel trend assumption, which posits that, in the absence of treatment, the difference between the treatment and control groups would remain constant over time. This allows researchers to attribute any deviations in the post-treatment period to the intervention itself rather than to other confounding factors.

One key advantage of DiD over simple before-and-after comparisons is its ability to account for time-invariant unobserved characteristics. Traditional before-and-after studies risk misattributing observed changes to the treatment without considering underlying trends, whereas DiD effectively controls for these baseline differences, strengthening the reliability of causal inference. Additionally, compared to cross-sectional methods, which examine different groups at a single point in time and can be confounded by unmeasured group-specific factors, DiD mitigates bias by focusing on changes within the same groups over time.

This implicit control over unobserved heterogeneity enhances its credibility as an econometric approach (Bertrand et al. 2004).

DiD leverages natural experiments in which policy changes or interventions are exogenously applied to one group but not to another, making it particularly suitable for policy evaluation. In this study, the unique implementation of the Severino Law solely in Italy within the Eurozone provides an ideal setting for a quasi-experimental analysis. By comparing Italy's outcomes before and after the law's enactment with those of Eurozone countries that did not implement this law, we can assess its causal impact on corruption control and inequality using the DiD framework.

To establish a causal relationship between the implementation of the Severino Law and its effects on key variables before and after 2012, we utilized a two-way fixed effects DiD estimator, which allows us to account for both time and group-specific unobserved factors. The basic equation for our DiD model is as follows:

$$Y_{it} = \beta_0 + \beta_1 \cdot \text{Treatment}_{it} + \beta_2 \cdot \text{Post}_{it} + \beta_3(\text{Treatment}_{it} \cdot \text{Post}_{it}) + \epsilon_{it} \quad (1)$$

where Y_{it} is the outcome variable for the i-th unit at time t. In our case, we estimate two Model being the outcome variables control of corruption extracted from the World Bank and Gini Index derived from Eurostat over the period 2002–2022. β_0 is the intercept, representing the baseline outcome for the control group in the pre-treatment period (2002–2011). Treatment_{it} is a binary indicator variable that equals 1 if the unit is in the treatment group and 0 otherwise. In particular it is 1 just when i is Italy and 0 the rest of euro members which act as control group. As previously explained, a set of donor countries is required for comparison with Italy. These countries must resemble Italy in key aspects and must not have experienced the event under analysis. Given these criteria, the other Eurozone countries serve as the most suitable comparison group, as they share similar economic and institutional trajectories with Italy but did not implement legislation akin to the Severino Law. β_1 captures the average treatment effect on the treated, representing the difference in the outcome between the treatment and control groups in the pre-treatment period. $Post_{it}$ is a binary indicator variable that equals 1 if the observation is in the post-treatment period, 2012 and later, and 0 otherwise. β_2 represents the average time effect for the control group, capturing any general trend in the outcome over time for the control group. β_3 is the DiD estimator, representing the difference-in-differences, i.e., the differential change in the outcome between the treatment and control groups from the pre-treatment to the post-treatment period. ϵ_{it} is the error term, representing unobservable factors that may affect the outcome.

Table 2 DiD estimator for the effect of the Severino Law on corruption in Italy. Period: 2002–2022. Pretreatment period: 2002–2011. Control group: other EMU countries

DiD estimator			
	β_3	Standard error	P-value
Control of Corruption	1.104	0.059	0.000
$N = 399$			
$R^2 = 0.933$			
Parallel trend stat. $= -4.229$(p-value $= 0.000$)			

As shown in Table 2, the implementation of these measures improves corruption control in Italy by more than one point. Figure 1 illustrates a clear divergence between the trends in Italy and those in the control group. Italy followed a trajectory of increasing laxity in corruption control, a trend that intensified in the aftermath of the Global Financial Crisis (GFC). In the initial years following the enactment of the Severino Law, no significant improvement was observed. However, after 2014, corruption control began to strengthen, bringing Italy's position closer to that of other Eurozone members. The results of the DiD estimator indicate that, while the overall effect of the law was positive, its impact materialized with a delay. This suggests that the measures had a tangible effect, albeit with a few years of lag, which aligns with expectations. Furthermore, the Severino Law not only contributed to containing corruption but also constituted evidence of the reinforcement of social capital through the diffusion of an anti-corruption culture. Such an outcome can be interpreted as a positive externality of institutional reform, as it may foster greater trust in public institutions and civic norms. Nonetheless, a crucial question remains as to whether these improvements have translated into concrete gains in social welfare, particularly in mitigating inequalities and vulnerabilities.

