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The Hidden Effects of Inflation

An Examination of Bracket Creep and Its Implications for the Income Tax: Evidence for Spain (1979-1987)

by

Xabier Moriana-Armendariz
xa1377mo-s@student.lu.se

This paper examines the impact of inflation on the income tax in Spain from 1979 to 1987. By introducing a new approach using dynamic microsimulation and the Elasticity of Taxable Income (ETI), we analyze three dimensions of the tax: revenue, progressivity, and redistribution. The microsimulation reveals that the lack of adjustment of the income tax to inflation: 1) accounts for 44% of the increase in revenue 2) shows negligible changes in the progressivity, due to two compensating effects (credits and schedule) that mainly affect the extremes of the income distribution and 3) explains 70% of the increase in redistribution. We estimate an ETI equal to 0.2, predicting small changes in taxpayer behavior in the face of changes in tax rates. This ETI is significantly lower than that found for more recent periods in Spain. Extending the microsimulation with the ETI minimally changes the results.

Keywords: Inflation, Taxation, Microsimulation, ETI

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Examiner: Olof Ejermo (olof.ejermo@ekh.lu.se)
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Introduction

Since the early 1990s, inflation has been close to zero in the vast majority of developed countries (Bouri et al., 2023). However, this evolution was sharply interrupted in 2021, from which inflation has reached levels not seen in the last 40 years. Although inflation has eased in recent months, the scope of this crisis has been such that the main international organizations have pointed to inflation as the protagonist of both the present and the near future (OECD, 2023; UN, 2023; IMF, 2023). On the other hand, these high rates are something recurrent in the developing world, with deep inflationary crises in the last decades (Pomfret, 2006; Barnichon and Peiris, 2008; Capistrán and Ramos-Francia, 2009).

Together with the explosion of inflation, a concept from the 1980s has regained prominence in the economic debate: the bracket creep effect (Nowotny, 1980). Bracket creep is defined as the effect that inflation has on income taxes through the erosion of the real value of all its items, from deductions, credits and brackets (Aaron, 1976, p. 193). If these items are not adjusted for inflation, higher nominal income from a general price increase causes taxpayers to have a higher tax burden even though their income remains constant in real terms. In adddition, and due to the structure of personal income taxes, this effect is likely to be heterogeneous, depending on the characteristics and income level of taxpayers. Thus, together with an expected increase in revenue, the literature on bracket creep analyzes the possible effect on the progressivity and redistribution of the tax. Although most of this literature comes from the 1980s, bracket creep has gained relevance nowadays (Rietzler, 2022; Tilley, 2023; Carling, 2023). In parallel, the current inflationary crisis has brought with it another debate: how to adjust the income tax to changes in inflation as some countries already do today (Beer et al., 2023).

Despite its current relevance, in this paper we propose to measure bracket creep from a historical perspective. First, because the current phenomenon is too recent to know the severity of the inflationary crisis. Second, because inflation is a cumulative phenomenon: although it is not clearly observable from one year to the next, this effect is magnified when it accumulates over several consecutive periods. In this vein, this paper focuses on the late 1970s early 1980s, the previous period of high inflation stemming from the 1973 and 1979 oil shocks (Bini et al., 2016).

In this paper, we focus on Spain. Spain in the 1980s provides a perfect context for analyzing bracket creep. First, it suffered inflation rates above 10% until 1987, coming from rates of around 25% in 1977 (Quintana, 2005). Second, in the face of this galloping price evolution, the new Personal Income Tax, introduced in 1979, was hardly adjusted during the whole period (Ferrari Herrero and Revilla Pedraza, 1988). Third, bracket creep and its possible solutions were a heated topic of debate both in Spanish politics (Congreso de los Diputados, 1977, 1978, 1984) and academia at the time (Gonzalez-Páramo and Argimón Maza, 1987; Valdés Sánchez, 1989).

This paper proposes a new approach to measure bracket creep. Previous literature consists of static analysis based on the indexation of incomes of a base period according to inflation (Immervoll, 2005). In contrast, we analyze bracket creep through the lens of tax reform, simulating a tax reform in which income tax is adjusted to inflation as a counterfactual scenario to measure bracket creep. Thus, the main question of this paper turns out to be: what were the consequences of not adjusting personal income tax to inflation during the period 1979-1987 in Spain? Due to data limitations, the first exercise of the paper involves the generation of full synthetic distributions for the first three years after the creation of the tax in Spain, 1979-1981, following the Generalized Pareto Curves method (Blanchet et al., 2022). Once the subsample for the period 1979-1981 has been obtained, we propose a microsimulation exercise in which we measure bracket creep by comparing the actual evolution against different scenarios of tax adjustments. Following the literature, we analyze three dimensions: tax revenue, progressivity, and redistribution, relying on the usual indexes from Public Economics (Kakwani, 1977; Reynolds and Smolensky, 2013). This microsimulation is dynamic: it follows the evolution of taxpayers' income during the period 1979-1987. Because of this, we expect that taxpayers might have behaved differently under different tax rates resulting from these hypothetical reforms. To capture this, we extend the simulation by incorporating an estimate of the Elasticity of Taxable Income, which captures the change in taxpayer behavior in the face of changes in the tax rate. For this estimation, we follow the two main approaches in the literature: the tax reform (Weber, 2014) and the Bunching Method (Bertanha et al., 2021). The latter exercise will allow us to measure the robustness of the baseline simulation to possible changes in taxpayer behavior.

Section 2 further explains the bracket creep and the Spanish context of the 1980s. Section 3 summarizes the data generation process. Section 4 illustrates the methodology proposed to measure the bracket creep. Section 5 shows the main results and discusses previous literature. Section 6 provides the main final considerations.

2

Literature Review: the Bracket Creep

2.1 Definition

The purpose of this paper is to analyze the bracket creep effect for the Spanish economy during the inflationary decade of the 1980s. In the literature, the bracket creep effect is defined as the effect that inflation has on revenue, progressivity, and redistribution of income taxes. In periods of high inflation, if the income tax is not continuously adjusted to the price level, taxpayers' nominal incomes will increase and their tax liabilities will be modified depending on how the value of different items of the tax function is eroded.

The vast majority of the literature on the effects of inflation on income taxation comes from the 1970s and early 1980s (Goetz and Weber, 1971; Vukelich, 1972; Allen and Savage, 1974; Bös, 1974; Jarvis and Smith, 1977; Majocchi, 1976; Hahn, 1978). At that time, the "persistent presence of inflationary problems in most industrialized countries (had) led to an interest in the relationships between inflation and the tax system" (Nowotny, 1980, p. 1025). Due to the price stabilization period starting in the 1980s, inflation decreased markedly to rates close to 0% in the Western world. This has shifted the inflationary problem to a second-order issue of importance in the Western political and academic spheres. This, however, requires two comments. First, we are currently (2023) experiencing the biggest rise in inflation since the 1980s, reaching values close to 10% in most developed economies. Second, the downward trend in inflation was not globally homogenous, as some regions in the world have been struggling with this issue having inflation rates not smaller than 10% since the 1990s (Pomfret, 2006; Barnichon and Peiris, 2008; Capistrán and Ramos-Francia, 2009).

Within this literature, a seminal paper by Henry Aaron defines clearly the concept of bracket creep (Aaron, 1976, p. 193).[1] If the income tax is not adjusted, inflation will

[1]In addition, there are up to two other effects notified in the literature. First, an income tax base assessed in nominal terms ignores changes in potential consumption that are due to changes in the

affect the tax function. The presence of inflation erodes the real value of every item of the tax function fixed in nominal terms, from deductions to credits and brackets (Aaron, 1976, p. 193). If the items are not adjusted to inflation, taxpayers will face a higher tax burden even if their income has not increased in real terms. The consequences of the erosion of the tax function have three distinct dimensions: tax revenue, tax progressivity and tax redistribution.

First, failure to adjust the tax for inflation will change the revenue potentially collected (Nowotny, 1980, p. 1028). This effect is of first-order importance if one takes into account that most income tax designs are progressive.[2] A progressive tax system is one in which tax burdens grow more than proportionally with income. If this is the case, in a period of inflation in which the tax is not adjusted, taxpayers' nominal incomes will move to a part of the scheme where tax burdens are higher. In this way, the real tax revenue will grow due to the dragging of taxpayers to higher tax brackets.

Second, we expect an effect on the progressivity of the tax. Progressivity here is defined as the change of the tax rate according to the taxpayer's income. The more the tax rate increases with income, the more progressive the tax will be. The income tax has several features (brackets, caps on the top rate, fixed credits) that rule out the possibility of a homogeneous effect across the income distribution (Immervoll, 2005, p. 41, Nowotny, 1980, p. 1028). At the bottom of the distribution, taxpayers are mainly affected by the erosion of personal exemptions, deductions and tax credits that are fixed in nominal terms. If these items are not adjusted in a context of inflation, their real value will be reduced, losing their potential to reduce the tax burden. These items are more relevant the lower the income of taxpayers, as the former will reduce their (lower) tax liability relatively more.[3] Second, in the middle-income part of the distribution, taxpayers will be affected by the structure of the tax brackets. Due to the jump to a higher bracket, their (same) real income will be taxed in a more progressive region of the tax function with higher marginal tax rates. Due to the progressive nature of the tax, this effect is expected to be larger the higher the taxable income of individuals. Finally, at the top of the distribution, the income tax becomes proportional. In most countries, tax laws set a ceiling on the marginal rate. Increasing the marginal rate beyond this

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purchasing power of money. According to the widely used Haig-Sminons (H-S) concept, income earned in a certain period is equal to the change in the power to consume. Ignoring gains and losses as a result of changes in the value of money thus leads to unequal tax burdens for equal amounts of (H-S) income, depending on how and when they are earned (Aaron, 1976; Immervoll, 2005, p. 40). Second, inflation affects the measurement of tax liabilities. Due to inflation, there is a potential problem with collection lags. Inflation implies a gap between the value of tax liabilities from the time the obligation to pay the tax is incurred and the time it is actually paid (Gonzalez-Páramo and Argimón Maza, 1987, p. 345, Immervoll, 2005, p. 40).

[2] If, on the contrary, the system is regressive, the effect will be the opposite, leading to lower tax revenue. And, if it is proportional, the effect will be negligible.

[3] In the limit, the erosion of these items will lead individuals to become taxpayers for the first time without a real increase in their income. This inflationary effect has recently been highlighted for the interwar period in the transition from "class tax" to "mass tax" (Torregrosa-Hetland and Sabaté, 2022; Steinmo, 2003).

value is considered a confiscatory policy, in which "too much" of the last unit of income earned is taxed. Thus, the inflationary impact on the upper end of the distribution is expected to be small. This is because more of their income will be taxed in the proportional region. These three channels point to different parts of the distribution as being more (or less) affected. Thus, the effect of inflation on income tax progressivity will depend on which effect dominates. The effect on tax credits and on the statutory limit decreases progressivity (affecting mainly the lower tail and not affecting the upper tail) while the effect on tax brackets increases progressivity (more impact the higher the individual's income up to a limit). The final direction will depend on the tax system (tax schedule, limits, credits) and the shape of the income distribution.

Third, the redistributive capacity of the tax will be affected by the inflationary effect. Redistribution is here understood as the reduction of income inequality resulting from the application of the tax. The effect of the lack of adjustment of the tax on redistribution is the result of changes in progressivity and revenue (Torregrosa-Hetland and Sabaté, 2022, p. 318). On the one hand, if progressivity does not vary, by increasing the tax revenue that is by nature progressive, its redistributive capacity will increase. However, redistribution depends in turn on how progressivity is affected by this inflationary effect. If progressivity increases (as the effect of tax brackets dominates the effects of tax credits and limits), there will be an unambiguous increase in redistribution. Conversely, if progressivity decreases (tax credits and tax cap effects dominate the effect of tax brackets) there will be two forces pushing redistribution in different directions. The total effect will depend on which effect dominates the other.

2.2 Evidence and Measurement

The vast majority of the literature on the bracket creeps comes from the 1970s and 1980s, as a consequence of the inflationary crisis from the two oil shocks. This literature drew similar conclusions for a long list of countries. First, inflation caused a significant increase in the tax rate for most taxpayers (and thus in tax revenue) (Goetz and Weber, 1971). Secondly, this effect was not homogeneous but clearly regressive: it was the lower incomes that were most affected by this lack of tax adjustment. These results were found for Canada (Vukelich, 1972; Jarvis and Smith, 1977), USA (Sunley and Pechman, 1976), Italy (Majocchi, 1976) among others.[4]

In the early 2000s, the "bracket creep" is once again the subject of debate, mainly analyzed from a historical perspective (for the US, Auerbach and Feenberg (2000)). The particularly detrimental effect of bracket creep on lower incomes, reducing progressivity, is again highlighted (for Australia, Smith (2001)). However, some papers point

[4]This literature, however, suffered from a very simplified methodology and a very limited database that did not allow for a detailed analysis of bracket creep. After this first wave, bracket creep disappeared completely from research during the period of price stability in the 1990s.

to an increase in redistribution explained by the fact that the increase in revenue more than compensates for the fall in progressivity (for Germany, Steiner and Haan (2004)). In 2005, Herwig Immervoll revisits this issue, laying the methodological groundwork for a second wave of research on bracket creep. In his seminal paper, Immervoll analyzes the bracket creep for the UK, the Netherlands, and Germany during the period 1998-2003 (Immervoll, 2005). In a first simulation exercise, Immervoll finds similar effects for all three countries. First, inflation increases revenue-raising capacity. Second, inflation significantly decreases the progressivity of the tax. Third, inflation increases redistribution because the increase in revenue more than offsets the fall in progressivity (Immervoll, 2005, p. 55). In a second step, it analyzes in more detail the case of the United Kingdom and the Netherlands, countries where the tax was adjusted to the evolution of inflation. In the period 1998-2003, the inflation-adjustment tools of the tax completely controlled for the bracket creep (Immervoll, 2005, p. 59-60).

Following Immervoll (2005), a long list of subsequent papers show similar results for different countries and periods. For instance, Fernández et al. (2006) studies the period 1999-2003 for Spain, finding the same directions for revenue (+), progressivity (-), and redistribution (+) (Fernández et al., 2006, p. 24). However, in a second step, Fernández et al. (2006) control for the 2003 reform, showing how this effect practically disappears (in other words, that the reform addressed the bracket creep). Similar results are found for Brazil in Levy et al. (2010), although the tax revenue is so limited in this country that the increase in redistribution hardly implies a change in post-tax inequality. Recently, Torregrosa-Hetland and Sabaté (2022) analyze the bracket creep for Sweden, UK, and US during the first half of the 20th century, showing the same directions for the three dimentions. Other papers confirm these results (Zhu et al., 2014; Dorn et al., 2017). In summary, for a variety of countries and periods, bracket creep: 1) increases revenue, 2) decreases progressivity, and 3) increases the redistributive capacity of the income tax.

The article by Immervoll (2005) not only recovered the concept of bracket creep, but also laid the methodological foundations followed by the rest of the aforementioned articles. This literature proposes to measure the bracket creep starting from one year's income as a reference. This income is indexed for subsequent periods (or previous periods in the case of Torregrosa-Hetland and Sabaté 2022) according to the evolution of inflation. This indexation assumes that income is perfectly adjusted to inflation (Immervoll, 2005; Levy et al., 2010). Thus, the severity of the bracket creep depends entirely on one factor: the degree to which nominal incomes change in response to inflation. If nominal incomes remain unchanged, the effect of the bracket creep will be negligible.[5] This assumption allows discriminating the part of income growth due to

[5] For Spain, earnings were essentially set by collective bargaining (Bover et al., 2002, p. 5). These negotiations were highly centralized. There were nationwide collective agreements setting wage growth rate bands (Serrano, 1992; Toharia and Jimeno, 1993). These bands were close to the inflation rates in some years, but the adjustment was far from perfect (Bover et al., 2002, p. 5, Dolado and Felgueroso, 1997). Altogether, collective bargaining did not achieve a full compensation of earnings for inflation

inflation from the part due to real income increase. In this way, it is possible to measure changes in income tax explained only by inflation. Changes in tax burdens are computed as the difference between the "before" and "after" inflation scenarios (Immervoll, 2005, p. 44). Holding "everything else" constant, this approach avoids identification problems that might come when using panel data that tracks taxpayers' income. Nevertheless, the approach's main strength is at the same time its main limitation, as it does not allow the effect of the bracket creep to be analyzed dynamically over time.

This paper proposes an alternative way of dealing with the bracket creep problem. Instead of assuming that nominal wages adjust perfectly to inflation, it posits a scenario in which it is the income tax that adjusts perfectly to inflation.[6] We then measure bracket creep through a comparison between adjusted and non-adjusted scenarios. At the end of the day, both are looking at the same problem: the effect that inflation (or the lack of adjustment to it) had on the income tax. However, the methodology that these two approaches propose is completely different. The previous literature is based on the establishment of a counterfactual in which there was no inflation throughout the period analyzed. In this way, individuals' incomes are compared from t_0 to t_n assuming that all incomes grow equal to the inflation rate. In doing so, changes in the evolution of income from t_o to t_n are completely ignored. In contrast, in this paper, the counterfactual is a scenario in which the tax authorities decide to automatically adjust the income tax in response to changes in the evolution of prices. Thus, the actual evolution is compared with the counterfactual in which the income tax is automatically changed in response to inflation. In doing so, this paper proposes for the first time in the literature a dynamic way of looking at the bracket creep problem. This perspective shifts the measurement of the bracket creep effect from macroeconomics to the tax reform analysis (Auerbach and Slemrod, 1997). Thus, the question here becomes: what would have happened if the income tax had been automatically adjusted for inflation?

To answer this question, this paper will analyze the case of Spain during the period 1979-1987. Spain in the 1980s provides the perfect context to measure bracket creep. This was a period in which annual inflation exceeded 10% at the same time that the newly created income tax was not adjusted to changes in the former. This lack of adjustment gave rise to a heated political debate that lasted throughout the 1980s. This historical framework will be explained in more detail in the next section. This paper is not the first one showing the bracket creep for this period for Spain (Gonzalez-Páramo and Argimón Maza, 1987; Valdés Sánchez, 1989; Jimenez and Salas del Mármol, 1992). However, it sheds light on many issues that were overlooked in these papers or that simply could not be demonstrated with the methodology and data of the time.

(Serrano, 1992, p. 54). As a result, there was a moderate decrease in earnings in real terms during the 80s (-0.19% according to Bover et al. (2002). Still, other sources of income such as capital and self-employed incomes were not subject to these collective agreements.

[6]This idea is derived from a similar proposal by Rice (1989). Unfortunately, this perspective was not subsequently followed up in the bracket creep literature.

3

Historical Context

The decade of the seventies marked a turning point for Spain, politically, socially and economically. The dictator Francisco Franco died on November 20, 1975. Two years after his death, the democratic period in Spain began with the first elections on June 15, 1977. During this period and until the approval of the Constitution on December 6, 1978, the Provisional Government proposed deep reforms that were to change Spain's political and economic system. In a spirit of consensus, the Provisional Government and the opposition discussed how Spain should move towards democracy, in the so-called *Pactos de Moncloa*. Among the topics of discussion, an evident asymmetry was identified between the development of the economy and the prevailing tax system, which had hardly undergone profound changes since the beginning of the dictatorship (Comín and Linares, 2013). The president, Adolfo Suárez, commissioned the economist Fuentes Quintana (appointed vice-president) to give final shape to a profound tax reform project that had been underway for several years (Comin, 2007; Torregrosa-Hetland, 2021) which included the creation of a new personal income tax: *Impuesto sobre la Renta de las Personas Físicas* (IRPF).

3.1 Spain in the 1970s

These proposals were discussed throughout the end of the decade of the 1970s. During these debates, the problems of the Spanish economy were discussed at length by the government and the opposition. Since the mid-1970s, Spain had a threefold problem: growing unemployment, an unbalanced balance of payments, and, above all, rampant inflation, which peaked in 1977 (25%) and remained at around 10% until almost 1990 (Quintana, 1984, 2005).[1]

Inflation was understood as the result of a concatenation of both external and in-

[1]While the opposition to the Government considered equally inflation and recession as the two fundamental and urgent problems (Lopez Rodó (Alianza Popular), Congreso de los Diputados (1977, p. 538)), the Government stated flatly that "the biggest problem we are facing is undoubtedly inflation" (Gamir Casares (UCD), Congreso de los Diputados (1977, p. 556)).

ternal forces (Gamir Casares (UCD), Congreso de los Diputados (1977, p. 556)). First, production costs had skyrocketed due to the growth of oil prices resulting from the 1973 (and later 1979) crises. This international shock affected the vast majority of countries. As can be seen in Figure 3.1, inflation soared from 1973 onwards in the developed world.[2] Although the evolution is similar, we can observe that during the period 1978-1988, inflation in Spain significantly exceeded the European average and that of leading powers such as the USA and Japan. Focusing on Europe, the inflationary phenomenon was somewhat generalized throughout the continent (table 3.1). However, in Spain (together with southern Europe, UK and Ireland) inflation increased considerably more than in other European countries.