The literature demonstrates that controlling dishonest behaviors yields positive effects on overall economic performance. This impact has been estimated both directly (Mauro 1995; Gründler and Potrafke 2019) and indirectly, through modifications to the structure of growth models or heterogeneity in their parameters (Durlauf et al. 2001; Beyaert et al. 2023a, 2023b). As Deaton (2013) argues, improvements in income levels should translate into reductions in inequality, which supports the expectation of a relationship between corruption and inequality. Furthermore, several scholars have both theoretically and empirically demonstrated this link.

As Uslaner (2015) explains, corruption produces de facto inequality by undermining fairness and institutional trust. In line with this, Tanzi (1998) notes that corrupt behavior systematically transfers resources from ordinary citizens to elites, effectively functioning as an additional tax. This reduces available funds for essential public spending, a dynamic also emphasized by Mauro (1998). The association between corruption and inequality is well-documented across diverse temporal and geographic contexts, reinforcing its relevance as a robust empirical regularity in the study of governance and development (Rose-Ackerman 1999; Gupta et al. 2002; Gyimah-Brempong and Gyimah-Brempong 2006; Uslaner 2008; Apergis et al. 2010).

Table 3 DiD estimator for the effect of the Severino Law on income inequality in Italy. Period: 2002–2022. Pre-treatment period: 2002–2011. Control group: other EMU countries

DiD estimator			
	β_3	Standard error	*P*-value
Gini Index	29.687	0.420	0.000
$N = 399$			
$R^2 = 0.873$			
Parallel trend stat. = 2.638 (p-value = 0.012)			

The results presented in Table 3 indicate an unfortunate positive impact on the Gini index, suggesting an increase in inequality. In conjunction with the findings on corruption control, this implies that while the law has had a positive impact, this effect has not yet translated into a reduction in inequality, thereby impeding a broader improvement in citizens' well-being and following a global trend as highlighted by Atkinson (2015). To further assess the robustness of these findings, we employ an alternative counterfactual methodology in the subsequent section to validate or challenge the reliability of these results.

5.2 Robustness check: Synthetic control method (SCM)

In the evaluation of public policies, counterfactual analysis plays a pivotal role. Various approaches are employed, each typically associated with its own set of robustness checks. To avoid the risk of conditioning the results on a single methodological framework, we adopt an alternative approach within the same analytical domain to identify a robust effect of the Severino Law. The second counterfactual technique employed in this study is the synthetic control method, developed by Abadie and Gardeazabal (2003) and improved by Abadie et al. (2011). The synthetic control method (SCM) aims to establish a valid counterfactual for comparing the actual progression of a specific outcome. Initially, the method selects a panel of untreated (not suffer the intervention) units (countries) called donor pool (euro countries) and determines the group of them that can most accurately replicate the pre-Severino Law scheme. Through a weighted combination of the characteristics of these selected countries, the SCM constructs an optimal representation of the counterfactual scenario. This counterfactual reflects the hypothetical trajectory of our variables had if the law had not been adopted. By comparing this counterfactual with the actual progression of the variables, the SCM provides an estimation of the impact of the fight against corruption in our selected variables.

Following the authors notation, consider a dataset comprising $(J+1)$ units observed over time denoted as $t=1, \ldots, T_0, T_{0+1}, \ldots, T$, where T_0+1 represents the event date under study. For our analysis, the units represent countries, with country 1 being the specific country affected by the event, while the remaining J countries serve as potential control (untreated) units, often referred to as the donor pool[14]. Let Y_{jt} be the different outcome variables of interest for $j=, 2, \ldots, J+1$ and $t=1, \ldots, T$. Let X_1 be the $(K \times 1)$ vector of pre-event values of K predictors for our variables in country 1 and let X_0 be the $(K \times J)$ matrix of the pre-event values of the same predictors for the countries of the donor pool, which are the other euro members.

The predictors utilized in this study are derived from Policardo and Sanchez-Carrera (2018) and Beyaert et al. (2023a, 2023b) and are described in the appendix. Specifically, they encompass institutional variables such as Voice and Accountability and Rule of Law, sourced from the World Governance Indicators (WGI) dataset provided by the World Bank. Additionally, economic variables include the unemployment rate, also obtained from the World Bank, as well as

[14] The donor countries comprise the remaining Eurozone members sharing a comparable economic and social structure to Italy but have not implemented the said policy.

indicators such as trade openness and GDP per capita at constant prices. The financial variable considered is the percentage of financial transactions relative to GDP per capita, sourced from Eurostat. Furthermore, a social variable, namely female labor force participation, is derived from the World Bank dataset. These predictors span from 2002 to 2022, with the Severino Law, enacted in 2012 (see Appendix I).

Let $W = (w_2, \ldots, w_{j+1})'$ be a $(J \times 1)$ vector of weights that add up to 1. These weights determine how control units are combined to form the synthetic control during the pre-event period, which serves as the basis for estimating the counterfactual corruption indicator for country 1 in the post-event period. Each value of W represents a distinct weighted average of the control countries, yielding various synthetic controls. Additionally, the matrix V signifies the relative importance of different predictors in constructing the synthetic control.

The optimal weights vector W^* is chosen to minimize the differences between X_1 and $X_0 W$:

$$W^* = \underset{W}{\operatorname{argmin}} \left(X_1 - X_0 W\right) V \left(X_1 - X_0 W\right)', \tag{2}$$

subject to $w_j \geq 0 \forall \mathrm{j} = 2, ..., \mathrm{J} + 1$ and $\sum_{j=2}^{J+1} w_j = 1$.

Hence W^* represents the weighted combination of other euro countries that most accurately resembles Italy in terms of corruption, tax pressure and inequality prior to Severino Law. However, W^* is influenced by V, the diagonal matrix indicating the relative importance of different predictors. The determination of V is also conducted through a data-driven process: it is chosen to minimize the disparity between the actual pre-event trajectory of our variables and their estimated synthetic variables. Let Y_1 denote the $(T_0 \times 1)$ vector containing the data on control of corruption, tax pressure and inequality of Italy before Severino Law. Similarly, let Y_0 be the matrix $(T_0 \times J)$ containing the data on these three variables of the donor pool countries before $T_0 + 1$. Then

$$V^* = \underset{V}{\operatorname{argmin}} \left(Y_1 - Y_0 W^*(V)\right) \left(Y_1 - Y_0 W^*(V)\right)' \tag{3}$$

Ultimately, we derive an optimal combination of W and V yielding the synthetic control estimator, $Y_0 W^*(V)$, for the pre-event period. This estimator closely approximates Y_1 by minimizing the root mean squared prediction error (RMSPE) of Y_1. A smaller RMSPE indicates a better fit, enhancing the reliability of the counterfactual for the post-Severino Law period.