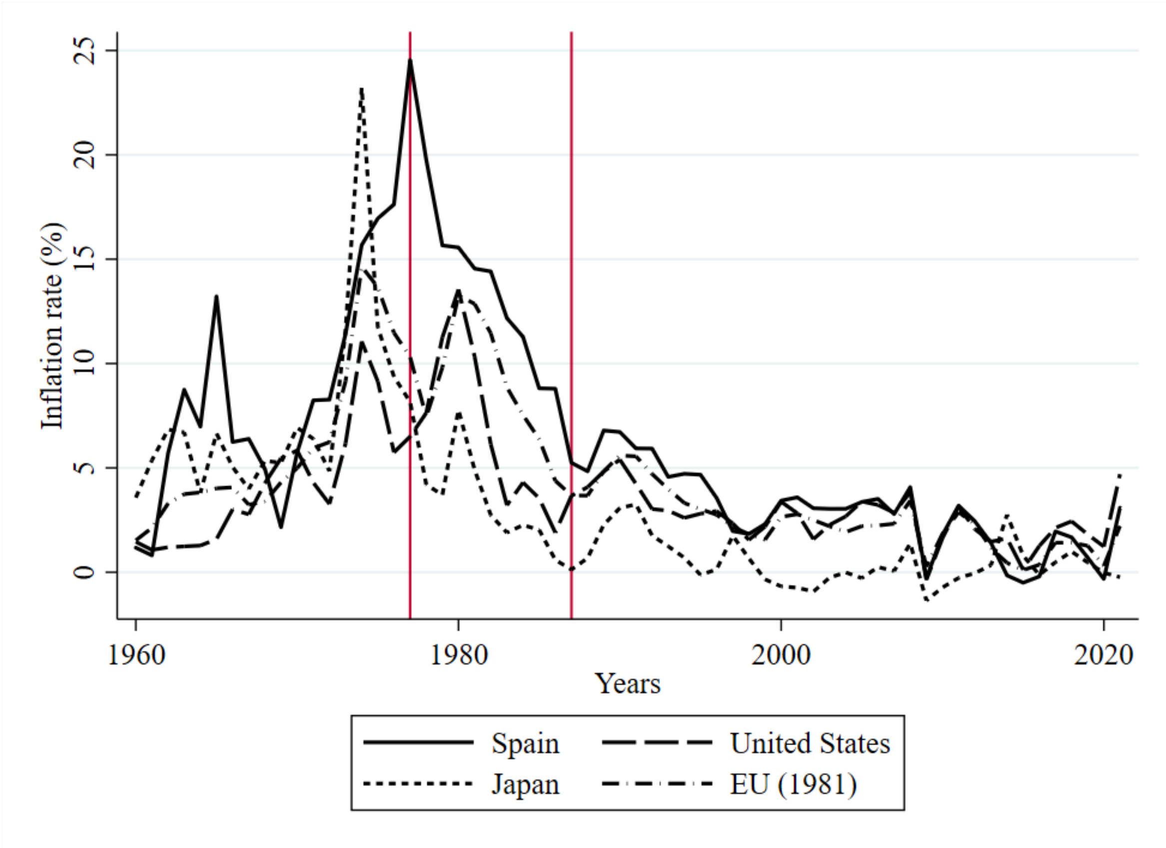

Figure 3.1: Inflation in an International Context (1960-2022).

Note: Source: World Bank (2023). This figure shows the evolution of inflation from 1960 to 2022 for Spain, the United States, Japan, and European Union members in 1981 (see table 3.1 for a disaggregation of this group).

Faced with this high inflation, the government blamed an endogenous problem derived from the political situation in Spain at the time. The climate of social unrest after forty years of repression had given rise to strong wage demands by workers and unions. The Government identified them as co-responsible for the inflationary spiral

[2]We emphasize again that other countries suffered harsher and longer-lasting inflationary crises during this and later periods (Pomfret, 2006; Barnichon and Peiris, 2008; Capistrán and Ramos-Francia, 2009).

Table 3.1: Inflation Rates in Europe (1965-1990)

	1965-1970	*1970-1975*	*1975-1980*	*1980-1985*	*1985-1990*
Germany	2.56	5.68	4.35	4.13	1.49
France	3.99	8.25	10.71	10.30	3.51
Italy	3.25	10.4	16.44	15.04	6.26
Belgium	3.55	7.68	7.4	6.98	2.57
Netherlands	4.66	7.79	6.71	4.58	0.99
Luxembourg	3.06	6.81	6.86	7.15	2.07
Denmark	6.46	8.86	10.28	8.68	4.05
Ireland	5.26	12.51	15.25	13.36	3.65
United Kingdom	4.61	12.05	16.04	9.02	5.27
Greece	2.60	11.06	15.89	21.35	17.72
EU (1981)	4.00	9.10	10.99	10.05	4.75
Portugal	5.87	13.72	21.03	21.41	12.97
Spain	6.45	11.05	18.35	12.80	6.88

This table reports the evolution of the 5-year-average inflation rate in 12 European countries. The first 10 rows represent the members of the European Union in 1981 (Germany, France, Italy, Belgium, Netherlands, Luxembourg, Denmark, Ireland, UK, and Greece) and the last two are the new members in 1986: Portugal and Spain. Source: World Bank (2023).

in Spain.[3] Thus, as a result of these demands, ”prices and incomes had been pursued in Spain in an endless chain, up to the present (1977), accelerating the inflationary process” (Fuentes Quintana (UCD), Senado de España (1977, p. 352)).[4] It was during

[3]In several plenary sessions, members of the Government also secondarily highlighted the role of devaluation due to the balance of payments problem and the mediocre role of monetary policy (Gamir Casares (UCD), Congreso de los Diputados (1977, p. 556)).

[4]This inflationary psychology was defined by Alianza Popular politician López Rodó: ”[...] an inflationist psychological attitude, sometimes contagious: a true inflation psychosis. The potential consumer or saver asks himself, what am I going to save for if it is not going to be worth anything to me? And one lives from day to day, consuming at any price, ”because money is worth nothing” -it is

this inflationary crisis that the Government considered a profound fiscal reform.

3.2 The Design of the Personal Income Tax

The Spanish tax reform in 1978 included the creation of the new Personal Income Tax (*Impuesto sobre la Renta de las Personas Físicas*, IRPF). The previous tax (*Impuesto General de la Renta sobre las Personas Físicas*, IGRPF, 1964-1978) had become outdated as it was not a unified and homogeneous tax (Quintana, 1971). Law 44/1978 gave rise to the development of this tax, which was implemented for the first time the following year, in 1979. It was a progressive tax with 28 brackets for which the marginal tax rate increased by about one percentage point each bracket, from 15% to 65%. The first six brackets increased by 200,000 pesetas and the following ones by 400,000 pesetas. However, a legal limit was established which did not allow the net tax liability to exceed 40% of the taxable base, since this was understood to be the limit above which the tax became confiscatory.[5] This meant a flattening of the average rate for incomes above 9.8 million pesetas and a sudden drop in the marginal rate from 65% to 40% (Figure 3.2).

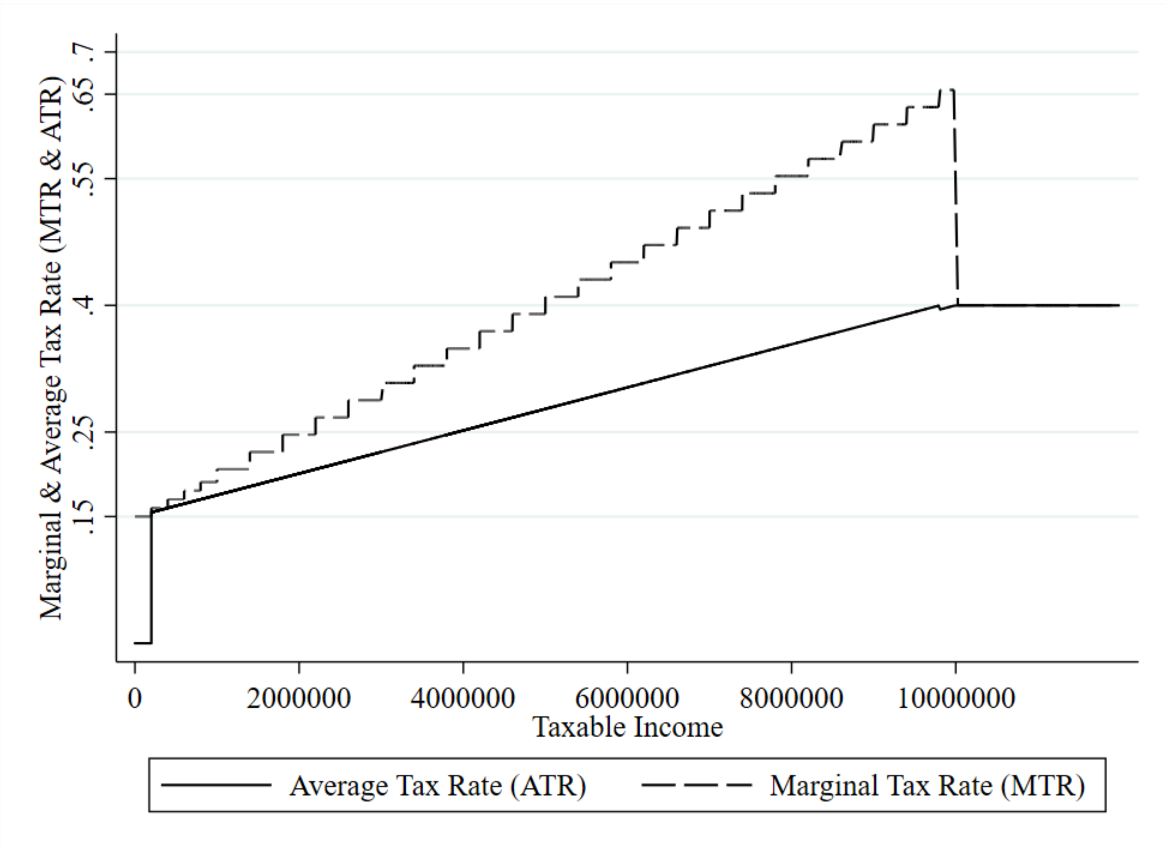

Figure 3.2: Personal Income Tax, year 1979

often heard in the street-" (Lopez Rodó (Alianza Popular), Congreso de los Diputados (1977, p. 537)).

[5] The legal limit established for tax liability was 40% of taxable income. The sum of this together with the amount coming from the Wealth Tax could not exceed 55% of the taxable income.

The elaboration of the proposal for the Personal Income Tax was conditioned by the inflationary situation suffered by Spain. Faced with this problem, the tax authorities had two different strategies at their disposal. On the one hand, they could follow the path of some countries that at that time adjusted personal income tax automatically. In the 1980s, a small list of countries in the world had different inflationary adjustment models (Nowotny, 1980, p. 1028).[6] Alternatively, there was the possibility of leaving to the discretion of the Government the decision to adjust (or not) the tax every year according to inflation and other economic policy motivations. The Spanish authorities opted for discretionary where the Government could "for reasons of economic policy [...] modify the tax rate and the amount of the deductions foreseen in article twenty-nine of this Law" (Law 44/1978). Thus, the automatic adjustment of personal income tax was ruled out.

As a result of this decision, the Personal Income Tax schedule remained practically intact during the first period of implementation (1979-1984). The first 28 brackets remained intact, with small changes in the marginal rate applied and with six new brackets at the top of the schedule (Figure 3.3). It was not until the 1985 reform that a significant change in the schedule was observed.[7] During the reform of 1985, the first bracket was modified, extending it up to 500,000 pesetas, and applying a marginal tax rate significantly lower than in the previous period (8% compared to 15%). This drop in the first bracket was offset by a sharp rise (12%, 21%, 27%) in the rates for the following brackets, up to 33% for 1,200,000 pesetas. However, the marginal rate fell again to around 22% for the next bracket. For the intermediate brackets, the tax schedule was barely changed compared to 1979. This reform sought to increase the redistributive capacity of personal income tax while at the same time broadening the taxation of capital. Thus, the major reform of this period was not directly aimed at alleviating the possible inflationary effect on the income tax.[8]

In addition, Spanish personal income tax had a system of tax credits that made it possible to reduce the tax liability if certain criteria were met.[9] Within this system of credits, we can distinguish two types. The first type of credits involved a fixed reduction of the tax liability if certain criteria were met by the reporting household (fixed credits). These credits were fixed at a specific amount that did not depend on the reported income. Among them was the general credit, which in 1979 was equal

[6] This list included: USA, Canada, Brazil, Chile, Israel, Netherlands, Switzerland, Iceland, Belgium and Denmark (Nowotny, 1980, p. 1028)

[7] Graphically, it is true that it can be seen how the inclusion of the six new brackets during 1979-1984 meant a change in the tax rate. However, it is important to keep in mind that this 1985 reform affected practically 70% of the taxpaying population. The previous reforms in the upper part of the rate affected less than the top 1% of the taxpaying population.

[8] The 1985 scheme remained intact for 1986. It was in 1987 when the Government decided for the first time to adjust the brackets in line with inflation, increasing them by 5%.

[9] These credits did not reduce the taxable income to which the tax rate was applied but reduced the tax liability once it was calculated.

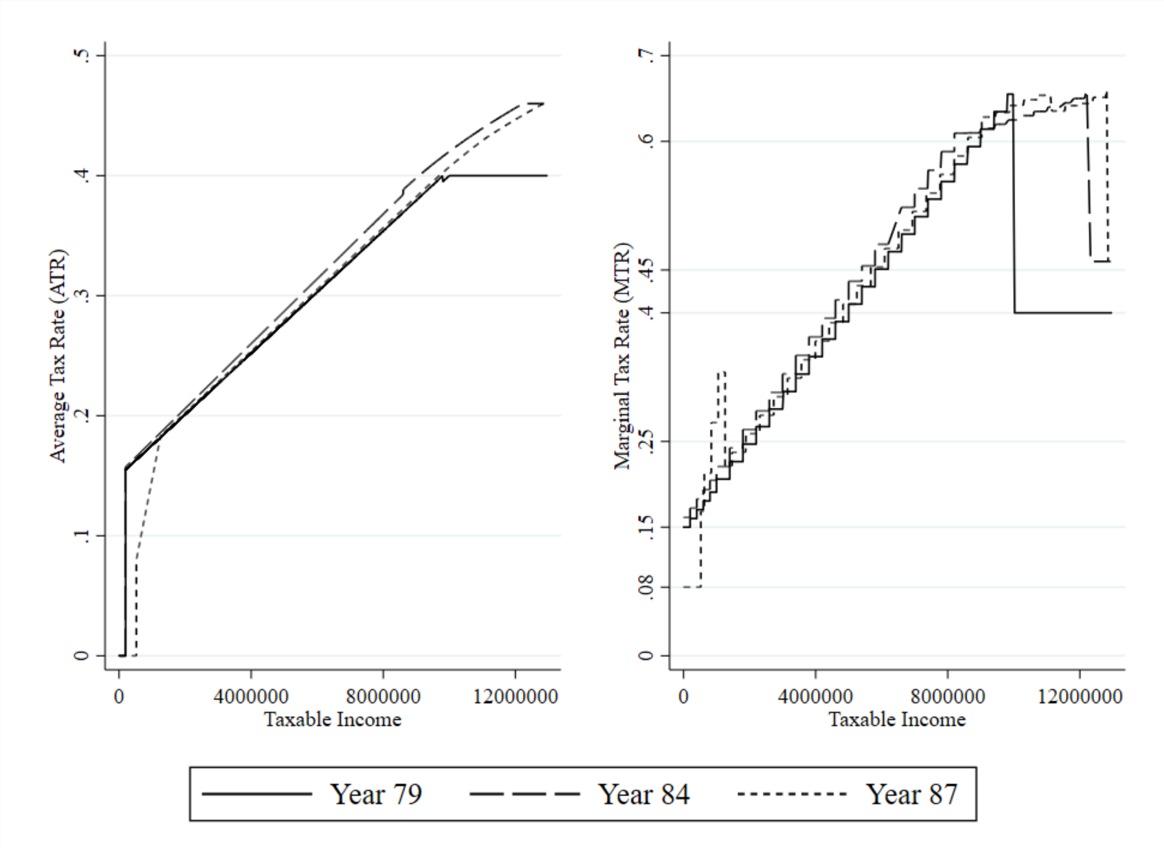

Figure 3.3: Marginal and Average Tax Rates. Years 1979, 1984 and 1987

to 15,000, establishing a virtual exempt threshold for incomes below 100,000 pesetas (15,000 pesetas/0.15). Actually, the exempt minimum that operated was another one: the minimum below which tax return was mandatory. This minimum did not correspond to that derived from the general credit. This was set at 300,000 until 1982 and up to 500,000 as of 1983. Thus, the paradox (until the 1985 reform) was that the mandatory minimum for filing a tax return was higher than the legal limit set by the general credit (Ferrari Herrero and Revilla Pedraza, 1988). Along with the general, there were up to six credits that involved a fixed amount. For 1979, these were: marriage (8500 pts), children (6000 for each), persons with disabilities (8000 for each), elderly dependents (over 70 years, 3000 for each), and young adults in the household (5000 for each). In a second group of credits, there was a long list that implied the reduction of the total tax liability by a percentage of the reported income (variable credits): dividends, donations, sickness, purchase of a house, etc.

The possible deterioration of Personal Income Tax due to inflation was also present through the erosion of fixed tax credits. If these were not adjusted annually, their real value would represent less and less compared to the (increasing) nominal income of taxpayers. Faced with this, the government applied an ad-hoc policy in which it adjusted the fixed credits unevenly and asymmetrically (Figure 3.4). There were credits that adjusted almost perfectly to inflation (marriage, children) and others that even grew more than the adjustment would have predicted (disabled and over 70 years).

However, the general credit was far from adjusting, remaining at values very close to the initial one (15,000) throughout the whole period. This asymmetric adjustment shows that the Government was fully aware of the possible effect of not adjusting personal income tax to inflation.[10]

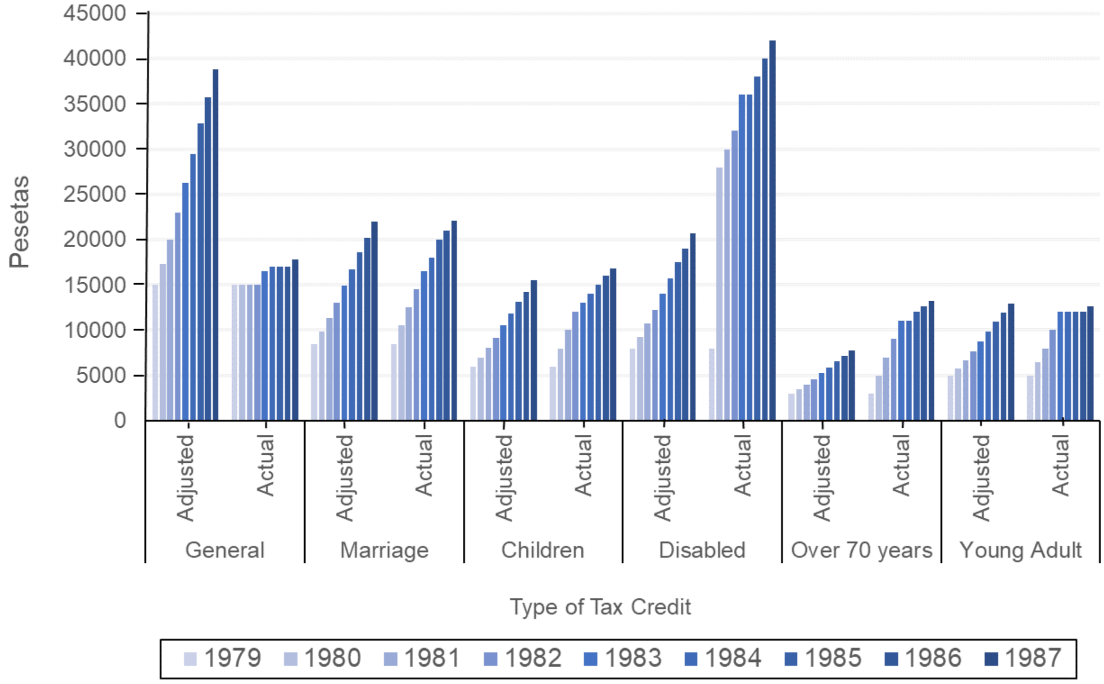

Figure 3.4: Tax Credits: actual vs inflation-adjusted evolution

Note: This figure shows the comparison between the actual evolution of fixed credits and the inflation-adjusted evolution. The inflation-adjusted evolution comes from indexing the value of the tax credits of the base year (1979) according to the accumulated inflation from 1979 to year*t*.

3.3 The Debate on Inflation Adjusment

The Personal Income Tax was far from adapting to the evolution of inflation. Under the protection of Law 44/78, neither the first UCD (*Unión de Centro Democrático*) government (1978-1981) nor the subsequent PSOE (*Partido Socialista Obrero Español*) governments (1982-1987) proposed an automatic adjustment of the tax due to inflation.[11] However, the evolution of the credits shows that the Government was aware of

[10]In addition, it reflects the government's interest in maintaining the situation of certain groups, such as families with children. This could be due to the fact that until 1988 the reporting unit in Spain was the household, not individuals. Thus, despite certain corrections, families with two earners saw their joint incomes climb into higher tax brackets than those of two single taxpayers with the same income. However, it is important to mention that at that time the vast majority of joint returns came from a single earner, due to the late incorporation of women into the labor market.

[11]There were two years in this period that were the exception, 1981 and 1987, in which the government adjusted personal income tax close to the inflation rate. However, in the other 7 years of the

this inflationary effect. In other words, the lack of adjustment was not by omission, but by deliberate decision. This becomes more evident when analyzing the long debate in Spain on the adjustment of personal income tax with respect to inflation, which arose in the mid-1970s and continued throughout the 1980s.

Already in the 1978 parliamentary debates concerning the implementation of the first income tax year (1979), a member of the opposition defined the bracket creep problem as follows:

> Inflation has serious effects on equity, because as people, due to inflation and not due to a real increase in their remuneration, are placed in higher brackets of the law, the progressive nature of the tax schedule takes effect and the result is that individuals [...] pay more than what really corresponds to a real increase in their purchasing power.
>
> (Trias Fragas (EDC), Congreso de los Diputados (1978, p. 5616))

The demand for an adjustment of the tax was continuous throughout the following ten years. It is interesting to note that, while differing in their solution, parties of very different political spectrums coincided in their diagnosis of bracket creep. As an example, in 1981, there is a proposal for the adjustment of personal income tax by the Communist Party. This proposal points out, in addition to the effect on brackets, the role played by the bracket creep through nominal erosion in the fixed tax credits:[12]

> [...] the credits according to personal and family circumstances, expressed in fixed amounts, will represent lower values each year, until they are, after a few years, reduced to inoperability.
>
> (Partido Comunista (1980, p. 365))

From another part of the ideological spectrum, the Minoria Catalana y Vasca group claimed since 1979 the need to find an automatic solution to the bracket creep problem. The Minoria Catalana y Vasca party formed an amalgam of Basque and Catalan parliamentary groups, ranging from social-democratic, liberal to conservative groups. Most of the time, their proposal was rejected because it would have "changed the State's income forecast, and then it (...) meant a decrease in revenue and could not be discussed" (Gasoliba I Bohm (Minoria Catalana y Vasca), Congreso de los Diputados (1984, p. 4795)). In 1983, after four years of trying, the Minoria Catalana y Vasca

period 1979-1987, the IRPF maintained a rigid structure whose changes responded to economic policy interests other than the bracket creep.

[12] In this case, the Communist Party does not propose an automatic adjustment, but will propose to move the marginal rate up one bracket, keeping the brackets intact. This proposal, debated after the 1981 budget, did not involve much parliamentary debate. The Government had already decided in 1981 to adjust the schedule via the marginal rate, adjusting it in a manner similar to that proposed by the Communist Party.

group succeeded in bringing to parliament the discussion of a bill guaranteeing an automatic adjustment of the personal income tax. This proposal not only pointed out the effect on tax collection but also highlighted the possible consequences that the lack of adjustment had on the progressivity of the tax:

> In addition, the progressivity of the distribution of the burden is reduced, as a consequence of the fact that the set of average or effective rates flattens out as one moves forward in the income brackets, because there is an upper limit on marginal rates.
>
> (Minoria Catalana y Vasca (1983, p. 158))

Minoría Catalana y Vasca identifies the intermediate brackets (1,000,000 to 5,000,000 pesetas) as the main ones affected by the bracket creep (Gasoliba I Bohm (Minoria Catalana y Vasca), Congreso de los Diputados (1984, p. 4795)), considering that it implies an overall loss of progressivity (intermediate incomes compared to the top income bracket). As a solution, the aforementioned alternative, which was discussed in the preparation of the Personal Income Tax, is proposed: an automatic adjustment of the tax according to the evolution of prices. More specifically, the tax brackets and tax credits would be adapted to the evolution of the Consumer Price Index (CPI):

> The income brackets of the tax schedule [...] and the fixed tax credits shall be updated annually in the General State Budget Law, increasing them by at least the percentage of the growth of the Consumer Price Index.
>
> (Minoria Catalana y Vasca (1983, p. 158))

This proposal was supported by several opposition groups (Coalición Democrática and Grupo Popular). However, the Government, at that time the Socialist Party (PSOE), refused to carry out this adjustment. Interestingly, the same Socialist Party had promised a similar solution to the income tax adjustment during the 1982 elections that brought it to power:

> For those who live on their earned income, the effects of inflation will be corrected regularly with the objective of maintaining at least the real income, taking into account the level of wage increases (...)
> The minimum level of the obligation to declare will be reviewed regularly to adjust it to the loss caused by inflation.
>
> (Partido Socialista Obrero Español (PSOE) (1982, p. 18))

As we can see, once in power, the PSOE changed its mind about the bracket creep adjustment.[13] In short, the Spanish period 1978-1987 was a time when inflation rates

[13]This contradiction was pointed out by Gasoliba I Bhom (Minoria Catalana y Vasca, Congreso de

exceeded 10 percent annually, resulting in cumulative inflation of more than 170 percent. In addition, at the beginning of this same period, the Personal Income Tax was designed. Despite constant demands from various opposition parties, the governments of the time refused to adjust the structure of the Personal Income Tax to the evolution of inflation. Thus, the bracket creep effect is not only expected to be significant in this period but was continuously pointed out by the personalities of the time both from right and left. All in all, the Spanish 1980s represent the perfect framework to measure and discuss the bracket creep effect.

los Diputados (1984, p. 4797)) in the debate on the automatic adjustment of the income tax to changes in inflation.

4

Data

In order to measure the bracket creep, this paper uses two different sources: aggregate administrative data from the Tax Reports of the Ministry of Finance and Economy and the Personal Income Tax micro-panel of the Institute of Fiscal Studies (Instituto de Estudios Fiscales, IEF). Although the IRPF was first implemented in 1979, the first information available from the micro-panel dates back only to 1982 (IEF micro-panel). Along with the data sources, this section deals with the simulation exercise for the first three years of the sample: 1979, 1980, and 1981. Due to the complexity of data collection and generation, we include in Appendix A a detailed explanation of the process carried out.

4.1 The Personal Income Tax: 1979-1981

The first period of implementation of the IRPF was in 1979. However, there is no detailed information for the first three exercises of the tax: 1979, 1980, and 1981. The literature on these years takes a macro approach relying on aggregated variables. However, the seminal paper on bracket creep for Spain carried out by Gonzalez-Páramo and Argimón Maza (1987) already indicates that the most appropriate approach would involve the use of micro-simulation techniques (Gonzalez-Páramo and Argimón Maza, 1987, p. 364). Following their advice, we create a synthetic distribution of tax filers for the first three years of implementation of the Personal Income Tax: 1979, 1980, and 1981.

4.1.1 Cross Sectional Simulation

First, we simulate a cross-sectional subsample made with three synthetic distributions of one million tax filers for each of the three years 1979, 1980, and 1981. For this purpose, we rely on the Generalized Pareto Curves methodology proposed by Blanchet et al. (2017, 2022). This method estimates synthetic income distributions using aggregate information derived from administrative reports. More specifically, Blanchet et al.

(2022) propose a methodology that simulates a representative sample of individuals from information collected by income thresholds using Pareto coefficients. The curve of inverted Pareto coefficients $b(p)$ is the ratio between the mean income above rank p and the p-th quantile $Q(p)$. This technique has proven to be superior to most of the interpolation techniques previously proposed in the literature.[1] Despite their recent development, Generalized Pareto Curves have been used extensively in recent years to estimate series of income distributions around the world.[2] This paper adds Spain to this growing list of countries.

The simulation of the Generalised Pareto Curves requires information on the total number of tax filers, the average income, the cumulative distribution of persons up to each income bracket and the average income of each income bracket. The information on the tax base by bracket comes from two complementary sources. First, the work of Sánchez et al. (1986), which provides information differentiated into 12 income brackets for the three periods 1979-1981. We will use this work as the basis for the simulation of income distributions. However, in order to complete this simulation, we will resort directly to the tax reports of the Ministry of Economy and Finance. For the first two years (1979-1980) we carried out a process of digitalization of the statistics contained in the *"Memoria de la Reforma Fiscal (1980, 1981)"* dealing with the fiscal years 1979 and 1980, available at the Library of the Ministry of Finance and Public Function (Madrid). For the last year of the period, 1981, we use the report *"El Impuesto sobre la Renta de las Personas Físicas en el periodo 1981-1987. Boletín de Información de la Dirección General de Tributos, 1991"*.[3] In Appendix A.1, table A.1 shows the degree of precision of this simulation.

The reasons for resorting to these direct sources are twofold. First, both the 1979 and 1980 reports serve as robustness tests of the income simulation since they include income distribution statistics for 12 income brackets slightly different from those used by Sánchez et al. (1986). This is even more evident in the case of 1981, where the bracket statistics are more detailed, providing information for the 28 income brackets present in the 1981 personal income tax. Replicating this simulation with these second source of data yields practically identical synthetic distributions (not included here).

Secondly, personal income tax (IRPF) taxation presents several concepts that depend on the specific characteristics of the tax filer. In the Spanish case, these concepts are mainly the credits: tax liability reductions if the tax filer meets certain requirements. These credits do not necessarily have to be evenly distributed across the income

[1]For this methodology, there is an interface available on the World Inequality Database (wid.world) and an R-package called "gpinter". See Blanchet et al. (2022) for more detailed theoretical and practical information on this method.

[2]From the Middle East (Alvaredo et al., 2019), Brazil (Morgan, 2017), India (Chancel and Piketty, 2019), Ivory Coast (Czajka, 2020), China (Piketty et al., 2019), France (Garbinti et al., 2018), Sweden, United Kingdom and United States Torregrosa-Hetland and Sabaté (2022).

[3]For more detailed information on these reports, see Ministerio de Hacienda (2023b) for 1979 and 1980 fiscal years and Ministerio de Hacienda (2023a) for 1981 fiscal year.

distribution. Assuming a constant proportion for each year could present significant biases in the simulation. However, Sánchez et al. (1986) do not include statistics on the distribution by brackets of the remaining tax items. This is where the digitized *"Memoria de la Reforma Fiscal (1980, 1981)"* play a key role. Specifically, the report for the fiscal year 1980 is the only one that presents disaggregated information on other items of the tax for the same 12 income brackets used for the simulation. More specifically, it includes information on the evolution of different types of tax credits, both fixed (a certain quantity) and variable (a percentage of the taxable income). For them, it indicates the percentage of tax filers within each income bracket who deduct their tax liability in the fiscal year 1980.

We use these percentages as parameters to simulate the distribution of tax credits for the sample of 3 million tax filers. For the fixed tax credits, the proposed methodology consists of generating 12 binomial distributions for each tax credit. For each binomial distribution, we use the percentages observed in the report as the average probabilities of tax filers from bracket i to qualify for the tax credit j. For variable credits, we use the information on the percentage of filers within each bracket and the average amount declared. For these credits, the simulation involves two steps. The first one replicates the previous exercise, simulating the distribution of individuals from each bracket i qualifying for the variable tax credit j using the percentages observed in the report as the average probabilities. The second step generates the amount of the tax credit for each individual based on the average credit rate and the individual's taxable income. It is important to note that the simulation has limitations. The lack of data for the years 1979 and 1981 necessitates using 1980 as a benchmark. Additionally, the analysis focuses only on a subset of variable credits present in the income tax. Further details and explanations can be found in Appendix A.1. After this simulation, we obtain a cross-sectional sample of 3 million individuals for 1979, 1980, and 1981. Columns 1 and 2 of table 4.1 summarise the characteristics of this sub-sample.

Table 4.1: Summary Statistics

	Cross-Section (1979-1981)		Panel (1979-1981)		Panel (1982-1987)	
Board A	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*
Taxable Income	898,489	960,461	904,908	749,022	1,304,191	1,255,845
Gross Income	950,500	981,321	962,985	783,505	1,375,378	1,257,030
Fix Tax Credits	37,758	16,256	38,206	17,442	64,850	32,841
Variable Tax Credits	18,364	62,051	22,797	72,858	30,502	82,511
Average Tax Rate	16.99	1.71	16.96	1.84	17.02	0.45
Married (%)	79.24	40.55	79.40	40.44	74.08	43.81
Children (%)	57.80	49.38	59.13	49.15	55.91	49.65
Over Age 70 (%)	7.50	26.34	7.48	26.31	7.17	25.79
Adult Children (%)	4.60	20.94	4.39	20.49	5.91	23.58
Employee	86.54	3.66	87.07	17.13	82.23	38.22
Employer / Self-employed	8.70	28.19	8.72	28.26	13.77	34.46
Investor	4.70	15.11	4.20	14.81	3.80	14.39
Board B	*Income Share*	*Cut-off*	*Income Share*	*Cut-off*	*Income Share*	*Cut-off*
Percentile 25	8.26	554,736	8.18	530,639	9.07	738905
Percentile 75	43.88	1,082,636	43.33	1,117,443	41.01	1,655,219
Percentile 99	41.67	3897378	42.45	4087996	43.88	5512767
Top 1	6.00	492,184,295	6.02	492,184,295	6.03	186,720,288
Board C						
First-Year Tax Filers	1,000,000		933,101		122,679	
New Tax Filers	2,000,000		189,578		102,045	
Total Tax Filers	3,000,000		1,122,679		224,724	
Nº of Observations	3,000,000		3,123,000		867,508	

Note: This table reports the summary statistics of the different subsamples: cross-sectional 1979-1981 (cols 1-2), panel 1979-1981 (cols 3-4), and panel 1982-1987 (cols 5-6). Board A shows the mean and standard deviations of the main variables. The last three rows indicate the type of tax filers according to their main source of income: labor (employee), business (employer/self-employed), or other sources (investor). Board B shows the distribution of income of each subsample, showing the income share of the population up to percentiles 25, 75, 99, and the top 1 together with the cut-off associated with each percentile. Board C shows the evolution of tax filers over time. First-Year Tax Filers are those who are present in the first year of observation (1979 for subsamples 1979-1981 and 1982 for subsample 1982-1987). New Tax Filers are those who report their income for the first time after the first year of observation. The aggregation of the latter groups gives the Total Tax Filers.

4.1.2 Panel Data Simulation

Along with the cross-sectional simulation, this paper includes the simulation of a panel-data subsample for the period 1979-1981. This simulation is used in the final part of the analysis, in which the estimates are corrected for the possible dynamic behavior of tax filers in the face of changes in the simulated tax rate. The development of this panel subsample starts from the synthetic one million tax filers generated in the previous section for the year 1981. Using this sample as a benchmark, we simulate the observations of these tax filers backward for the years 1980 and 1979. In developing this subsample, this exercise faces two challenges.

First, the above cross-sectional simulation does not generate information for the same individual over the three tax years 1979-1981. That simulation results in 3 million different tax filers, 1 million for each of the years. Thus, the synthetic filer number 1 for the fiscal year 1979 is not the same as the one for the fiscal year 1980, although their characteristics are probably very similar. However, for the creation of the panel, we need an approximation that guarantees an observation for each of the three tax years for the same tax filers. To guarantee this point, we use 1981 as the reference year and predict the tax filers' returns backward for the years 1980 and 1979. Since we do not have this information at the individual level, we assume that tax filers' income increased in the same rate *within* each income percentile (1-100). The methodology assumed here is based on Growth Incidence Curves (GIC) that show the percentile growth of income along the income distribution (Ravallion and Chen, 2003; Grimm, 2007; Bourguignon, 2011; Lakner and Milanovic, 2015). Using the cross-sectional simulation from the previous section, we calculate the GICs for each income percentile. That is, we calculate income growth (both taxable income and gross income[4]) for each of the 100 income percentiles for the period 1979-1980 and for the period 1980-1981. Using these growth rates retrospectively (Figure 4.1), we predict the value of gross income in the two periods prior (1979, 1980) to 1981 for the 1 million tax filers generated in the latter year. Although this methodology assumes that the growth rates within each income percentile are constant, it ensures sufficient flexibility to control for changes in the income distribution over the observed years.

However, the use of Growth Incidence Curves is subject to a previous modification. During this first period, 1979-1981, almost 1 million new tax filers were incorporated in Spain, going from barely 5 million in 1979 to more than 6 million in 1981 (Sánchez et al., 1986, p. 464). Therefore, the three cross-sectional simulations carried out in the previous section will incorporate the entry of this considerable part of new tax filers. If this is not corrected, the estimated predictions of GICs will incorporate the entry of new filers, potentially biasing the predicted growth rates for each percentile. Therefore, prior to calculating the GICs it is necessary to downsample for the period 1979 and 1980

[4]Gross income is defined as taxable income plus deductible labor and capital expenditures.

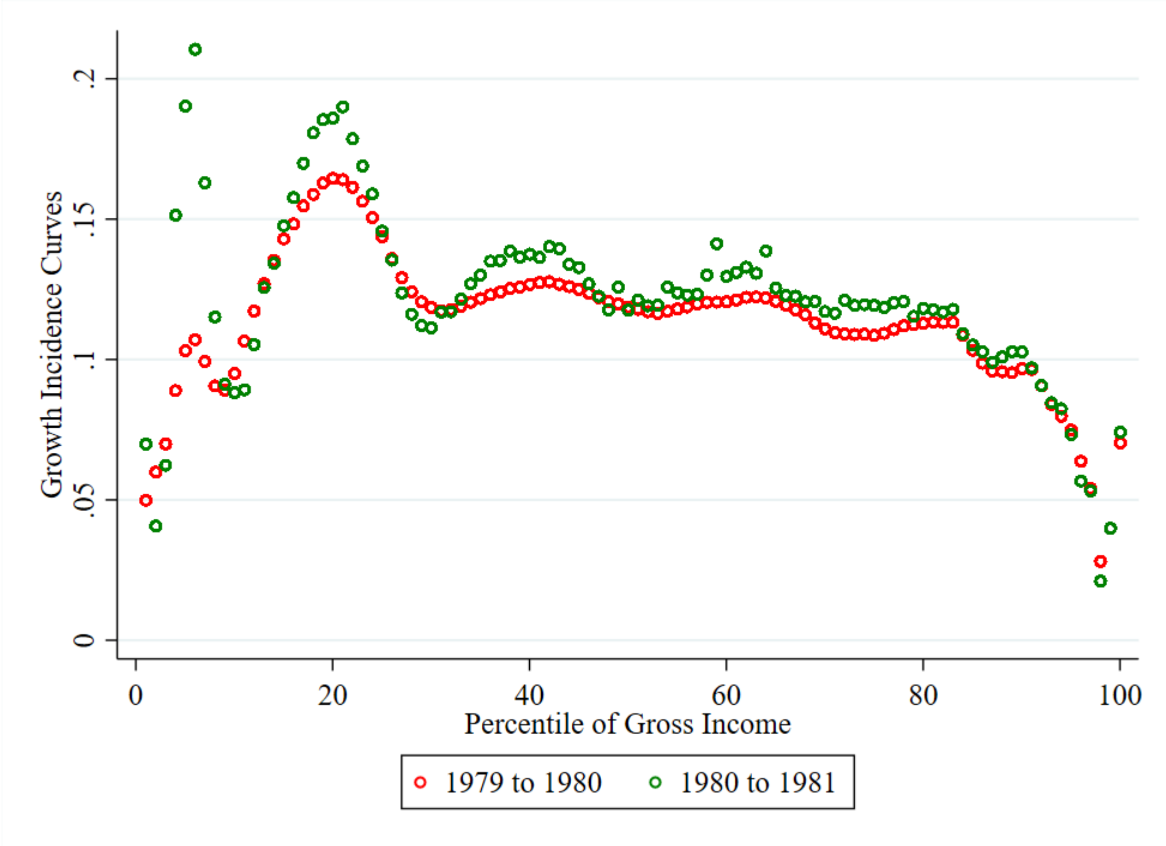

Figure 4.1: Growth Incidence Curves: Years 1979 and 1980

Note: This figure shows the Growth Incidence Curves for the years 1979 and 1980. Each value of the Curve represents the growth rate of gross income for each percentile from 1979 to 1980 and from 1980 to 1981. These parameters are used to predict gross income from 1981 backward to 1980 and 1979. Appendix A.2 gives more detailed information. We replicate this estimation for taxable income and variable tax credits (donation, dividends, professional fees, capital acquisition, and housing). Not included here.

to ensure that the sample of individuals resembles a pure panel. The only information available on the incorporation of new filers is aggregate: from 1979 to 1980 the number of filers increased by 14.74% and from 1979 to 1981 the rate was 4.2% (Sánchez et al., 1986, p. 464). A possible alternative would be to reduce the 1979 and 1980 samples by the aggregate percentage indicated above. However, using this methodology, the estimation of the GICs will be valid only under the assumption that the filers would have been incorporated homogeneously throughout the income distribution, and that the 1st percentile of year $t-1$ corresponds to the 1st percentile of year t. Thus, this methodology will be clearly biased if the filers were incorporated non-homogeneously throughout the distribution.[5] According to the available evidence, the incorporation of

[5]Let us imagine an illustrative example. Suppose that the number of filers increases by 10% from $t-1$ to t. If all these new filers are homogeneously distributed across the distribution, reducing the sample at $t-1$ by 10% would ensure that the percentiles compared are sufficiently similar to each other. If, on the other hand, all the new filers were incorporated at the lower end, reducing the sample homogeneously by 10% would cause us to erroneously predict an excessive number of filers at $t-1$ for the lower end and reduce the high end of the distribution when the distribution had not changed at

new filers occurred mainly at the lower end of the distribution, because previous non-filers exceeded the minimum (mandatory or legal) reporting threshold (de Estado de Hacienda, 1983, p. 65-66).