The counterfactual is computed utilizing data from the control countries (donor pool), optimally chosen and weighted by W*—for the period following Severino Law. Let Y_1^N represent this counterfactual, constituting a $\left(T - T_0 \times 1\right)$ vector calculated as $Y_1^N = Y_0^N W^*(V^*)$ where Y_0^N denotes the $\left(T - T_0 \times J\right)$ matrix of donor pool outcome data for the post-event period. Similarly, let Y_1^I denote the observed outcome variable for country 1 during the same period, possessing the same dimensions Y_1^N. Then, the effect for country 1 (Italy), for every t from the date of Severino Law, is estimated by the difference between these two vectors:

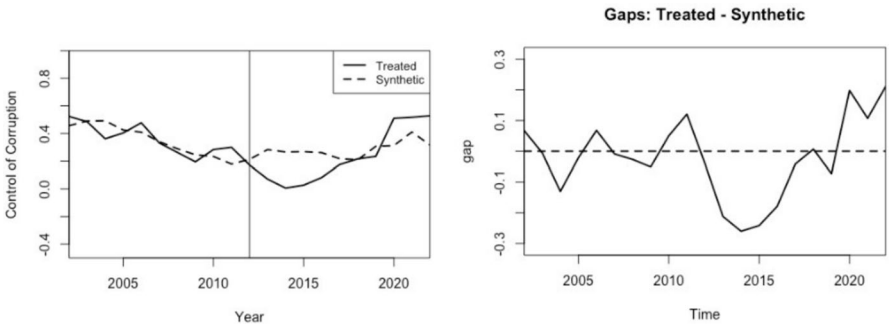

Fig. 3 Synthetic counterfactual for control of corruption, Italy, 200–2022. Source: own elaboration

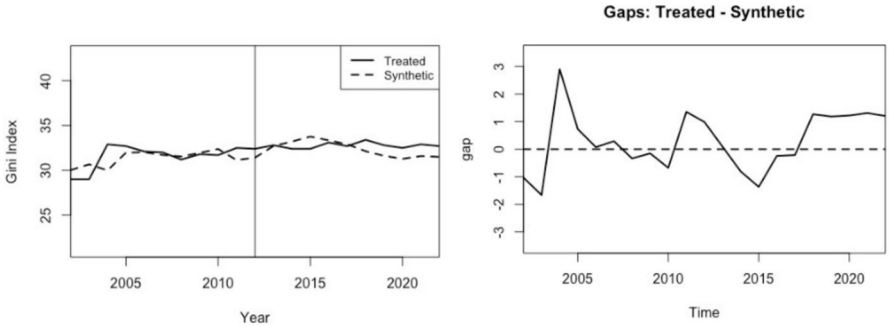

Fig. 4 Synthetic Counterfactual for Gini index, Italy, 2002–2022. Source: own elaboration

$$\beta_1 = Y_1^I - Y_1^N \tag{4}$$

for

$$t = T_0 + 1, \ldots, T$$

The synthetic control method (SCM) serves as a valuable tool for assessing the effects of policy interventions on various variables. The SCM, as highlighted by Abadie (2021), offers transparency, simplicity, and clarity in obtaining a counterfactual, thus avoiding extrapolations. Furthermore, it facilitates easy interpretation and evaluation. However, successful application of SCM necessitates meeting certain conditions. Firstly, the outcome variable should not exhibit excessive volatility to effectively detect its effects. Another challenge lies in identifying an appropriate donor pool and acquiring sufficient pre- and post-intervention data, which may constrain the application of this method and pose difficulties. Nevertheless, overcoming these challenges yields clear and reliable results. Given that our data satisfy these conditions, SCM proves to be a suitable approach for analyzing the impact of Severino Law in the fight against corruption and its possible impact on inequality in Italy.

The results of the counterfactual analysis presented in Figs. 3 and 4 confirm the findings obtained in Tables 2 and 3 (DiD estimation), indicating that there has been greater control of corruption following the implementation of the Severino Law. However, while this trajectory is More pronounced than what would have been expected in the absence of the law, the initial years showed no positive effect, and there was a delay in addressing dishonest behaviors. Thus, the DiD estimator confirms an overall positive increase, which is also detected in the synthetic control method, albeit with a delay. In the case of the Gini index, the SCM shows an inequality increase in the years following the enactment of the law in 2012. Therefore, the positive overall effect, as indicated by DiD, is again confirmed.