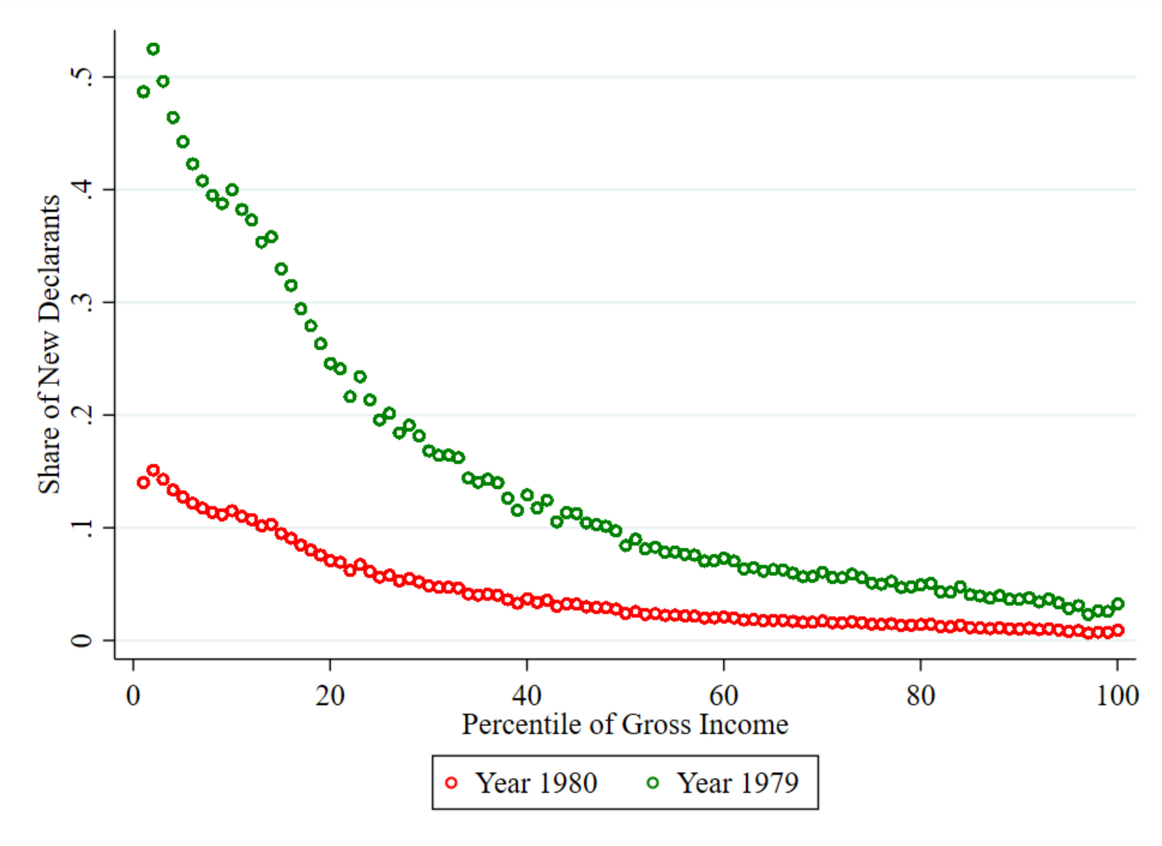

Figure 4.2: Share of New Tax Filers: Years 1979 and 1980

Note: This figure shows the predicted share of new tax filers in the years 1979 and 1980. Each value of the curve represents the share of new tax filers predicted for time t for each percentile. These parameters are used to reduce the samples for the years 1979 and 1980. Appendix A.2 gives more detailed information.

We propose an alternative methodology. Using the panel of microdata for the later 1982-1987 period (explained in the next section), we are able to analyze how filers were incorporated across the income distribution. Using this information, we calculate the average incorporation of each income percentile for the period 1982 to 1987. In this way, we can calculate the annual percentage of new filers for each income percentile. We will use the average incorporation for the 1982-1987 period as benchmarks for the 1979 to 1981 period (correcting for the aggregate incorporation percentages, 14.74% for 1980 and 4.2% for 1981). This methodology has clear limitations. It is possible that the way in which new filers were incorporated in the early periods of the 1979-1981 tax was different than in the later 1982-1987 period.[6] Despite this limitation, the 1982-1987

all.

[6]This problem is even greater if we bear in mind that the mandatory minimum tax return increased from 300,000 pesetas in the pre-1982 period to 500,000 pesetas for the following years. However, this methodology assumes that the incorporation for each percentile was not affected by this and that it

panel evidence shows a clear constant in the form of incorporation of new individuals: it follows a decreasing line along the income distribution of individuals and being constant for the period 1983 to 1987 (Figure A.2, see Appendix A.2). Using these parameters as a reference, the imputation of new filers for the years 1979 and 1980 is illustrated in Figure 4.2. This methodology results in 1 million observed filers in 1981, 959,320 of whom will be present in 1980 and 834,726 in the fiscal year 1979. That is, there are 124,594 new filers in 1980 and 40,680 new filers in 1981.

As expected, the subsample results in a group virtually identical on average to that generated in the cross-sectional simulation. The main characteristics of the panel subsample are included in columns 3 and 4 of Table 4.1. For the sake of length, we include more detailed information on the creation of this panel in Appendix A.2.

4.2 The Personal Income Tax: 1982-1987

For the period after 1981, we use the Panel de Declarantes por IRPF of the Instituto de Estudios Fiscales (PDIRPF). This panel is a microdata base elaborated by informative records from the Spanish tax filer Administration Agency (Agencia Estatal de Administración Tributaria) in relation to Personal Income Tax. More specifically, we use the version of the panel for the period 1982-1998 (for later versions, see Perez (2018)).

This panel (PDIRPF) was constructed on the basis of a simple random sampling process, in which every year one declaration was selected out of every fifty declarations submitted (Fernández et al., 2004). Thus, in 1982, 123,599 returns were selected. For the following years, the returns of the same respondents were selected. This sub-sample is the "pure panel" version of the PDIRPF. However, the use of this sample does not guarantee representativeness over the period. There are two reasons for this. First, the use of the same sample throughout the period suffers from a serious attrition problem: individuals disappear from the sample when they cease to declare for various reasons (death, marriage and joint declaration, falling below the threshold for declaring, etc.). Secondly, during this period the number of new declarers joining the sample is around 2% of the national total from 1982 onwards (Sánchez et al., 1986). Thus, in order to guarantee national representativeness throughout the period, the PDIRPF was extended to include both incoming and outgoing tax filers. The main characteristics of the panel are shown in Table 4.1, columns 5 and 6.[7]

remained constant and equal to the 1982-1987 average for the entire 1979-1987 period.

[7]This panel has been commonly used in the literature concerning Spain Fernández et al. (2004). The panel has been used for a wide range of purposes, from general research (Jiménez and del Mármol, 1991; Salas del Mármol and Pérez Villacastín Ballesteros, 1992; Pazos et al., 1995; Gómez et al., 2000; Carrasco et al., 2001; Castañer et al., 2004; Fernández et al., 2007), to more specific analyses of certain topics, such as savings tax incentives (Colera and Farré, 1994) or the design of the tax in relation to family composition (Laborda et al., 1998). But, above all, its main use has been in the study of tax reforms, where microsimulation exercises are abundant (Cabré and Abelló, 2002; Cabré, 2003; Fernández et al., 2004).

5

Methods

5.1 Microsimulation Approach

This paper presents a counterfactual in which the Spanish tax authorities adjusted personal income tax according to inflation. For that purpose, we propose an exercise of microsimulation. Microsimulation refers to a wide variety of techniques that operate at the level of individual units, simulating changes in state or behavior (Figari et al., 2015, p. 2142). Microsimulation exercises, which originated in the 1950s and 60s (Orcutt, 1957, 1961) have been applied to very diverse economic policy domains. This paper focuses on tax reform analysis, along the lines of the tax-benefits microsimulation models.[1] This paper adds to the long list of IRPF microsimulation exercises for Spain (Cabré and Abelló, 2002; Cabré, 2003; Fernández et al., 2004).

The bracket creep literature has previously used microsimulation models (Immervoll, 2005; Levy et al., 2010; Fuenmayor et al., 2008). However, this is limited to static models where incomes are indexed to inflation and taxpayers' behavior remains constant (Figari et al., 2015). This paper proposes an extension of this literature, based on a dynamic microsimulation exercise that tracks taxpayers' income over time, allowing their characteristics and responses to change over the period studied (Li et al., 2013).

Four different microsimulation exercises are presented in this paper. The first simulation corresponds to the baseline (actual) scenario, in which the tax is calculated without any policy changes.[2] Then, we propose a three-fold microsimulation exercise. The second simulation corresponds to a full adjustment scenario, in which both the tax schedule and the fixed tax credits are adjusted for inflation. The other two simulate a partial adjustment exercise: in the third, only the schedule is adjusted and in the

[1] See for instance, EUROMOD for EU (Sutherland and Figari, 2013), TAXBEN for UK (Mirrlees et al., 2011) or ifo-MSM TTL for Germany (Blömer and Peichl, 2020)

[2] For the 1979-1981 simulated part this is relatively straightforward, as the panel is relatively simple. For the 1982-1987 part of the panel, we manipulate, rename and clean the 100 cells of each six cross-sectional declarations waves (1982 to 1987) merging them in my own panel data version. There is an already-made panel dataset, but the cells are not consistent, corresponding to different variables over time.

fourth, only the tax credits are adjusted. By comparing these three scenarios with the real scenario, we can quantify the consequences of not adjusting personal income tax for inflation.

To perform this task, we use the evolution of the Consumer Price Index (CPI) as the reference for inflation (from Instituto Nacional de Estadística (2022)). In this simulation, we assume that the authorities will index the year $t+1$ fiscal year to the end of year t. Therefore, we use the inflation of year t to adjust the tax parameters of year $t+1$. Tax credits are indexed from the base year (1979). This adjustment was already illustrated in Figure 3.4.

To index the schedule of the marginal tax rates, we multiply the brackets by the previous year's inflation and adjust the average rate formula to match these new brackets.[3]

For illustrative purposes, in 1987 the simulated tax scheme would be as follows (Figure 5.1).[4] This figure shows how both the marginal and average tax rates have shifted considerably to the right. An individual with an income of 1 million pesetas pays an average rate of 40% and a marginal rate of 64% in the absence of the reform. With the reform, however, she woud pay an average rate of 25% and a marginal rate of 38%. In this line, the adjustment for inflation in 1987 would result in a lower average rate for all filers. However, at a glance, we already see that the result will not be the same for taxpayers in other parts of the distribution of income. The distance between the actual and simulated average rate varies greatly if we move along the distribution of reported income. Related to this, and due to the irregular scale design, the reform would not decrease all taxpayers' marginal rates. There are two exceptions, those between 2.07 and 3.1 million pesetas (13,955 individuals) and those between 15 and 30 million pesetas (128 individuals) for whom this adjustment will result in a higher marginal rate.[5]

With this information, we will be able to simulate four different complete tax returns for each year for each of the filers in the sample (4.2 million for the cross-sectional version and 1.2 million for the panel data). In this way, we will be able to calculate both the effect on revenue and the redistributive effects of not adjusting the income tax for inflation.

[3]Formally, this means modifying the slopes of the average tax rate formula, since the scheme is shifted to the right in an increasing way due to the fact that the absolute increase is greater the higher the value of the affected sections. Let us look at a concrete example. The average rate formula 1980 is equal to $\tau_z = 0.1449 + 0.0255 \cdot z$ if $z < 9.8$ million pesetas, where z is taxable income in millions. However, with the adjustment for inflation, this bracket jumps to 11.33 million ($9.8 \cdot 1.1566$, where 0.1566 is 1979 inflation). With this new cut-off, the slope is equal to 0.02205. Thus, the new formula for this part is $\tau_z = 0.1449 + 0.02205 \cdot z$. We do the same for all the cut-off points of the average rate functions for the years 1980 to 1987

[4]In Appendix C we include other intermediate years in which the cumulative effect of inflation can be appreciated (Figures C.1 and C.2).

[5]Until 1985 only the upper part of the distribution would face a higher marginal tax rate under this reform. See Figures C.1 and C.2 from Appendix C.

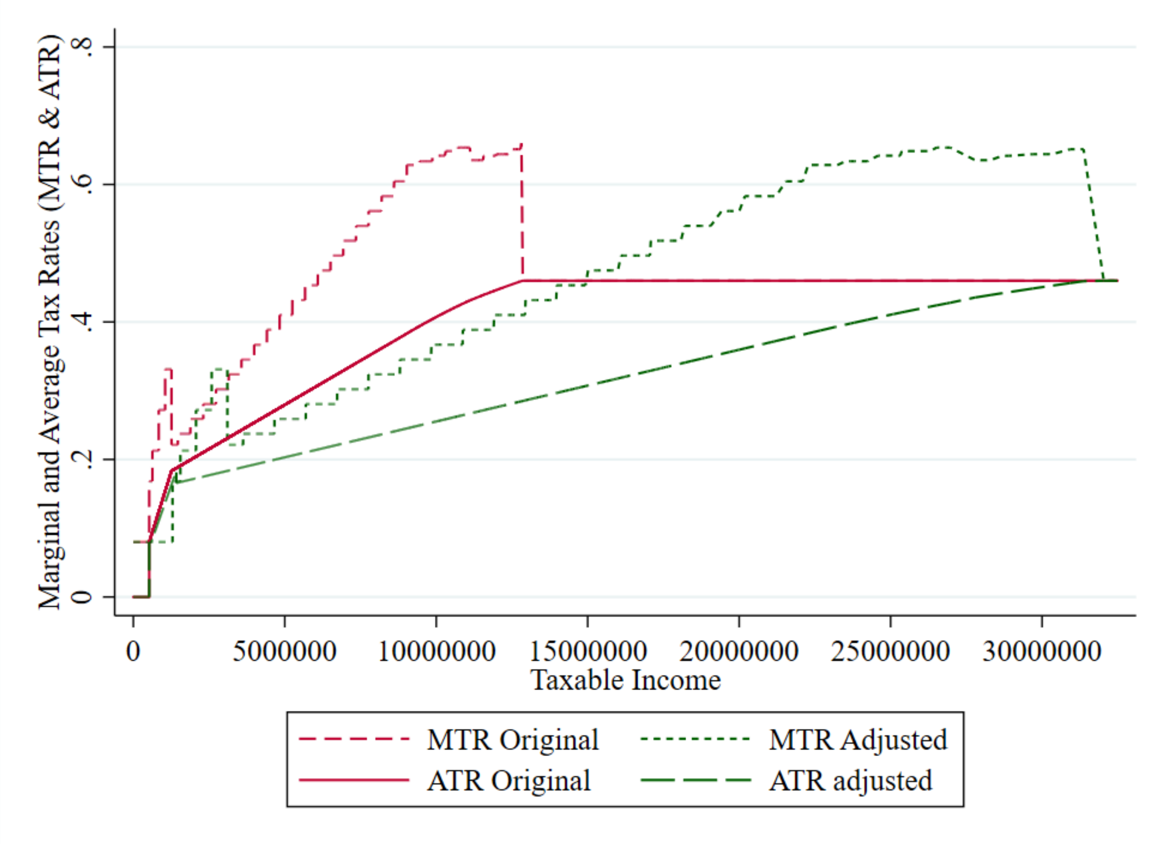

Figure 5.1: Personal Income Tax, 1987: actual vs simulated

5.2 Progressivity and Redistribution

This paper aims to measure the effect of inflation on three different dimensions: tax revenue, progressivity and redistribution. For revenue, the estimated value is simply the result of aggregating all tax liabilities and multiplying it by the ratio between the number of total taxpayers and the number of taxpayers in the sample for that year.

To measure progressivity and redistribution, we follow the standard Public Economics literature based on the concentration curve estimation (Lambert, 1992). Progressivity means that effective tax rates increase with income or, in other words, that tax liabilities are more concentrated than gross income. The most common index for measuring progressivity is the Kakwani index (Kakwani, 1977) :

$$K = C_\tau - G_Z \tag{5.1}$$

Where C_τ indicates the concentration of the tax system and G_Z is the measure of inequality before taxes using gross income. Then, the Kakwani index (K) can increase because: 1) an increase in the concentration of the tax (policy decision), 2) a decrease in the inequality of gross income (both because of tax and non-tax factors), and 3) a combination of both.

On the other hand, redistribution indicates a reduction of income inequality derived from the implementation of the tax. Redistribution then depends on two aspects: 1) the progressivity of the tax (measured by the Kakwani Index) and 2) the size of the tax revenue. In the extreme case, a 100% progressive tax will not modify the distribution of income if the size of the average tax rate is insignificantly different from zero. Then, redistribution depends positively on both the average tax rate and the progressivity of the tax. Formally, we use the Reynold-Smolensky index (Reynolds and Smolensky, 2013):

$$RS = \left(\frac{aetr}{1 - aetr}\right) \cdot K - RR \tag{5.2}$$

Where $aetr$ is the average effective tax rate, K is the Kakwani index and RR is the re-ranking effect between tax units. To compute these values, we use the Stata package "progres" from Peichl and Van Kerm (2007).

Both indexes rely on concentration curves, in Gini indexes. These coefficients have their limitations. First, they are incapable of differentiating different kinds of inequalities (De Maio, 2007, p. 850). Second, they are more sensitive to inequalities in the middle part of the income spectrum (Hey and Lambert, 1980; Ellison, 2002). As we have seen, the upper top and bottom of the spectrum are expected to be clearly affected by the adjustment of the income tax, so the previous indexes might offer an incomplete picture. Due to that, we follow Torregrosa-Hetland and Sabaté (2022) which extend the analysis showing the evolution of the average effective tax rate for each percentile of income, comparing different scenarios. In doing so, we will be more aware of the roots of different evolutions in progressivity and redistribution due to the lack of adjustment of the IRPF.

5.3 Elasticity of Taxable Income

The aim of this paper is to compare the actual evolution with a scenario in which the Government corrected the tax schedule for the inflationary effect, indexing the items (tax brackets and credits) according to the annual Consumer Price Index. Without any additional control, this technique will be potentially biased. The indexation of the tax schedule causes taxpayers to face a different tax rate in this counterfactual scenario. However, it is likely that taxpayers will adapt their behavior to this change in the tax rates. For this reason, this paper extends a dynamic microsimulation exercise to take into account changes in taxpayer behavior.

In the Public Economics literature, the Elasticity of Taxable Income (ETI) framework tries to capture this behavioral answer (see Saez et al. (2012)). In order to do that, it relies on an extension of the canonical labor-supply model (explained together with the Bunching Method in Appendix B.2). In this paper, we will estimate the ETI for Spain in the 1980s following the two most common methods in this field: the tax reform approach (Kleven and Schultz, 2014) and the bunching method (Saez, 2010).[6] The fundamental difference between the two methods lies in their identification strategy. The tax-reform approach exploits longitudinal tax data to identify the behavioral answer of taxpayers due to a reform in the tax system (Gruber and Saez, 2002; Kleven and Schultz, 2014; Weber, 2014). In other words, it identifies the ETI from the changes in income due to exogenous shifts in marginal tax rates due to tax reforms. Formally (Gruber and Saez, 2002, p. 7):

$$\Delta ln(z_{i,t}) = \varepsilon * \Delta ln(1 - \tau_{i,t}) + \Delta\gamma_t^c * x_i^c + \gamma^c * \Delta x_{i,t}^v + u_{i,t} \tag{5.3}$$

where $\Delta ln(z_{i,t})$ is the difference (in logarithms) of income, $(1 - \tau_{i,t})$ is the marginal net-of-tax rate, ε the elasticity of taxable income (ETI), x_i^c any time-invariant characteristics (gender, type of declaration), $x_{i,t}^v$ any time-varying characteristics (marriage, children, presence of old people, age, region, etc.). Marginal net-of-tax rates $(1 - \tau)$ represent the inverse of the marginal tax rate (τ). Thus, counterintuitively, a negative relationship between marginal tax rates and taxable income will be captured by a *positive* ETI. As an example, an ETI equal to 0.5 indicates that an increase by 1% of the marginal net-of-tax rate (a decrease in the marginal tax rate) will predict an increase by 0.5% in the taxable income. The time length between the two-pair observations is generally set at three years (Feldstein, 1995).

Without further control, this estimation will be downward biased as ε will capture two different effects. First, the change in taxable income due to changes in marginal tax rates (ETI). But, second, any automatic shift in the marginal tax rates as taxable income changes. If, for instance, the taxpayer's income increases due to a positive shock, she will face a higher marginal tax rate (and a lower marginal net-of-tax rate) as her taxable income is now in a more progressive part of the bracket. This second effect will lead to an underestimation of the ETI, as it establishes a negative relationship between marginal net-of-tax rates (1-marginal tax rate) and taxable income.

To solve this problem, the tax-reform approach isolates the exogenous variation in the marginal tax rate due to only the tax reform. This exogenous variation is captured by predicting the marginal tax rates the individual would have faced assuming that their real taxable income remained constant. Formally (Gruber and Saez, 2002; Almunia and Lopez-Rodriguez, 2019):

$$\tau_{i,t}^p \equiv \frac{T_{t+s}(z_{i,t} + 10) - T_{t+s}(z_{i,t})}{10} \tag{5.4}$$

Where $T_{t+s}(.)$ is the tax schedule in time t+s, and $z_{i,t}$ is the real taxable income in time t and $T_{t+s}(z_{i,t})$ the tax liability from applying tax schedule in t+s to income in time t. Then, $\tau_{i,t}^p$ will represent the marginal tax rate the individual would have

[6] See He et al. (2021) for a literature review comparing both methods

faced in time t+s if their income remained equal in real terms to time t. This predicted marginal tax rate $\tau^p_{i,t}$ will be used as an instrument for the actual marginal tax rate, in an Instrumental Variable (IV) framework (Gruber and Saez, 2002; Almunia and Lopez-Rodriguez, 2019). Formally, the first stage of the IV approach is:

$$\Delta ln(1-\hat{\tau}_{i,t}) = \varepsilon * \Delta ln(1-\tau^p_{i,t}) + \Delta\gamma^c_t * x^c_i + \gamma^c * \Delta x^v_{i,t} + u_{i,t} \tag{5.5}$$

And the second stage:

$$\Delta ln(z_{i,t}) = \varepsilon * \Delta ln(1-\hat{\tau}_{i,t}) + \Delta\gamma^c_t * x^c_i + \gamma^c * \Delta x^v_{i,t} + u_{i,t} \tag{5.6}$$

However, running an IV regression following the previous specification might lead to biased estimates of the ETI if the elasticity is correlated with income z (Gruber and Saez, 2002, p. 10). If taxpayers' income evolves differently along the distribution during the period analyzed, we will identify as ETI what is partially driven by other non-tax factors driving these income trends. The literature has identified two potential channels for this heterogeneity in income trends: a change of the shape of the distribution of income explained by non-tax factors (Kleven and Schultz, 2014, p. 272) and a case of mean reversion as taxpayers return to their permanent-income level (Kleven and Schultz, 2014, p. 272).[7]

The literature on ETI has offered a variety of specifications to solve this issue. In a seminal paper, Auten and Carroll (1999) proposed controlling the IV estimation with the logarithm of the base year income. This base year observation will capture part of the correlation between the elasticity and the income in time t. However, this solution is assuming that the two previous effects mentioned before operate linearly over the distribution. This is not likely to be the case, especially in combination with each other (Gruber and Saez, 2002, p. 11). As an alternative, Gruber and Saez (2002) propose a more flexible estimation of the base year income. Instead of logarithms, the IV estimation is extended with ten-piece splines of the base year income, allowing for more flexibility over the distribution of income. Finally, Weber (2014) argues in favor of using lagged values to create both the instrument and control for base-year income. Using lagged values minimizes mean reversion, as any potential shock affecting an individual is likely to be reduced within time. In addition, it also minimizes heterogenous trends in income, as we control for a longer-run estimation of the distribution of income. In the following section, we will compute the ETI following these three different approaches: Auten-Carrol, Gruber-Saez and Weber.

This analysis is extended in three different ways. First, we replicate the exercise with the gross income of individuals. This gross income is the closest possible approximation to the true income of individuals. Thus, the so-called Elasticity of Gross Income (EGI)

[7]These two problems have been identified as particularly important in the 1980s (Gruber and Saez, 2002).

represents the actual changes in behavior on the part of the individual in the face of a change in the tax rate. If the values of ETI and EGI are very close to each other, there is evidence that most of the change in agents' behavior is due to changes in their economic performance and not in their tax behavior. Second, we replicate the exercise for several subsamples according to various criteria (marriage, children, age, and income source) in search of evidence of heterogeneity in the elasticities (Almunia and Lopez-Rodriguez (2019), see Appendix B.1). Third, as robustness, in Appendix B.2, we analyze an alternative approach to the Tax Reform method, the so-called Bunching method (Saez, 2010). If individuals respond to changes in the marginal rate, we can expect that there will be an accumulation or bunch of taxpayers near the kink points where the marginal rate jumps. This excess of taxpayers will be the key to the estimation of the elasticity following this alternative method.

Once we estimate the elasticities, we replicate the proposed dynamic microsimulation exercise by including this parameter. This exercise allows us to test the robustness of the microsimulation exercise since it replicates the tax reform exercise by controlling for possible changes in taxpayer behavior in the face of changes in the tax rate derived from the reform. The inclusion of these elasticities is done according by the following algorithm. First, we calculate the simulated marginal net-of-rates in the face of inflation adjustments up to t $(1-\tau_{i,t}^{s_1})$. Second, we calculate the simulated marginal net of rates in the absence of inflation adjustments in t, but adjusted up to $t-1$ $(1-\tau_{i,t}^{s_0})$. As we can see, the scenario with which we compare the simulation is *not* the actual evolution. If we were to use the actual evolution as the comparison scenario, we would be assuming that taxpayers compare their marginal rate resulting from the reform in t with the rate that would be given if the tax had not been adjusted in t and in *all* previous years $t-n$. It is hardly thinkable that taxpayers would do this comparative exercise. In contrast, we propose that taxpayers change their behavior in t according to the tax changes from not adjusting the tax in that year t (but having done so in all previous periods, $t-n$). Second, we calculate the difference between marginal net-of-tax rates:

$$\Delta(1-\tau_{i,t}^{s}) = \left(1-\tau_{i,t}^{s_1}\right) - \left(1-\tau_{i,t}^{s_0}\right) \tag{5.7}$$

where $1-\tau_{i,t}^{s_1}$ is the predicted marginal net-of-tax rates with adjustment in time t (and all previous periods) and $1-\tau_{i,t}^{s_0}$ is the predicted marginal net-of-tax rates without adjustment in t (but in all previous periods). Third, we modify the tax base (and gross income) in time t according to the change in the marginal net-of-tax rates $(\Delta(1-\tau_{i,t}^{s}))$ and the estimated elasticity (ε):[8]

[8] This formula comes from the following derivation: $\ln(\frac{z_{i,t}^s}{z_{i,t}}) = \varepsilon \cdot \ln(\frac{1-\tau_{i,t}^s}{1-\tau_{i,t}})$; $e^{\ln(\frac{z_{i,t}^s}{z_{i,t}})} = e^{\ln(\frac{1-\tau_{i,t}^s}{1-\tau_{i,t}})^\varepsilon}$; $\frac{z_{i,t}^s}{z_{i,t}} = \left(\frac{1-\tau_{i,t}^s}{1-\tau_{i,t}}\right)^\varepsilon$; $z_{i,t}^s = z_{i,t} \cdot \left(\frac{1-\tau_{i,t}^s}{1-\tau_{i,t}}\right)^\varepsilon$; $z_{i,t}^s = z_{i,t} \cdot \left(1 + \left(\frac{(1-\tau_{i,t}^s)-(1-\tau_{i,t})}{1-\tau_{i,t}}\right)^\varepsilon\right)$. For relatively small values of $\Delta(1-\tau_{i,t}^s)$, this is equivalent to: $z_{i,t}^s = z_{i,t} \cdot \left(1 + \varepsilon \cdot \Delta(1-\tau_{i,t}^s)\right)$.

$$z^s_{i,t} = z_{i,t} \cdot (1 + \varepsilon \cdot \Delta(1 - \tau^s_{i,t})) \tag{5.8}$$

Fourth, we redo the tax with the predicted value of net taxable income and gross income for 1980. Fifth, we predict the value of the net taxable income and gross income for the following year (1981), according to the growth rate actually observed in the panel from year 1980 to 1981 ($\gamma_{i,t}$):

$$z^s_{i,t+1} = z^s_{i,t} \cdot (1 + \gamma_{i,t}) \tag{5.9}$$

Sixth, we repeat the algorithm by going back to step 1 using the predicted values for 1981. We redo this algorithm successively until 1987. This form of correction includes elasticities in a relatively simple way, assuming an immediate and sticky[9] change in taxpayer behavior in the face of changes in the marginal rate. The literature on elasticities is much more complex, with a long discussion of temporality, and the long vs short-run taxpayer behavior (see Saez et al. (2012) for a detailed discussion). However, we consider that this baseline is sufficient to control for possible changes in taxpayers' behavior in the face of the proposed reform.[10]

[9]i) Immediate: taxpayers answer in the same year to changes in the tax rates and ii) sticky: changes in prior behavior from period $t-n$ are still "affecting" taxpayers behavior in time t.

[10]Especially given that in this case, the estimated elasticities are low, as will be shown.

6

Empirical Analysis

6.1 Results

6.1.1 Baseline Simulation

In this first exercise, we use the cross-sectional sample from 1979-1981 (3,000,000 taxpayers) together with the PDIRPF panel (224,724 taxpayers) to estimate the potential consequences of not adjusting the tax to inflation. This sample includes 3,224,724 taxpayers. Relying on this sample, we measure and compare the actual evolution with up to three different scenarios in which the tax system was adjusted. In this first estimation, we do not control for potential changes in taxpayers' behavior derived from the tax reform, estimated in the next subsection and included in an extension at the end of this section.

Revenue

How much of the increase in tax revenue in Spain from 1979 to 1987 was explained by the lack of adjustment of the tax? The main results are summarized in Table 6.1. This table presents four different scenarios: 1) the original scenario, in which the tax was not adjusted, 2) the scenario in which the entire tax was adjusted, and 3 and 4) two other scenarios in which only brackets or fixed credits were adjusted. As we can see, the increase in revenue during this period was spectacular in nominal terms. Tax revenue increased by 370% from 1979 to 1987, from 440 billion to just over 2 trillion pesetas (columns 1-2).[1]

[1]The aggregation of tax revenue has been done by multiplying the number of taxpayers in the sample for each year by the parameter that gives the total number of taxpayers for that same year. This technique gives an estimate of tax revenues that differs slightly from the aggregate statistics. We have the following prediction errors for the first six years 1979-1984 (numbers in millions): 1,01% for 1979 (441,795 vs 437,059), 0.02% for 1980 (610,244 vs 610,383), 2.28% for 1981 (668,025 vs 683,622), 0.52% for 1982 (804,368 vs 808,620), 1.5% for 1983 (990,887 vs 1,005,694) and 1.08% (1,231,884 vs 1,245,368). The source for this comparison comes from Lasarte Alvarez (1986).

However, the increase in revenue is much more modest in the scenario where authorities adjust the tax. In this scenario, revenue increases about 200% from 1979 to 1987, reaching 1.3 trillion pesetas in 1987 (columns 4 and 5). The differences in the change in tax revenue between both scenarios give the increase in revenue derived from the lack of adjustment of the tax. For 1987, this is equal to 708,869 million pesetas. In the original evolution, tax revenue increased from 1979 to 1987 by 1,627,551 million pesetas. From this quantity, 43.55% is due to the lack of adjustment of the tax.[2] In brief, inflation (or the lack of adjustment to it) accounts for approximately 44% of the increase in tax revenue from 1979 to 1987 in Spain.[3]

Table 6.1 also shows information regarding the two main channels of the inflationary effect on the tax: the brackets and the fixed credits. Columns 6-7 represent the inflationary effect derived solely from the lack of adjustment of the tax schedule, predicting for 1987 an inflationary increase in revenue of 32.41% (column 6). Thus, the lack of bracket adjustment accounts for about 75% of the total inflationary effect (column 7). The remaining 25% of the effect corresponds to the lack of adjustment of fixed credits (column 9), which alone predicts an increase in revenue of 12% for the years 1979-1987 (column 8).[4]

Progressivity

How was the bracket creep distributed over the distribution? Who was more harmed by the inflationary effect? How would progressivity change under alternative scenarios of adjustment? Figure 6.1 shows the results according to the Kakwani Index.

Observing the actual evolution of progressivity during the period 1979-1987, it increased considerably. Originally, the progressivity of the Spanish system was close to that of countries such as the USA (0.15-0.18) and Canada (0.16-0.19), and much lower than that of other systems (Australia, 0-19-0.24, United Kingdom, 0.25-0.32) (Kakwani, 1980, p. 158-161). However, in the 1980s it increased to values close to 0.25 (Figure 6.1).[5] It is important to mention here that this progressivity analysis is not performed for the whole population, but only for the sample of reporting taxpayers. The inclusion of the entire population could significantly change the results (see Torregrosa-Hetland and Sabaté (2022) for an example of this approach).

[2]These values come come from the following formulas: i) $708,869 = 2,069,346 - 1,360,477$, ii) $1,627,551 = 2,069,346 - 441,795$, iii) $43.55 = \frac{708,869}{1,627,500} \cdot 100$ and iv) $75\% = \frac{32.41\%}{43.55\%}$

[3]In table 6.1 we can also observe how bracket creep increases over time. In 1980, only 15% of the increase in tax revenue is predicted by the lack of adjustment, or in other words, around one-third of the result estimated for 7 years later (1987).

[4]There is a slight error in the estimation, as the sum of the shares does not equal to 100, although this error does not surpass the 1% in any year of the period.

[5]The analysis of progressivity and redistribution is robust with respect to previous research on this period in Spain. Indeed, it shows identical Kakwani and Reynold-Smolensky indexes for the second part of the sample (1982-1987) as in Fernández et al. (2007) that relies on the sample micro-panel database as this paper.

Table 6.1: Tax Revenue: Main Results

Year	Original		Total Adjustment			Bracket Adjustment		Credit Adjustment	
	Absolute (millions)	1979 = 100	Absolute (millions)	1979 = 100	Inflationary revenue (%)	Inflationary revenue (%)	Share of total (%)	Inflationary tevenue (%)	Share of total (%)
1979	441,795.7	100	441,795.7	100	-	-	-	-	-
1980	610,383.8	138.16	584,368	132.27	15.43	13.28	86.07	2.15	13.93
1981	668,024.6	151.21	602,871.8	136.46	28.80	22.68	78.75	6.15	21.35
1982	804,368.8	182.08	684,463.3	154.93	33.07	24.75	74.84	8.55	25.85
1983	990,887.3	224.28	789,486.5	178.70	36.68	28.03	76.42	9.21	25.09
1984	1,231,884	278.84	940,745.4	212.93	36.85	28.53	77.42	8.60	23.33
1985	1,319,058	298.57	962,943.4	217.96	40.59	30.53	75.21	10.15	25.01
1986	1,689,974	382.52	1,136,367	257.22	44.35	33.28	75.04	11.53	25.99
1987	2,069,346	468.39	1,360,477	300.79	43.55	32.41	74.42	11.84	27.19

Notes: This table presents the evolution of tax revenue from 1979 and 1987 under four different scenarios. Columns 1 and 2 show the actual evolution. Columns 3,4 and 5 show the Total Adjustment scenario in which both brackets and tax credits are adjusted to inflation. Column 5 (*Inflationary revenue*) shows the percentage of the increase in total tax revenue that is driven only by the lack of adjustment of the tax to inflation. Columns 6-9 show the decomposition under two partial adjustments. Columns 6 and 7 show the evolution of tax revenue under the hypothesis that only the brackets are adjusted. Column 6 shows the inflationary revenue (calculated in the same way as in column 5). Column 7 (*Share of total*) shows the share of the inflationary revenue that is explained only due to a lack of adjustment of the bracket. Columns 8 and 9 show the same results for a scenario of credit adjustments.

What would have happened if the tax had been adjusted to inflation both in its brackets and in the system of fixed credits? As we can see in Figure 6.1, almost nothing. The evolution of the Kakwani Progressivity Index is practically identical in both scenarios, showing only small differences at the end of the period.[6] Thus, we predict a Kakwani Index equal to 0.26 in 1987 under the total adjustment scenario versus 0.25 in the original. If authorities had adjusted the income tax, progressivity would have increased from 1979 to 1987 by 70% (0.15 to 0.26), practically the same as the 66% (0.15 to 0.25) observed in the actual scenario without adjustment.

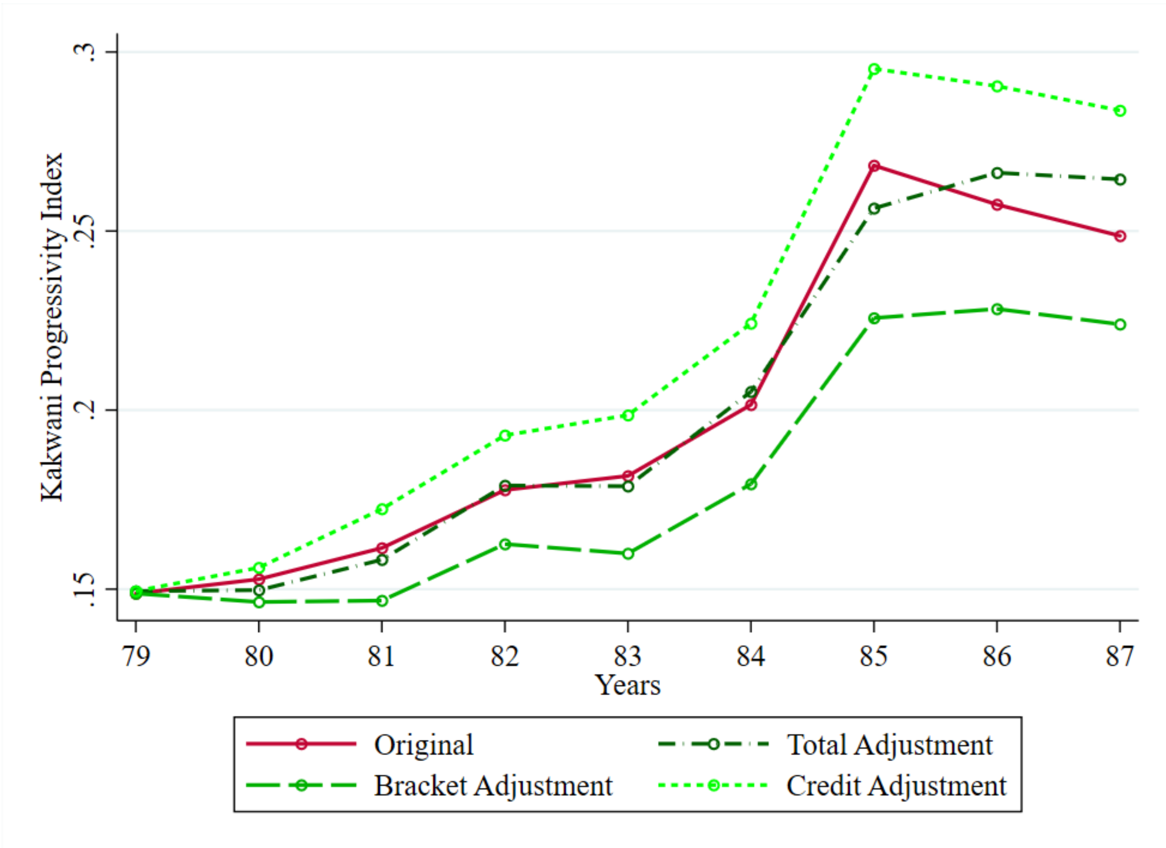

Figure 6.1: Kakwani Progressivity Index

In reality, this result hides a more complex truth. To see this, we propose two other scenarios in which only a partial adjustment of the tax is considered. First, if only the brackets are adjusted, progressivity would have reached significantly lower levels (0.23) in 1987. In this case, progressivity would have increased by 50% (0.15 to 0.23) compared to the 66% observed in the original scenario. As expected, inflation (or the lack of adjustment to it) leads to an increase in progressivity when we only consider the tax brackets. On the other hand, the lack of adjustment of fixed tax credits provides the opposite result. Had they been adjusted, progressivity would have reached values above 0.28. That is, progressivity would have increased by 80% instead of 66%. This is due to the fact that tax credits imply in relative terms a greater reduction in the tax

[6]For further information on the estimation of progressivity, see Table C.1 in Appendix C.

liability for lower incomes. A total adjustment of the tax would hardly have changed the progressivity of the tax. But not because the inflationary effect was non-existent, but because there were two compensatory effects playing a role here: the positive effect through the brackets and the negative effect through the tax credits.

Following Torregrosa-Hetland and Sabaté (2022), we include the evolution of the average effective rate along the income percentiles for the period 1980-1987. Figure 6.2 shows the averages for the whole period (1980-1987). In Appendix C we include the average effective tax rates for 1980, 1984, and 1987, where we can see how the inflationary effect is magnified over time (see Figures C.3, C.4 and C.5).

Relying on these estimations, we can better observe what the lack of tax adjustment meant for each taxpayer depending on their position in the income distribution. In the subfigure on the left, we compare the actual and simulated average effective rates from a full adjustment scenario (Figure 6.2, left). At a glance, we might conclude that the curve shifts downward practically homogeneously throughout the distribution. This would be consistent with the minimum change in the Kakwani progressivity index. However, this result is more complex than that. Figure 6.3 shows the ratios between the actual average effective rate and the simulated average effective rate under an adjustment scenario. The horizontal line $y = 100$ implies no change between both scenarios. The difference with respect to the horizontal line shows the percentage increase in the average effective rate due to the lack of tax adjustment. For instance, a value equal to 101 implies that inflation (or the lack of adjustment to it) predicts an increase of 1% in the average effective tax rate. The subfigure on the left compares the actual evolution with a full tax adjustment scenario (Figure 6.2, left). As we see, the evolution has a clear M-shape. The sub-extremes of the distribution are the most adversely affected by the lack of adjustment of the tax. For percentiles 2-10, the lack of adjustment supposes an increase up to 80% in the average effective rate. On the other part of the distribution, for percentiles 90-98, the lack of adjustment predicts an increase of up to 40% in the average effective rate. For the intermediate percentiles (10-90), however, the lack of adjustment predicts a smaller and almost-constant increase of 20%. Interestingly, the negative effect found for the sub-extremes almost disappears for the first and last percentiles of the distribution. In the first percentile, the taxpayer is exempted to pay in both scenarios (the average effective rate is 0 in both scenarios). In the percentile 100, the ratio is significantly smaller than previous percentiles due to the legal limit, above which the tax becomes proportional and any inflationary effect on the schedule disappears.