This raises the question of why, despite the literature showing that controlling corruption leads to improvements in inequality levels, this law has not achieved the same result. To address this, we perform a non-linear estimation that relates inequality to other determinants aligning with approaches used by Chong and Gradstein (2007) and Mauro (1995), including corruption control but for the Italian case, thus determining the country's idiosyncrasies and the relationship between these two variables.

5.3 MARS estimation

In this section, we adopt a semiparametric approach known as Multiadaptive Regression Splines (MARS) models. The key advantage of these models lies in their regularization mechanism for explanatory variables, which facilitates the selection of the most relevant ones and helps mitigate issues related to omitted variable bias. Additionally, MARS models inherently incorporate significance thresholds for variables, allowing for the identification of varying levels of impact and seamlessly integrating nonlinear relationships into the model. While one potential drawback is the risk of overfitting, this issue is addressed through the use of cross-validation techniques. We begin with a specification similar to the one in equation:

$$\begin{aligned} Gini_t = \alpha + \beta_1 GDPpc_t + \beta_2 \text{Population}_t + \beta_3 \text{Unemployment}_i + \beta_4 \text{Trade}_t \\ + \beta_5 \text{Financial}_t + \beta_6 Tax_t + \beta_7 CC_t + \epsilon_t \end{aligned} \tag{5}$$

where Gini_t is Gini index for country Italy at time t. GDPpc_t is the gross domestic product per capita at time t at constant US$, 2017. Population_t is the size of population. Unemployment_t is the unemployment rate of Italy at time t. Trade_t is the trade openness measured as a percentage of its GDP. Financial_t is a proxy for the financial development defined in section 4 from the World Bank. Tax_t and CC_t are tax income (% of GDP) and Control of Corruption, respectively (See Sect. 4 for greater details).

Instead of performing a traditional parametric estimation, we adopt a semiparametric approach that allows for the existence of thresholds. The procedure is as follows:

$$y_t = \beta_0 + \sum_{m=1}^{M} \gamma_m b_m(x_t) + u_t \tag{6}$$

where y_t is the independent variable at the time t (Gini Index in Italy). β_0 is the constant term, γ_m is the coefficient for the m-basis functions since $m = 1, \ldots .., M$. On the other hand, b_m is the m- basis function; while x_t are the explanatory variables introduced in the model (Eq. (5)). Finally, u_t is the error term.

Basis functions are adaptatively constructed using hinge functions to depict the relationship between explanatory variables and the dependent variable, accounting for the presence of thresholds that dictate the nonlinear relationship. The form of the basis function is as follows:

$$b_m(x_t) = h_m(x_t^k, \pi_{k,m}) \tag{7}$$

for any

$$k = 1, \ldots .., p$$

where $\pi_{k,m}$ is the threshold value for the variable x_t^k in the m-th basis function and $h(x_t^k, \pi_{k,m})$ is a hinge function that has the following form depending on whether the basis function affects the dependent variable above or below the threshold $\pi_{k,m}$:

1. When the basis function is above the threshold, the hinge function has the following form:

$$h_m(x_t^k, \pi_{k,m}) = \max(x_t^k - \pi_{k,m}, 0) \tag{8}$$

2. If, on the other hand, it is below the threshold, the hinge function takes the form:

$$h_m(x_t^k, \pi_{k,m}) = \max(\pi_{k,m} - x_t^k, 0) \tag{9}$$

The construction of the MARS model follows a forward iterative approach. Initially, it begins with a simple model featuring only the constant term, progressively augmenting it by incorporating a matrix of basis functions. These functions are added iteratively if they enhance the model's fit, achieved by minimizing the residual sum of squares (RSS). This iterative process continues until a predefined complexity threshold is reached. The selection of basis functions for inclusion in the model entails an exhaustive search, examining the existing set of basis functions along with all other explanatory variables, and identifying potential threshold positions. This meticulous procedure often leads to a model that excessively fits the data; a phenomenon known as overfitting. To counteract overfitting, a backward deletion process is employed to prune the model. Variables are systematically removed in reverse order, one by one, targeting those that contribute the least to the model's error increase. In essence, the model initially starts with simplicity and gradually grows in complexity until overfitting occurs. Subsequently, the pruning process, augmented by cross-validation techniques in our case, ensures the mitigation of overfitting without unduly escalating the error term. It is important to note before interpreting the findings that the MARS model identifies knots (thresholds) for each explanatory variable, indicating points where the relationship with the dependent variable can chang slope. Some knots may fall outside the observed data range; in