Disaggregating the analysis into partial adjustment scenarios further explains this M-shaped. With only a bracket adjustment, the highest part of the distribution would have benefited the most (Figure 6.2, center). Thus, the absence of bracket adjustment was particularly detrimental for this group, implying an increase of almost 40% in the average effective rate (Figure 6.3, center). Again, we see that this effect shrinks for

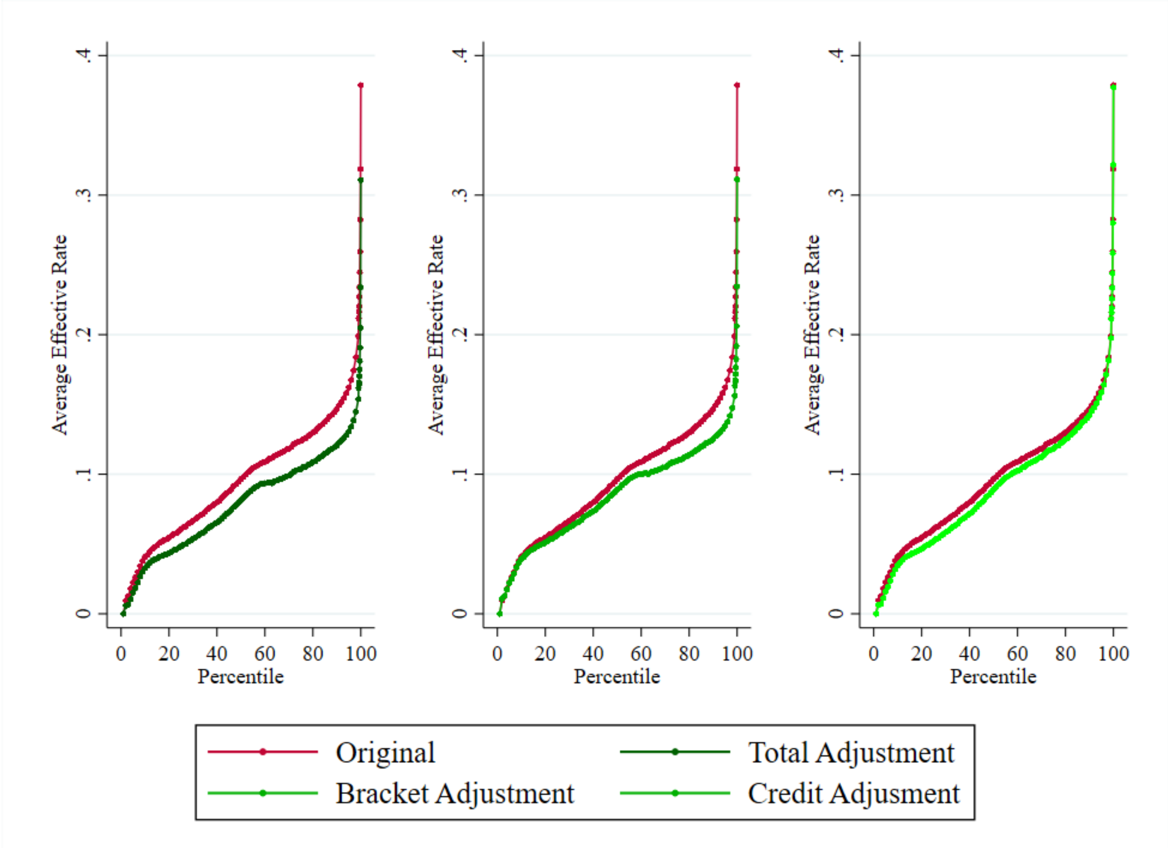

Figure 6.2: Average Effective Tax Rates (average 1980-1987)

the top 1 percentile thanks to the legal limit. This was exactly the point argued by Minoria Catalana y Vasca in their proposal of automatic adjustment of the IRPF to inflation (Congreso de los Diputados (1984, p. 4795), Minoria Catalana y Vasca (1983)). However, a partial adjustment in credits would have benefited the other part of the distribution. Given an adjustment in tax credits, the main beneficiaries of this measure would have been lower incomes, for whom it represents a larger relative reduction of their tax liability (Figure 6.2, right). Thus, not adjusting the tax credits would have meant an increase of up to 80% in the average effective rate of the lowest percentiles (Figure 6.3). This was the point emphasized by the Communist Party in their proposal to adjust the IRPF to inflation (Partido Comunista, 1980, p. 365). We observe again the exception of percentile 1, which would face the same average effective rate as in a total-adjustment scenario, e,g. 0.

A complex M-shape like the one shown agreed with the effects identified by both Minoria Catalana y Vasca and the Communist Party. However, it disagrees with them showing that actually *both* effects are happening at the same time. In addition, this M-shape is completely overlooked by concentration measures such as the Kakwani index. In this case, inflation (or the lack of adjustment to it) does not change the progressivity of the tax not because of a lack of effect or because the effect was homogeneous across the distribution, but because the losses at the upper and lower ends of the distribution compensate each other.

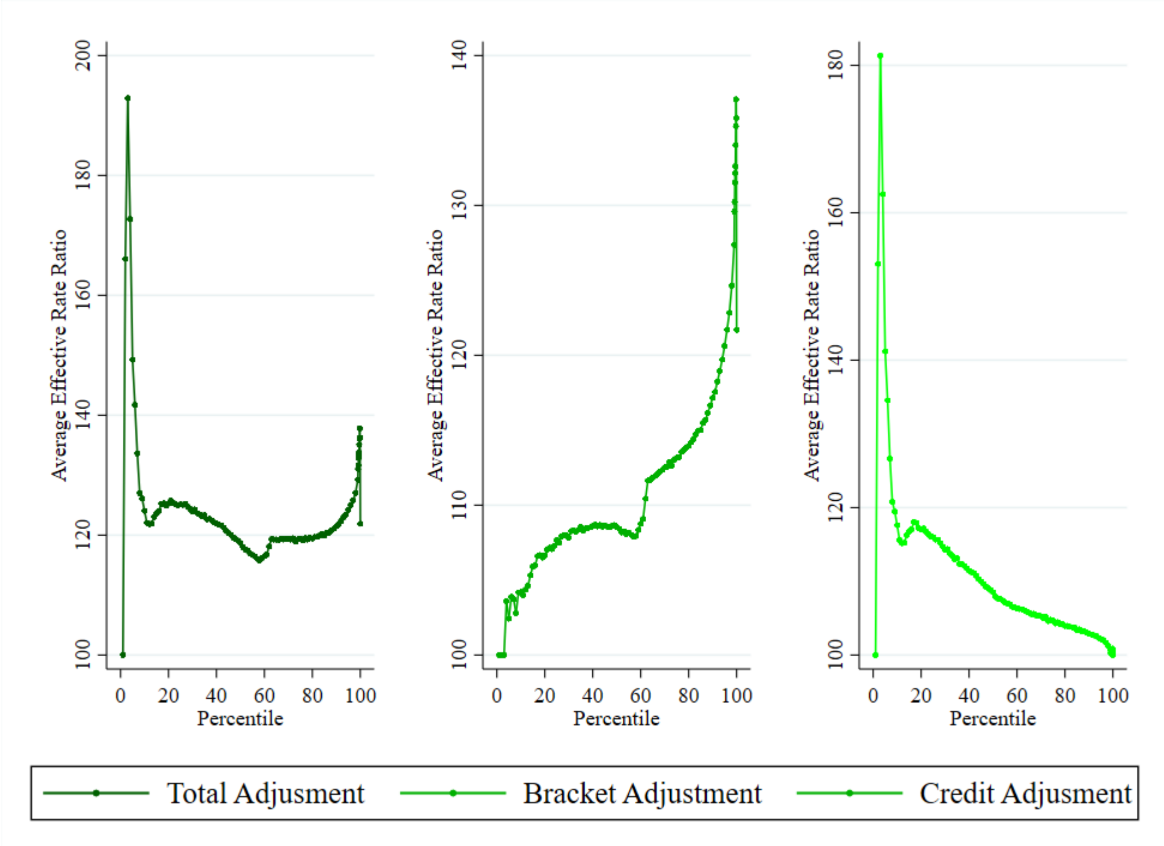

Figure 6.3: Average Effective Tax Rate Ratios (average 1980-1987)

Redistribution

What happens with the redistributive capacity of the tax? As we have seen, redistribution depends on both progressivity and total revenue. We have also seen that both progressivity and revenue increased considerably throughout 1979-1987. The result is visible by following the evolution of the Reynolds-Smolensky (RS) index over the period. It rose by 85% from 0.02 in 1979 to 0.037 in 1987.[7]

What happens in the scenario in which the tax is adjusted for inflation? In the full-adjustment case, the RS grows modestly from 1979 to 1987 (Figure 6.4) increasing only by 25% from 0.02 to 0.025 in 1987. The remaining 60% of the increase in the redistributive capacity is due to the lack of adjustment of the tax. In other words, inflation (or the lack of adjustment to it) predicts more than two-thirds of the increase in redistribution observed from 1979 to 1987. This result is in turn explained by the 44 % increase in total revenue together with the minimum effect on progressivity due to the lack of adjustment of the tax.

A decomposition analysis shows different results for partial reforms. If only the brackets had been adjusted, the RS would have reached values even lower than 0.025. In this case, both progressivity and revenue would go in the same downward direction, implying a cumulative effect. In contrast, in the credit adjustment scenario, RS would

[7]For further information on the estimations of redistribution, see Table C.2 in Appendix C.

increase to values even higher than 0.037. In this case, the increase in progressivity would have compensated for the (small) revenue losses.

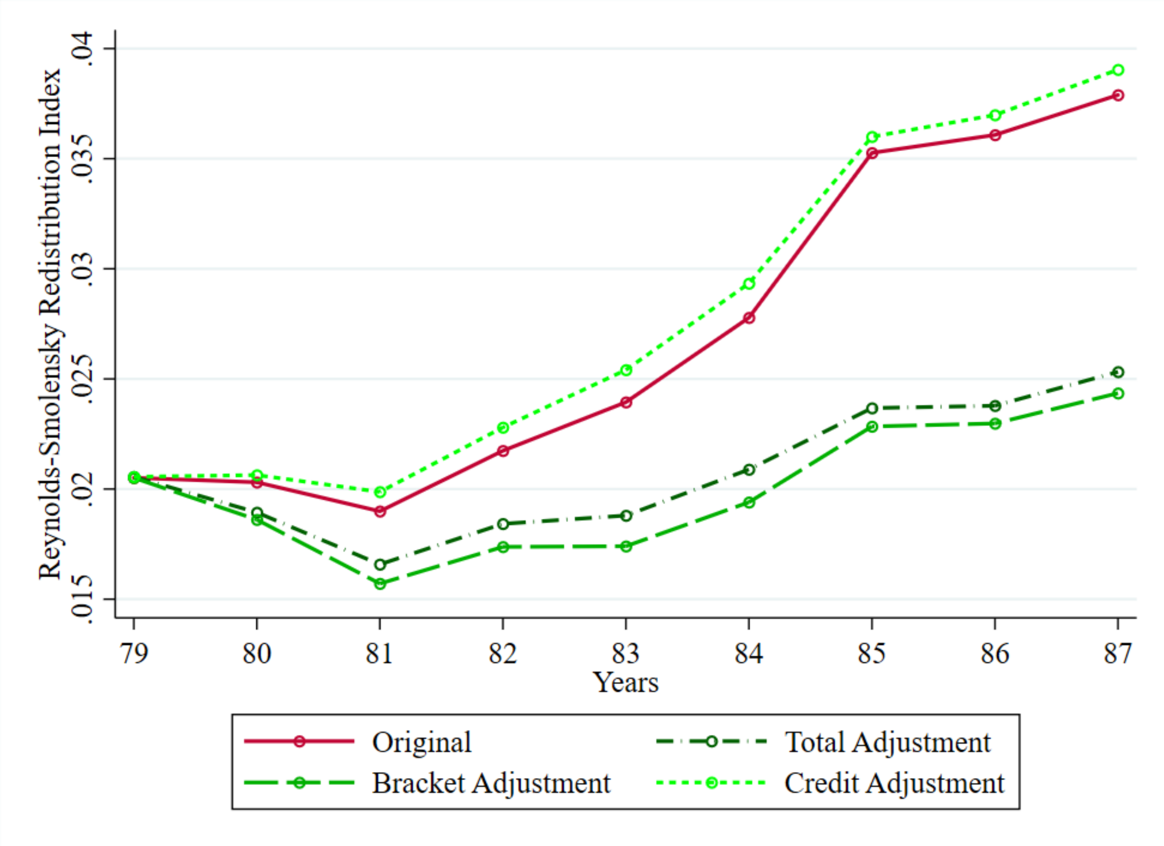

Figure 6.4: Reynolds-Smolensky Redistribution Index

A similar way of analyzing the redistributive capacity of the tax is to plot the evolution of inequality before and after taxes (which is basically what the RS Index measures, Figure 6.5).[8] Pre-tax income Gini went from values equal to 0.32 to values close to 0.39 in 1987. However, post-tax inequality grew more moderately, from 0.30 to 0.353. Thus, the gap between pre and post-tax inequality increased from 0.02 to 0.037 (equal to the evolution of the RS index). However, if the tax had been adjusted for inflation, post-tax inequality would have reached higher values by the end of the period, slightly above 0.365. Thus, the gap between pre- and post-tax inequality would have remained virtually constant throughout the period (as indicated by the modest increase in RS from 0.02 to 0.025).

[8]Notice that these are indices of inequality of gross incomes between tax filers, not inequality measures for the whole population. This paper does not discuss the evolution of income inequality for this period for Spain, a matter of debate in the literature (Pena et al., 1996; Gradín et al., 2002; Torregrosa-Hetland, 2016).

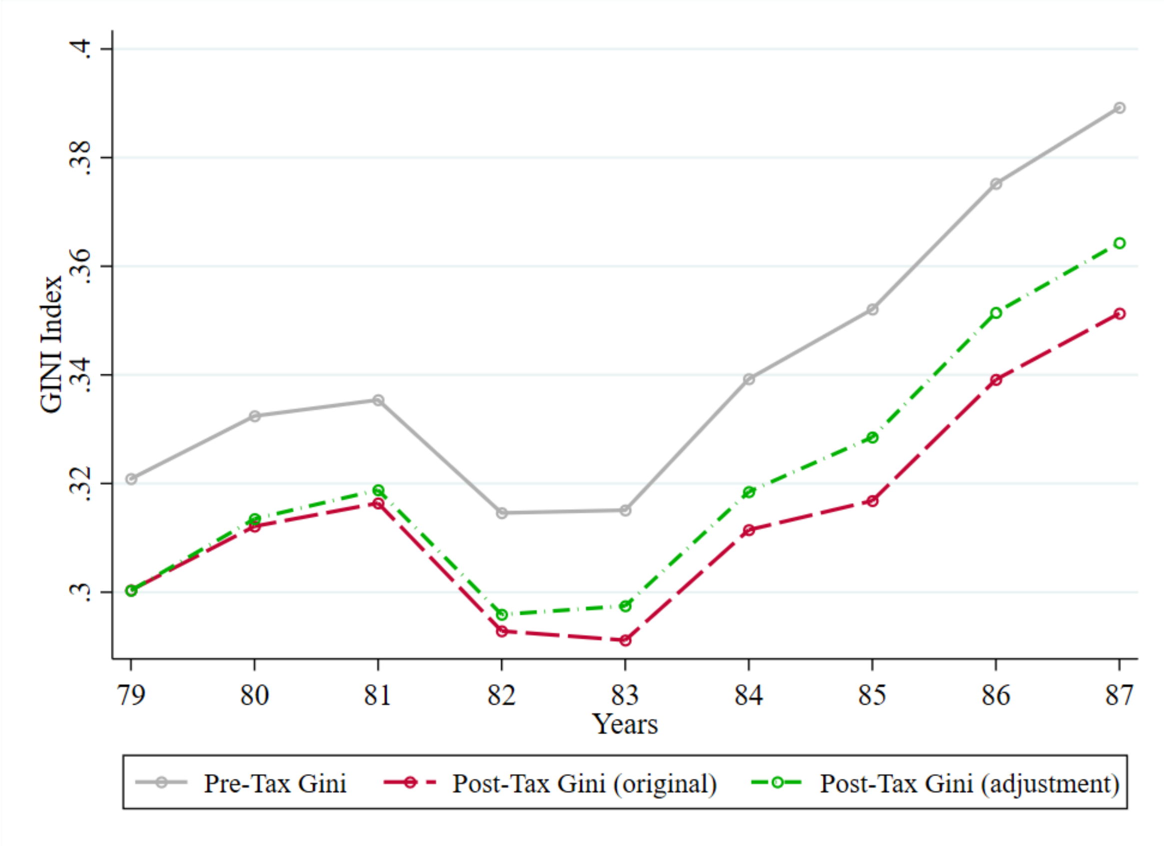

Figure 6.5: Pre and Post-Tax Income Gini Index

6.1.2 Elasticity of Taxable Income

The previous subsection has been carried out without controlling for changes in the possible behavior of taxpayers to changes in the tax rate. This subsection captures this behavior by estimating the Elasticity of Taxable Income. Following the Tax Reform approach, we compare three-pair observations with three years of difference (1982-1985, 1983-1986, 1984-1987). The tax schedule changed considerably due to the reform in 1985, which lies within the three-pair year observations. This change in the marginal tax rates will be the source of exogenous variation to identify the ETI.

Table 6.2 shows the main results. Column 1 illustrates how the OLS regression will underestimate the estimation of the elasticity. In this case, the ETI predicted by this baseline estimation is equal to -2.5. An increase of 1% in the net-of-tax rates will predict a decrease of 2.5% in the taxable income. In other words, an increase in marginal tax rate will predict a bigger increase in taxable income. This result is driven by the automatic effect of the tax schedule mentioned before (higher taxable income, higher marginal tax rate). Column 2 shows the results for the IV estimation without correcting for mean reversion or heterogeneous income trends. This leads to an elasticity of 0.5. However, this estimation is likely to be significantly (upper) biased.

Columns 3, 4, and 5 represent the three main approaches within the tax reform approach. Column 3 shows the Auten and Carroll (1999) approach. To compute this

Table 6.2: Tax Reform Approach: Elasticity Estimates

	OLS	IV	Auten-Carroll	Gruber-Saez	Weber
			Second stage IV estimation		
Taxable Income (ETI)					
$\Delta \ln(1-\tau)$	-2.563***	0.516***	0.0798	0.168**	0.223**
	[-2.50,-2.53]	[0.39,0.64]	[-0.03,0.19]	[0.07,0.27]	[0.09,0.36]
R^2	0.306	0.089	0.32	0.357	0.41
Gross Income (EGI)					
$\Delta \ln(1-\tau)$	-2.510***	0.531***	0.116*	0.207***	0.307***
	[-2.55,-2.48]	[0.40,0.65]	[0.01,0.22]	[0.10,0.31]	[0.17,0.44]
R^2	0.30	0.087	0.301	0.332	0.382
			First stage IV estimation		
Predicted Net-of-Tax Change					
$\Delta \ln(1-\tau^p)$		0.312***	0.316***	0.315***	0.284***
		(0.0036)	(0.0035)	(0.0036)	(0.0045)
Regional FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Household Controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Base-year Income	*No*	*No*	*Log*	*Splines*	*Splines (lags)*
N	332,254	332,011	332,011	332,011	203,058

This table report regression results for the panel dataset 1982-1987. Column 1 shows the OLS estimation. Column 2 shows the IV estimation without controlling for base-year income. Columns 3, 4, and 5 show the main results of the three approaches proposed. Column 3 shows Auten and Carroll (1999), including the logarithm of base year income. Column 4 shows Gruber and Saez (2002) estimation, including 10-piece spline of base-year income. Column 5 illustrates Weber (2014) approach, including 1982-year observations as lags for the 1983-1986 and 1984-1987 analysis. All specifications include regional fixed effects and year fixed effects. Household controls are the type of tax return (standard vs simplified), marital status, presence (and number) of kids, presence (and number) of people over 70 years, presence (and number) of ascendants (children over 18 and dependent on first earner's income), presence (and number) of disabled, type of taxpayer according to her main source of income (employee, self-employed, or investor). Standard errors are clustered by household. For the interest of the analysis, instead of standard errors, we include in brackets the 95% confidence interval of the estimations for the elasticities. Significance levels: *** = 1%, ** = 5% and * = 10%.

method, we include the logarithm of the income of 1982 for 1982-1985, 1983 for 1983-1985, and 1984 for 1984-1987. This leads to an elasticity equal to 0.09, non-significantly different from zero. Still, this result will be potentially driven by the assumption of a linear effect from the mean reversion and from changes in the distribution. Column 4 illustrates the estimation of the ETI relying on Gruber and Saez (2002) methodology. In order to do that, we create ten-piece splines of the base-year taxable income for each pair of observations. This is the same approach as Auten and Carroll (1999) but it allows for more flexibility over the distribution of the base-year income. This extension increases the ETI to 0.17, significantly different from 0 at 5%. This estimation has a lower bound equal to 0.07 and an upper bound equal to 0.27. Finally, column 4 shows the result following Weber (2014) approach. Weber argues in support of the superiority of the estimation using lags of the base year income for both the creation of the instrument and the creation of the splines. Due to limitations in the panel database (1982 was the first year recorded) we interpret this approach using 1982 as the base year income for the subsequent two-pair observations: 1983-1986 and 1984-1987. This approach leads to an ETI really close to the one by Gruber and Saez (2002). Following Weber, the elasticity is equal to 0.22, significant at 5% with a lower bound equal to 0.09 and an upper bound equal to 0.36.