Table 4 MARS Model estimation. Dependent variable Gini index. Period: 2002–2022

Variable	Coefficient	Threshold
α_t	54.045	-
GDP_{pc_t}	0.0001	Under 36.2934
GDP_{pc_t}	− 0.0004	Above 36.2934
$Population_t$	− 0.00001	Under 1.04mill
$Population_t$	− 0.0005	Between 1.04 and 1.38mill
$Population_t$	0.00006	Between 1.38 and 5.37mill
$Population_t$	− 0.00004	Above 5.37 mill
$Trade_t$	− 0.053	Under 79.87%
$Trade_t$	0.066	Between 79.87% and 236.57%
$Trade_t$	− 0.010	Above 236.57%
CC_t	− 0.759	Under 1.584
CC_t	1.614	Above 1.584
$Financial_t$	− 0.007	Under 40.31%
$Financial_t$	− 0.158	Above 40.31%
Tax_t	− 0.969	Under 29.81%
Tax_t	− 0.345	Between 29.81% and 37.55%
Tax_t	1.064	Above 37.55%
$GR_{sq} = 0.708$		
$R_{sq} = 0.743$		
$Mean.oofR_{sq} = 0.688(sd = 0.057)$		

Source: own elaboration

these cases the corresponding hinge functions do not influence predictions within the dataset but allow the model to capture potential nonlinear patterns if extrapolated beyond the observed data. The resulted obtained from this estimation are presented in Table 4.

The results obtained from the multivariate adaptive regression splines (MARS) model provide significant insights into the nonlinear relationships between corruption control, economic variables, and inequality in Italy. The model estimates, based on hinge functions, indicate the presence of threshold effects, which suggest that the impact of certain economic determinants on inequality is not constant but varies depending on specific breakpoints. The goodness-of-fit measures, including a generalized R-squared (GRSq) of 0.7086, an R-squared (RSq) of 0.7427, and an out-of-sample mean R-squared (mean.oof.RSq) of 0.6884 with a standard deviation of 0.0574, suggest a strong explanatory power of the model while ensuring robustness across different subsamples.

The findings offer crucial insights into the relationship between corruption control, economic variables, and inequality in Italy. In particular, they shed light on why the reduction in corruption levels observed after the implementation of the Severino Law did not translate into lower inequality. The previous analysis confirmed that the Severino Law had a positive impact on corruption control, albeit with a delay, although the decline in corruption levels only became evident after 2014. However, despite this improvement, overall inequality in Italy has continued to rise, suggesting

that the link between corruption control and inequality is more complex and mediated by other economic and institutional factors.

The nonlinear effects identified in the MARS model provide a possible explanation for this apparent disconnect. The results indicate that while corruption control has a negative relationship with inequality below a certain threshold (1.584 on the corruption control index), its effect reverses beyond that point. This suggests that while initial efforts to curb corruption can significantly reduce inequality, additional improvements in corruption control may not automatically lead to further reductions in inequality. Instead, other structural factors—such as economic growth, financial development, and taxation policies—may play a more decisive role in shaping inequality dynamics.

Moreover, the trajectory of inequality in Italy appears to be strongly influenced by economic conditions that were deteriorating in the years following the GFC. Table 3 indicates that GDP per capita only has a significant inequality-reducing effect beyond a threshold of approximately €36.293. Given that Italy experienced stagnant economic growth during the 2010s, it is likely that GDP per capita remained below this level for a prolonged period, preventing economic expansion from contributing to inequality reduction.