Regarding the Elasticity of Gross Income, the results are very similar to those derived from the ETI. Using both Auten-Carroll and Gruber-Saez, the EGI values differ by less than 5 percentage points with respect to the ETI. The largest difference is observed using Weber's methodology, where the EGI gives a value of 0.3 versus 0.22 derived from the ETI. This difference goes against expectations since we would assume that the EGI, if anything, would be lower than the ETI. However, the minimum and maximum values are around the same units (0.1 and 0.4), while the EGI estimates are quite close to the 0.2 proposed for the ETI. Overall, we believe that this is evidence enough to assume that the EGI will be the same as the ETI. That is, all the change in the behavior of individuals comes from actual economic changes and not from changes in their reporting pattern. This evidence is consistent with the situation of Spain at that time: taxpayers were unable to optimize their decisions in the face of a tax under construction and as unpredictable in its evolution as the personal income tax was in the 1980s.

In Appendix B.1 we include extra evidence regarding the potential heterogeneity of this estimation (see Table B.1). The literature has shown that the behavioral answer might change depending on the taxpayer's characteristics (Almunia and Lopez-Rodriguez, 2019). Due to that, we decompose de analysis following up to four different criteria. First, we split the sample between married and single taxpayers (Díaz and Onrubia, 2015; Díaz-Caro and Onrubia, 2018). The ETI is slightly bigger for the latter (0.3) than for the former (0.17). Second, in a similar vein, we distinguish between households with and without children. The ETI is slightly higher for households without children (0.33 vs 0.15). Third, we split the sample between young adults (25-45 years) and older adults (45-65 years). In line with the literature (Sanz-Sanz et al., 2015), the result points to higher elasticities for younger individuals (0.17 vs 0.14). Finally, we distinguish between employees and other types of taxpayers. Contrary to the literature (Almunia and Lopez-Rodriguez, 2019), we find that employees are slightly more sensitive to changes in tax rates (0.28 vs 0.12). However, these estimations are not significantly different at 5%. Overall, up to eight different subsamples give values between the same bounds (0.1-0.4). Similar results are found for the EGI (see Table B.1).

In addition, in Appendix B.2, we prove the robustness of this estimation by relying on an alternative approach: the bunching method. We conduct this analysis for the only kink for which bunching behavior is visually identified (800.000 pesetas, see B.1). Within the bunching literature, we replicate three different approaches. First of all, we follow the seminal paper by (Saez, 2010). Using Saez's approach gives an ETI equal to 0.19 (see Figure B.2). This methodology has been discussed in subsequent papers (Bertanha et al., 2021) due to its strong assumptions for the identification of elasticity. Due to that, we extend this analysis with Bertanha et al. (2021) which offers weaker conditions for the estimation of the ETI. Bertanha et al. (2021) propose two methods, a non-parametric and a semi-parametric one, to estimate the elasticity. The first one, non-parametric, give lower and upper bounds for the elasticity of taxable income. For this kink (800.000 pesetas), the lower bound is set at 0.16 and the upper bound at 0.37 (see Figure B.2). The second approach relies on individual covariates to semi-parametrically estimate the elasticity. This second method gives an ETI from 0.25 to 0.19, the level at which it converges with further reductions of the sample size (see Figure B.3).

Overall, up to two theories, six specifications, four decomposition analyses, and two-income definitions yield values very close to 0.2, with bounds between 0.1 and 0.4. Even more, these estimations are almost identical to the review done by Saez et al. (2012) that finds that the best available estimates range from 0.12 to 0.4 with a midpoint of 0.25. Thus, altogether, we believe that an estimation equal to 0.2 is robust enough to any potential biases from the identification process. In other words, a 1% increase in the marginal net-of-tax rates predicts an increase in 0.2% both in the taxable and gross income. This elasticity is assumed to be constant for the whole population. Even though this is a strong assumption, up to four decomposition analyses give really close values to 0.2, ranging from 0.1 to 0.4. Still, together with the most preferred estimation (0.2), we will replicate the following exercise in Appendix C using both a lower and an upper bound. The values for this interval are chosen by both the confidence interval from the tax reform estimation and from the bounds identified using the bunching method. These are: a lower bound equal to 0.1 and an upper bound equal to 0.4.

6.1.3 Extended Simulation

The lack of adjustment of the tax explains 44% of the increase in total revenue, while hardly changing progressivity because the ends of the distribution were the most adversely affected, offsetting this effect mutually. In addition, inflation (or the lack of adjustment to it) explains up to two-thirds of the increase in redistribution from 1979 to 1987. Moreover, the potential change in taxpayer behavior resulting from tax reform is very modest: for a 1% increase in net marginal tax rates, we expect a 0.2% increase in taxpayer income. Putting both results together, we expect that controlling for taxpayer behavior will not considerably modify the results found in the baseline estimation.[9]

For this purpose, we use the panel sample for the years 1979-1981 (1 million filers) together with the PDIRPF panel (227,724 filers). For the construction of this panel sample, we have used the growth rates for each percentile. This exercise has clear limitations, as it assumes that inequality within each income percentile remains constant. At the same time, the presence of taxpayers whose income changes in an extreme way from one year to another adds a bias to these average estimates.[10] As a consequence, the results shown in the baseline estimation are slightly modified using this panel sample. Yet, the purpose of using this panel sample is to see to what extent the analysis is robust to changes in taxpayer behavior. Within the same tax adjustment scenario, we will focus on the potential differences between incorporating or not taxpayers' behavior. Along with that, we consider that there is no compelling reason that taxpayer behavioral differences would change significantly with an improved version of the panel. However, we make clear these limitations, which will be discussed at the end of this section along with several proposals for extending the analysis.

On the revenue side, controlling for taxpayer behavior predicts a 6 percentage points higher increase in tax revenue in the total adjustment scenario (245% vs 239%, Figure 6.6 and Table C.3). The lower marginal rates resulting from the reform would lead to an increase in taxpayers' income (gross and reported), which explains why the full adjustment scenario now predicts a relatively higher increase in tax revenue. The inflationary revenue, measured as the difference between the original and the adjustment scenario, would now represent a slightly smaller percentage of the increase in total revenue. Without controlling for taxpayer behavior, inflation (or the lack of adjustment to it) predicts the 37% of the total increase in revenue, while controlling for the former we predict 35%, 2 percentage points lower.[11]

[9] For further information on these estimations together with the replication of the exercise with lower (0.1) and upper bounds (0.4) of the ETI see Table C.3 in Appendix C.

[10] At its extreme, in this sample there are several taxpayers whose reported income becomes practically 0 from t to the $t+1$. Thus, the predicted growth rates for these individuals in t are well below -100%. The opposite happens with taxpayers whose reported income was 0 in the previous exercise $t-1$, predicting growth rates well above 100% for period t.

[11] These values come from: $1 - 239/375 = 0.37$ and $1 - 245/375 = 0.35$. Here we see the limitations of these panel data, as the baseline value predicts a significantly lower increase in revenue (37%) than the 44% observed in the cross-sectional sample (preferred estimate).

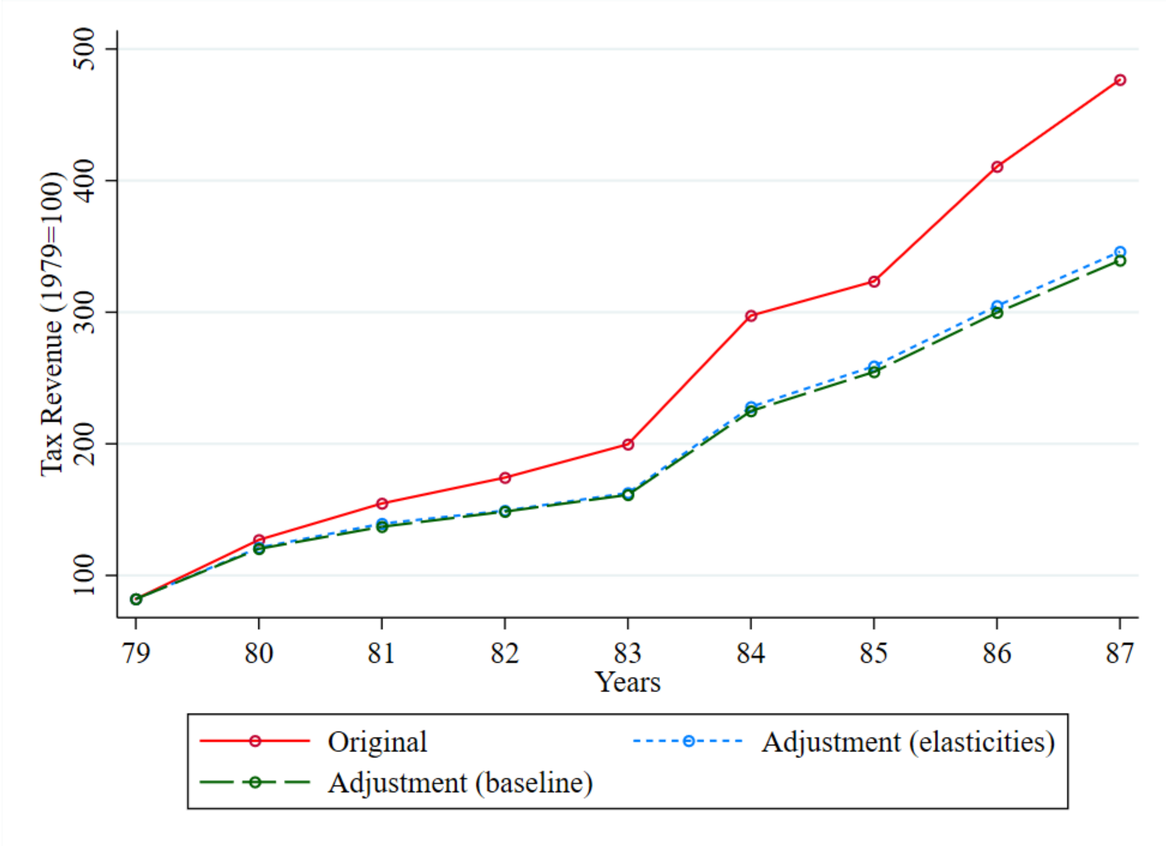

Figure 6.6: Tax Revenue: Robustness

Regarding progressivity, controlling for taxpayer behavior does not change the evidence shown under the tax adjustment scenario (Figure 6.7). Using the panel sample, the Kakwani Index increases in the original scenario by 69% from 1979 to 1987 (0.146 to 0.248). The scenario with adjustment predicts a slightly lower increase in progressivity (58.2%, from 0.146 to 0.231). By including the elasticities, the Kakwani index increases slightly more, up to 58.9% (from 0.146 to 0.232). The overall higher level of income predicted from the tax rate reduction would move the distribution of taxpayers to a slightly more progressive part of the tax. However, within the tax adjustment scenario, this increase is almost negligible: progressivity would increase by 0.8 percentage points more by controlling for taxpayers' behavior (58.9% vs 58.2%).[12]

Finally, the panel sample indicates an increase in redistribution under the original scenario by 118% (from 0.0188 in 1979 to 0.041 in 1987). With a full tax adjustment, the Reynolds-Smolensky index would grow by only 40.4% (from 0.0188 to 0.0264). Controlling for the behavioral effect, we see a slightly higher increase in redistribution under the adjustment scenario, equal to 42.4% (from 0.0188 to 0.0268). This difference comes from the cumulative effect observed on both progressivity and revenue. Even so, this effect is virtually negligible (Figure 6.8). Incorporating taxpayers' behavior would

[12]Using this panel, we find that the lack of adjustment of the tax *increased* moderately the progressivity of the income tax compared to the original scenario. However, we refer back to the baseline estimation as the most rigorous comparison between adjustment and non-adjustment scenarios.

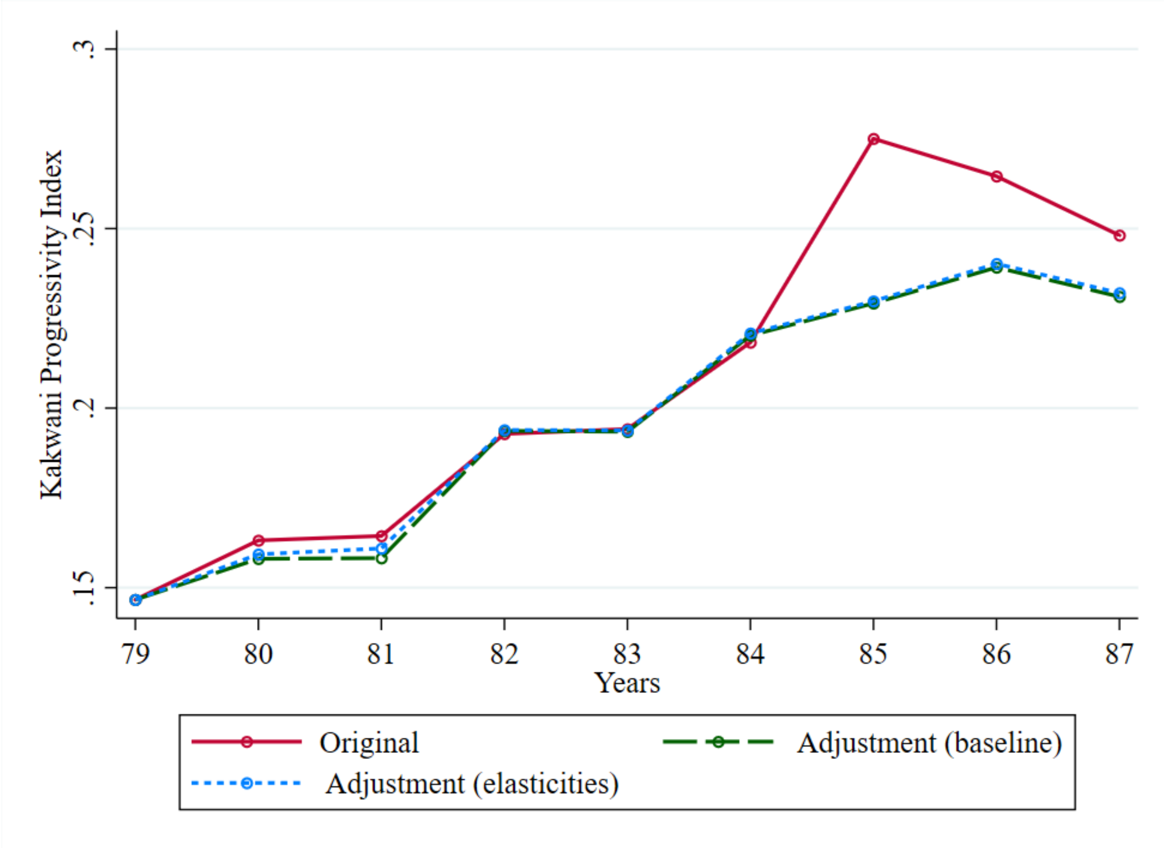

Figure 6.7: Kakwani Progressivity Index: Robustness

hardly change the previous evidence: the vast majority of the increase in redistribution in the 1979-1987 period is due to the lack of tax adjustment to inflation (118% vs. 42.5-40.2%).

In brief, neither the effect on revenue nor on progressivity or redistribution would be significantly modified taking into account the possible change in taxpayers' behavior due to the changes in tax rates from the tax reform scenario. In addition, the replication with lower (0.1) and upper (0.4) bounds of the elasticity barely changes the results (see Table C.3). Still, we refer back to the baseline estimation as the most rigorous comparison between adjustment and non-adjustment scenarios.[13]

6.2 Discussion

6.2.1 Revisiting Previous Literature

The literature on the bracket creep for the period 1979-1987 for Spain focused mainly on the effect of the nominal increase in income on tax revenue, leaving the analysis of progressivity in the background. Regarding revenue, our estimate is significantly below

[13] As we can observe Table C.3, a higher elasticity predicts higher differences between scenarios. Still, even using the upper bound (0.4) barely changes the differences with respect to the baseline scenario that does not control for taxpayer behavior.

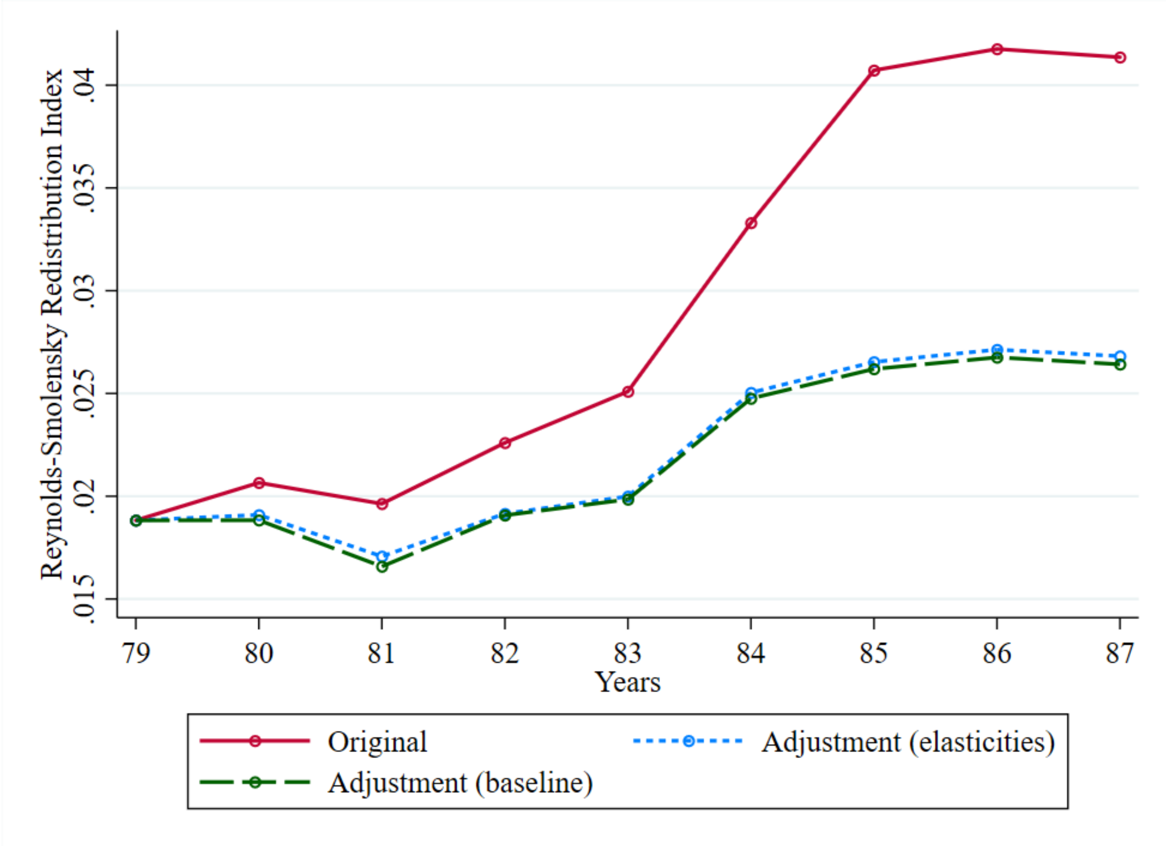

Figure 6.8: Reynolds-Smolensky Redistribution Index: Robustness

the previous literature for this period in Spain. In their seminal paper, Gonzalez-Páramo and Argimón Maza (1987) estimate for 1979-1984 that inflation accounted for up to 85% of the increase in revenue. For the same period, our estimate is less than half, about 36%. An extension of this work is done by Valdés Sánchez (1989), which uses random cross-sectional samples of 100,000 returns for 1979-1985, estimating that the nominal increase in income accounted for 60-75% of the total increase in revenue. Our cumulative estimate through 1985 establishes a value equal to 40%, significantly lower. Finally, Jimenez and Salas del Mármol (1992), using the same micro-panel we use here (the PDIRPF) estimate the bracket creep for the period 1982-1987 at 65%, which is reduced to 53% controlling for changes in fiscal policies over time.[14] In short, as the methodology and data improve, the previous literature converges towards the values estimated in this paper, where inflation (in our case the lack of adjustment to inflation) explains 44% of the increase in revenue during the period 1979-1987. A comparison of our estimates with previous literature for other countries shows the cumulative effect

[14]These papers illustrate the improvement in both data and methodology over time. The seminal paper even if laid the groundwork for bracket creep analysis in Spain, suffered from the absence of micro-level data (Gonzalez-Páramo and Argimón Maza, 1987, p. 364). This was addressed by Valdés Sánchez (1989), but the latter suffered from the lack of panel data following the same taxpayers and the lack of special treatment of new filers joining the return (Valdés Sánchez, 1989, p. 39). These two weaknesses were faced in Jimenez and Salas del Mármol (1992). This paper, however, ignored the three periods of peak inflation (1979, 1980 and 1981) since the date of the creation of the income tax, which considerably affected the identification of the inflationary effect.

of inflation. Due to the length of the period (9 years) and the severity of inflation in the 1980s, our estimates are significantly higher than for shorter and more recent periods (Immervoll, 2005; Zhu et al., 2014) but lower than for longer periods with higher inflation (Torregrosa-Hetland and Sabaté, 2022).