Population dynamics also exhibit nonlinear effects, with negative impacts observed at lower and very high levels, but a positive inflection point around 5.37 million inhabitants. This result suggests that medium-sized population centers in Italy may have more balanced economic structures, whereas extremely small or large population sizes could exacerbate inequality due to either lack of economic diversification or excessive urban concentration (Kuznets 1967; Glaeser et al. 2009; Bucci et al. 2021).

Trade openness follows a similar pattern, with negative effects observed at lower levels and a reversal to positive effects once trade openness surpasses 236.57. This finding aligns with previous studies suggesting that trade liberalization, when not accompanied by sufficient institutional capacity, may initially increase inequality (Aisbett 2007), but beyond a certain threshold, the benefits of international trade contribute to economic stability and inclusivity.

Financial development consistently shows a negative association with inequality, and slightly weaker beyond this level. This finding supports the argument that financial inclusion policies are essential in reducing inequality, as access to credit and financial services enables broader participation in economic activities (Beck and De La Torre 2007). Taxation, on the other hand, presents a more complex dynamic (Slemrod 1992; Piketty and Cantante 2018), with a negative effect below 29.81, a stronger negative impact between 29.81 and 37.55, and a reversal to a positive effect beyond 37.55. This suggests that moderate levels of taxation may contribute to reducing inequality through redistribution mechanisms, but excessively high tax burdens may have adverse effects, possibly by discouraging investment or promoting tax avoidance (Dianov et al. 2022).

From a policy perspective, these findings highlight the necessity of complementing anti-corruption measures with targeted economic policies aimed at reducing inequality through growth-enhancing and redistributive mechanisms. While the Severino Law successfully strengthened corruption control, its effects on inequality were likely muted due to the broader economic environment and the absence of parallel policies addressing the structural drivers of inequality. Efforts to promote financial inclusion, foster sustainable economic growth, and design an effective tax system will be essential to ensuring that gains in corruption control translate into tangible reductions in inequality.

Ultimately, these results emphasize the importance of adopting a multidimensional approach when assessing the effectiveness of institutional reforms. While corruption control is undoubtedly a critical component of good governance and economic stability, its ability to reduce inequality depends on a broader set of economic conditions that must be taken into account when designing policy interventions.

6 Conclusions

The findings of this study provide crucial insights into the broader dynamics of corruption control and economic outcomes in Italy, reinforcing existing literature on the nonlinear and heterogeneous effects of anti-corruption reforms. Our results contribute to the ongoing debate on the effectiveness of institutional reforms in countries with entrenched corruption, aligning with research that underscores the complex interactions between corruption, economic performance, and inequality (Mauro 1995; Rose-Ackerman 1999; Rose-Ackerman and Palifka 2016).

The implementation of the Severino Law, in 2012, has demonstrably improved Italy's ability to control corruption, as evidenced by the reduction in corruption levels observed in our analysis. This supports previous studies highlighting the role of legislative frameworks in addressing systemic corruption (Porta and Vannucci 1999; Golden and Chang 2001). However, our results also indicate that these effects were not immediate, as corruption levels only began to decline after 2014, confirming that institutional reforms often exhibit delayed impacts. Despite this improvement in corruption control, we find no evidence that this translated into a reduction in inequality. On the contrary, inequality has continued to rise, suggesting that the mechanisms linking corruption control to broader socio-economic benefits have not been fully activated. The results from the MARS model further highlight the threshold-dependent nature of these relationships, indicating that while corruption control can reduce inequality under certain conditions, other structural economic and institutional factors play a more decisive role in shaping income distribution (Policardo and Sanchez-Carrera 2018; Saha et al. 2021).

These findings carry important policy implications. While the Severino Law has been successful in curbing corruption, its limited impact on inequality points out

the need for complementary reforms. Strengthening Italy's institutional framework should go beyond corruption control and focus on fostering inclusive economic growth, improving financial development, and designing redistributive policies capable of translating governance improvements into tangible societal benefits. The persistence of inequality despite enhanced corruption control suggests that broader structural reforms—particularly those addressing taxation, labor market conditions, and social policies—are necessary to ensure that anti-corruption efforts yield more equitable economic outcomes (Keneck-Massil et al. 2021; Markussen et al. 2021; Ambassa 2024).

In conclusion, while the Severino Law represents a significant milestone in Italy's fight against corruption, its inability to reduce inequality highlights the limitations of anti-corruption measures when implemented in isolation. As Italy continues to enhance its institutional quality, policymakers should adopt a more comprehensive strategy that integrates corruption control with economic and social policies aimed at reducing inequality. Future reforms should be designed with a multidimensional perspective, drawing on lessons from other Eurozone countries to create policies that not only strengthen governance but also promote inclusive economic development. These insights can contribute to Italy's broader integration within the European framework, ensuring that institutional improvements translate into sustainable and equitable growth.

Our effort to measure the effect of the Severino law on corruption and inequality in Italy finds contrasting evidence with respect to what scholars, for the majority, claim. One of our results is that despite a decrease in corruption, we do not observe robust effects on inequality. This suggest that in Italy, different factors may affect inequality and certainly corruption is not one of the most relevant. In this vein, a deeper investigation on the causes of inequality in Italy would be a good question for future research projects. Another limitation of the study that should be addressed in future research is the quantitative analysis of stakeholders, which will provide clarity on the causes behind the results, confirming the improvement in social capital in the form of a stronger anti-corruption culture and analyzing with vulnerable sectors the keys to transferring this improvement to society through reductions in inequality, which are predicted in the literature but have not been observed in practice in Italy. Overall, we obtain robust and novel results that allow us to know that Italy has made progress in the fight against corruption but still needs to make greater efforts to transfer the benefits of that fight to the Italian economy and society as a whole.

Appendix I

Data and results for SCM method.

See Table 5

See Table 6

Table 5 Predictors weights for all synthetic variables (SCM method). Period: 2002–2022

	Control of corruption	Gini index
Control of corruption	-	0.070
Tax income (%GPD)	0.001	0.000
Gini index	0.002	-
Voice and accountability	0.006	0.160
Rule of law	0.617	0.114
Female labor force	0.022	0.001
Capital inflows	0.011	0.000
Trade	0.015	0.001
GDPpc	0.114	0.040
Unemployment rate	0.194	0.613

Table 6 Weights of the different control units (donor pool) for all variables. Period: 2002–2022

	Control of corruption	Gini index
Austria	0.000	0.000
Belgium	0.000	0.000
Cyprus	0.157	0.150
Germany	0.000	0.000
Estonia	0.000	0.000
Spain	0.000	0.000
Finland	0.000	0.000
France	0.000	0.000
Greece	0.535	0.353
Latvia	0.000	0.000
Luxembourg	0.000	0.058
Lithuania	0.308	0.317
Malta	0.000	0.000
Netherlands	0.000	0.000
Portugal	0.000	0.000
Slovak Republic	0.000	0.000
Slovenia	0.000	0.122

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Data availability All data used in this study are publicly available and can be accessed through the respective databases referenced in the text. The datasets analyzed are available from World Bank and Eurostat and have been described in detail within the manuscript. Researchers interested in replicating the analysis or utilizing the data can consult the sources listed in the references section. No proprietary or private datasets were used in this study.

Link are listed below:

- https://data.worldbank.org/
- https://ec.europa.eu/eurostat/data/database
- Unemployment.https://ec.europa.eu/eurostat/databrowser/view/une_rt_a/default/table?lang=en&category=labour.employ.lfsi.une
- Gini index. https://doi.org/10.2908/ILC_DI12
- Financial index.
- GDPpc. https://data.worldbank.org/indicator/NY.GDP.PCAP.KD
- Tax revenue: https://doi.org/10.2908/TEC00021
- Trade. https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS
- Population. https://data.worldbank.org/indicator/SP.POP.TOTL
- Control of corruption. https://www.worldbank.org/en/publication/worldwide-governance-indicators

Declarations

Competing interests The authors declare no competing interests.

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