In relation to the redistributive aspects, our paper marks a clear modification of the seminal work. Gonzalez-Páramo and Argimón Maza (1987) estimate that the effect of the bracket creep is clearly regressive, mainly affecting lower incomes and decreasing until it almost disappears in the upper-income bracket. This is in line with literature for other countries, both from the 1970s (Goetz and Weber, 1971) and more recent (Levy et al., 2010; Dorn et al., 2017). On the contrary, in the face of a total adjustment of the tax, we find hardly any difference in progressivity. This is in line with other papers for this period in Spain (Valdés Sánchez, 1989; Jimenez and Salas del Mármol, 1992) that rule out a clear effect on the progressivity of the tax. However, our analysis differs from this literature by refuting that the lack of change in progressivity implies a homogeneous effect of the bracket creep across the distribution of income. Progressivity does not change because the two extremes of the distribution are the most affected by the lack of adjustment (with the exceptions of percentiles 1 and 100). On the one hand, the lower end is affected by the erosion of fixed credits, and the upper end by the erosion of brackets. In this line, we show that the concentration measures broadly used in the bracket creep literature (Fernández et al., 2006) such as the Kakwani Index provide a partial picture of the effect. These measures have to be complemented by a double exercise: a decomposition analysis between two distinct channels (brackets and credits) and an analysis of the average effective tax rate over the distribution of income. In addition, our estimates for redistribution confirms the previous literature, in which tax revenue dominates over progressivity (Immervoll, 2005; Torregrosa-Hetland and Sabaté, 2022). In our case, as progressivity barely changes, the increase in revenue from inflation explains almost completely the increase in redistribution observed.

We extend the analysis controlling for potential changes in taxpayers' behavior through the estimation of the elasticity of taxable (and gross) income, which allows us to decompose the "behavioral effect" from the "structural effect" derived from the tax reform (Alinaghi et al., 2021; Creedy, 2022). However, our preferred estimate results in an ETI equal to 0.2. This low value confirms the robustness of the previous bracket creep analysis to changes in the taxpayers' behavior. Our ETI estimate is among the lowest in the literature for Spain. For the late 1980s, Díaz Mendoza (2004) obtains an ETI between 0.13 and 0.7. Subsequently, Caro and Fernández (2015) estimates an ETI close to 0.4 for the period 1999-2014. The more rigorous estimation recently carried out by Almunia and Lopez-Rodriguez (2019) estimates an ETI for the same period 1999-2014 between 0.45 and 0.6.[15] Interestingly, Almunia and Lopez-Rodriguez (2019)

[15]Díaz Mendoza (2004) and Caro and Fernández (2015) follow the method by Gruber and Saez (2002), whereas Almunia and Lopez-Rodriguez (2019) extend the previous method with Weber (2014)

obtain an estimate of the gross income elasticity (EGI) significantly lower, and very close to that of our results (0.1-0.25). While ETI seems to have increased from values close to 0.2 to values close to 0.5, EGI seems to have remained relatively constant from the 1980s to the present.

We suggest two complementary theories for this evidence. First, Spanish taxpayers might have learned to adapt their filing behavior over time to the design of the tax. This adaptive taxpayer behavior brings the ETI literature closer to Behavorial Economics (Hashimzade et al., 2014; Torgler, 2021). In the first years of the implementation of the IRPF, taxpayers were unaware of and unable to foresee what the tax obligations derived from a new-created tax would entail for them (Torgler, 2014). With the establishment of the IRPF as an income tax, taxpayers adapted to the tax, optimizing part of their filing behavior in accordance with the changes in tax legislation. A second explanation points to the simplification of the personal income tax scheme since its creation in 1979. Thus, the number of brackets in the 1980s was 34, while it was reduced to 17 in 1988, to 9 in 1998, and to 5-6 in the early 2000s. It is possible that taxpayers reacted less in the 1980s because of the large number of brackets and the relatively moderate increase in the marginal rate implied by the bracket jump. This is consistent with Chetty et al. (2011), which suggests that a larger number of brackets (and a smaller jump in the marginal rate) generates a much smaller taxpayer response than a regime with larger jumps and fewer brackets. If, in addition, part of the taxpayer response comes from income shifting (Gorry et al., 2021), our paper suggests that schemes with more brackets and smaller jumps may more effectively avoid this problem.

6.2.2 Limitations and Further Research

This article presents considerable methodological limitations. First, bracket creep is measured from the perspective of tax reform, taking as a reference a scenario in which the tax is perfectly adjusted to inflation. The difficulty of decomposing nominal and real income growth makes indirect means of measurement necessary. Secondly, this exercise proposes an automatic adjustment of the tax according to the Consumer Price Index, following the parliamentary proposals presented at the time (Minoria Catalana y Vasca, 1983). However, there are other ways of adjusting the tax to inflation (see Beer et al. (2023)) that could lead to different results from those found here. Third, the redistribution and progressivity analysis refers only to the population of tax filers. This analysis could differ considerably taking into account the whole population (see Torregrosa-Hetland and Sabaté (2022)). Fourth, the panel sample has been generated according to the average income growth of each percentile, leading to some differences from the baseline estimation. Fifth, the incorporation of the elasticity assumes a very

and a method not used here by Kleven and Schultz (2014) simplified taxpayer behavior, being 1) homogeneous, 2) immediate, and 3) sticky.[16] These and other limitations discussed in Saez et al. (2012) open the door to capture taxpayer behavior differently.

In addition, this paper does not address two aspects that we consider fundamental for bracket creep analysis. First, the potential role of personal income tax as a macroeconomic stabilizer: due to the bracket creep, the increase in the tax burden could have slowed down consumption and aggregate demand, helping as a stabilizer to reduce the "inflationary psychology" of the moment (Immervoll, 2006). This argument was mentioned at the time by the PSOE government: "For the same reason, (*the adjustment of the tax*) breaks the very important possibility that personal income tax could also serve as an instrument to fight inflation" (Garcia Ronda (PSOE), Congreso de los Diputados, 1984, p. 4797). This form of macroeconomic stabilizer could have ensured a faster reduction of inflation thanks to a brake on aggregate demand. If so, our estimation would face an important bias, since it depends on the indirect assumption that inflation would have risen in the same way in the face of an automatic adjustment of the tax.

Second, we do not take into account the redistributive role of public spending that resulted from the increase in revenue caused by the bracket creep. The non-adjustment of the tax accounted for 44% of the increase in revenue, which in turn led to an increase in the redistributive capacity of the tax. However, this is only one side, as it does not take into account the redistributive effect via expenditure derived from this additional revenue (Musgrave et al., 1974). The redistributive increase could derive not only from a relative increase in the taxation of high incomes but also from the increase in a system of public services especially beneficial to low incomes. In Spain, social expenditure skyrocketed during this period (Espigares and Torres, 2004; Espuelas Barroso, 2013). A general analysis (expenditure and revenue) would provide a more complete and realistic view of the bracket creep effect.

Finally, this paper suggests two lines of further research. First, an analysis that contemplates in greater depth the heterogeneous and dynamic behavior of taxpayers. This would imply a more refined examination of the effect on taxpayers' behavior derived from the tax reforms used as a reference to measure bracket creep (Alinaghi et al., 2021; Creedy, 2022). Second, a strategy focused on certain population subgroups for which income and/or economic behavior are more easily controllable. Among others, a promising example to capture bracket creep would be pensioners, whose 1) income is mainly derived from inflationary adjustments and 2) presents relatively limited economic behavior in the face of changes in tax rates.

[16] i) Homogenous: same elasticity for all taxpayers), ii) immediate: taxpayers answer in the same year to changes in the tax rates and iii) sticky: changes in prior behavior from period $t-n$ are still present in time t.

7

Conclusion

This paper offers a new way of measuring bracket creep based on a dynamic approach that tracks changes in taxpayer behavior. For this purpose, we have used the case of Spain in the 1980s, where the newly created Personal Income Tax (IRPF) (1979) hardly changed despite the fact that inflation rates hovered above 10% during the whole period. This paper contributes in different dimensions to previous literature.

First, we offer a solution to the lack of micro data for the first three years of the IRPF (1979-1981). For this purpose, we resort for the first time for Spain to Generalized Pareto Curves (Blanchet et al., 2022), generating a synthetic evolution from 1979 to 1981. This allows us to show from a micro perspective (consistent with aggregate statistics) the evolution of the IRPF in its first three years of application.

Second, we measure the bracket creep based on a dynamic microsimulation approach that refines the previous static exercises in the literature (Immervoll, 2005). To do that, we compare the actual evolution with different scenarios in which the income tax is adjusted to inflation. Our results significantly modify some of the previous literature. On the revenue side, we estimate that the lack of adjustment implied a 44% of the total increase revenue, significantly lower than previous estimates (Gonzalez-Páramo and Argimón Maza, 1987). As for progressivity, we find a minimal effect in the Kakwani Index. Putting both results together, we show that almost 70% of the increase in the redistributive capacity of the tax was due to the lack of adjustment to inflation. Redistribution is mainly driven by the increase in revenue, in line with previous literature (Torregrosa-Hetland and Sabaté, 2022).

Third, we provide a further examination of the (apparent) minimum change in progressivity. First, we perform a decomposition analysis, in which we include two partial adjustment scenarios, one concerning brackets and other tax credits. The lack of change in progressivity is not due to a homogeneous effect but to two opposing effects: eroded credits reduce progressivity and the eroded schedule increases it. This evidence is complemented by an analysis of the percentile evolution of the average effective rates. We show a clear M-shape where the sub-extremes of the income distribution were the most affected by the lack of adjustment of the tax. The lack of adjustment of credits affected mainly the lower end, which had to face an 80% higher average effective tax rate than in the adjustment scenario (with the exception of percentile 1, exempted to pay in both scenarios). The lack of bracket adjustment affected the high-end, which had to pay up to a 40% higher average effective tax rate (with the exception of the top percentile, which benefited from the legal limit). This double decomposition highlights the limitations of the usual tools in the literature, based on concentration curves, when measuring bracket creep.

Fourth, we discuss the robustness of the dynamic microsimulation controlling for the possible change in taxpayer behavior in the tax reform scenario. To this end, we provide for the first time for 1982-1987 in Spain estimates of the Elasticity of Taxable (and Gross) Income. Up to two theories (Tax Reform and Bunching Method), six specifications (Auten and Carroll, 1999; Gruber and Saez, 2002; Weber, 2014; Saez, 2010; Bertanha et al., 2021)), eight population subgroups, and two different definitions of income yield values very close to 0.2, with bounds between 0.1 and 0.4. Due to the small elasticity, neither the effect on revenue nor on progressivity or redistribution is significantly modified taking into account the possible change in taxpayers' behavior due to the changes in tax rates from the tax reform scenario. Thus, we show that the "behavioral effect" is minimum compared to the "structural effect" derived from the reform (Creedy, 2022).

Fifth, the estimation of the elasticity points to a change in the behavior of Spanish taxpayers from the creation of the income tax (IRPF) in 1979 to the present. More specifically, Spanish taxpayers now react more to changes in the tax rate. However, this increase is not due to greater real changes (labor supply), but rather to changes in the way of filing. We propose two complementary theories that suggest this change 1) is an adaptive phenomenon (Hashimzade et al., 2014) and/or 2) is due to the simplification of the income tax schedule over time (Chetty et al., 2011).

Our results have important implications for today. In the current inflationary period, the vast majority of countries do not have an automatic adjustment mechanism. Therefore, it is crucial to understand the bracket creep to ensure a transparent tax policy that ensures the protection of those most affected by this effect. Moreover, bracket creep is a first-order issue for the developing world. In many of these countries, the revenue-raising capacity of direct taxes has much room for improvement (Benedek et al., 2022). This paper sheds light on a potential explanation for their stagnation: the continuous distortions arising from the inability of income taxation to adjust to a phenomenon as common and persistent in these countries as inflation.

Finally, the clear limitations of the paper motivate further analyses for the future based on more precise estimates of elasticities and on certain subgroups of taxpayers. However, these points are beyond the scope of this paper.

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Appendix A

Microsimulation of the Subsample 1979-1981

This section explains in more detail the simulation of the two different subsamples for the periods 1979-1981.

A.1 Simulation of Cross Sectional Subample

For the cross-section subsample, once I carry out the simulation following Blanchet et al. (2022) methodology, I have three synthetic income distributions for 1 million different individuals for each tax year, consistent with the aggregate information collected in the reports (see Table A.1). However, to obtain a complete sample of tax returns, I need to extend this simulation exercise. Personal income tax returns have several variables that depend on the socioeconomic characteristics of the taxpayer. For the case of Spain in the 1980s, this was evident in the case of fixed-rate credits. These credits meant a reduction of the tax liability by a fixed amount if the taxpayer met the imputation criteria. For this period, the main fixed-rate credits in Spain were: marriage, children, disabled persons, elderly persons (over 70 years old) and young adults in the household.

A first option to determine what percentage of the synthetic sample meets a given characteristic (married, disabled, elderly, etc.), would be to resort to the annual averages reporeted in the Tax Reform Reports of 1980 and 1981. However, the literature shows how these demographic characteristics vary significantly with the income level of individuals (for number of children, Koball et al. (2021), for disability, Banks et al. (2017), for youth independence, Iacovou (2010)).[1] To avoid this bias, I use the report

[1]Indeed, a quick glance at the report from 1980 rejects the homogeneous distribution of these characteristics by income. For instance, the percentage of married people among the filers increases from 75% in the first bracket (less than 200,000 pesetas) to almost 90% for families with an income of more than 3.4 million pesetas (see Table A.2). Similarly, while the lower brackets are more likely to have one child (17% vs. 10%), the proportion is reversed with a higher number of children. Thus, the percentage of families with more than 4 children is almost double in the last bracket (3.85%) compared to the first (1.8%).

Table A.1: Validity of the Simulation based on Generalized Pareto Curves.

	1979			1980			1981		
Bracket (millions)	*Actual*	*Simulation*	*Error*	*Actual*	*Simulation*	*Error (%)*	*Actual*	*Simulation*	*Error (%)*
0-600	456.710	458.711	0 %	445.274	445,273	0 %	504.530	503.331	0.23 %
600-800	736.633	736.689	0.007 %	710.687	710.829	0.019 %	697.832	697.809	0.003 %
800-1,000	947.315	947.426	0.011 %	906.093	906.035	0.006 %	893.788	893.559	0.026 %
1,000-1,400	1,240.197	1,239.363	0.067 %	1,206.845	1,206.147	0.057 %	1,1170.896	1,1171.205	0.0027 %
1,400-1,800	1,672.555	1,672.598	0.0025 %	1,624.382	1,624039	0.0001 %	1,1577.433	1,576.942	0.03 %
1,800-2,200	2,103.512	2,103.515	0.0001 %	2,050.911	2,051.118	0.01 %	1,978.137	1,978.356	0.011 %
2,200-2,600	2,534.226	2,534.711	0.019 %	2,467.156	2,466.320	0.03 %	2,384.350	2,384.214	0.0057 %
2,600-3,000	2,966.008	2,965.098	0.030 %	2,896.346	2,895.873	0.016 %	2,785.756	2,786.692	0.033 %
3,000-3,400	3,396.008	3,396.020	0.0003 %	3,325.079	3,324.335	0.02 %	3,188.085	3,187.603	0.015 %
3,400-3,800	3,787443	3,787.999	0.014 %	3,677.130	3,678.331	0.03 %	3,592.610	3,594.559	0.054
>3,800	8,319.026	7,681.838	8.15 %	5,930.794	5,913.678	0.28 %	5.760.000	5,609.006	2.85 %

This table reports the mean values for each income threshold. It compares the value from actual reports and the simulated value together with the mean relative errors.

of 1981 on the statistics of the IRPF for the 1980 fiscal year (*Memoria de la Reforma Fiscal*, 1981). This report offers disaggregated demographic information for the same 12 income brackets used for the previous simulation. Because of the lack of this information in the 1979 and 1981 fiscal years, I assume that the distribution of these characteristics by bracket remains constant (albeit with different total means) for the period before (1979) and after (1981) the fiscal year 1980.

For each type of credit, the 1981 report includes the percentage of total filers in each income bracket who deduct their tax liability in the fiscal year 1980. From the percentages collected in the report, I can estimate the probability that taxpayer i belonging to income bracket j has a fixed credit x^f. Using these probabilities, I generate a binomial distribution for each income bracket whose mean is equal to the percentage observed in the report. Thus, the total distribution of each credit arises from the aggregation of the 12 binomial distributions, one for each of the 12 income brackets. Formally:

$$P(n) = \sum P(\{(e_1, \ldots, e_N)\}) = \binom{N_i}{k_i} \cdot p_i^k \cdot q_i^{N_i - k_i}$$

where N_i is the number of tax filers in each threshold i and k_i is the number of tax filers in threshold i that meet the criterion set by the credit x^f. The parameter p_i is the probability of meeting this criterion, whereas q_i is the probability of not meeting this criterion $(1 - p_i)$. In this simulation, I set the parameter p_i to the value that the report for the fiscal year 1980 gives to the percentage of tax filers in threshold i that meets the criterion set by the credit x^f. Thus, a simulation of a binomial distribution with an average probability of success of p_i will identify a number of individuals k_i whose share of the population N_i of the threshold i will be equal to p_i. In doing so, I generate an Indicator (0,1) that is equal to 1 when the taxpayer is predicted to meet the criterion. For 1979 and 1981, these average probabilities per income bracket are adjusted to match the aggregate average for each year.[2] Table A.2 shows an example of the tax credits for marriages. As we can see, the predicted value using our approach presents an error always below 0.3%.

Table A.2: Share of Marriage by Threshold: Actual vs Simulation

Income Threshold (millions)	*Share (actual)*	*Share (simulation)*	*Error*	*N*
0-200	76.95	76.99	0.04	43,022
200-400	65.36	65.33	0.03	43,562
400-600	72.48	72.44	0.04	287,464
600-800	77.60	77.67	0.07	218,655
800-1000	82.57	82.43	0.14	154,490
1000-1400	86.09	86.00	0.09	136,531
1400-1800	87.72	87.72	0	54,432
1800-2200	90.34	90.07	0.27	25,397
2200-2600	92.76	92.54	0.22	12,912
2600-3000	87.78	87.49	0.29	7,292
3000-3400	88.55	88.72	0.17	4,549
>3400	86.61	86.42	0.19	11,594
Total	76.91	76.90	0.01	1,000,000

This table reports the percentage of marriage for each income threshold. It compares the value from actual reports and the simulated value together with the mean relative errors.

In addition to fixed credits, the income tax presents certain credits that depend on the income reported by the individual. These are referred to as variable credits. In the report for the fiscal year 1980, there is information disaggregated by brackets for the following variable credits: donation, dividends, professional fees, capital acquisition, and housing. For these five credits, I have information on the percentage of filers per bracket and the average amount reported. The simulation of these variables is done in

[2]It is important to mention that this information comes from fiscal data, which may not match the national distribution. In addition, it is to be expected that certain characteristics (e.g., being married) increase the probability of having others (having children). In the case of children and marriage, I make this distinction by correcting the probabilities by the mean number of children for married and unmarried. However, I do not have cross-sectional information for other variables, which are likely to be related. Therefore, this simulation is performed under the assumption that these variables are orthogonal, being totally independent of each other.

two steps. First, I simulate the probability of filing each variable credit following the same process conducted above with fixed credits. This gives an Indicator (0,1) that has an average probability of p_i for each income threshold i. Once I have the sample of taxpayers identified with filers of this credit, I have to generate the value of these items. To carry out this task, I first calculate the average rate associated with each variable credit. Formally:

$$\bar{\tau}_{x_j^v} = \frac{\bar{x_j}^v}{\bar{z}^v}$$

where $\bar{x_j}^v$ is the average variable credit j for the whole sample and $\bar{z}^v$ is the average taxable income for the sub-sample of taxpayers reporting this credit j. Then, $\bar{\tau}_{x^v}$ represents the average rate of credit j. I use this rate for all the taxpayers that fill this criterion:

$$x_{i,j}^v = z_i \cdot \bar{\tau}_{x_j^v}$$

where z_i is the taxable income of individual i, $\bar{\tau}_{x_j^v}$ is the average rate for credit j, and $x_{i,j}^v$ is the predicted variable credit j for individual i For the years 1979 and 1981, I assume the same parameters (predicted probabilities and average rates) as in 1980.

This simulation has clear limitations. Firstly, I am using 1980 as a benchmark for the years 1979 and 1981. Due to the lack of data, I do not directly observe the distribution by brackets of variable and fixed credits for the fiscal years 1979 and 1981. Second, the list of variable credits is much longer than the five included in the analysis.[3] Nevertheless, this methodology accurately predicts the information collected in the reports and is consistent with the period for which I have a micro-database (1982-1987).

A.2 Simulation of Panel Data Subsample

To create the panel subsample, I start from the synthetic sample of 1 million taxpayers for 1981 as a reference. In a first step, I triple this sample, resulting in 3 million filers (3 times the same taxpayer). For each taxpayer, I substitute the year in the replicated observations equal to 1979 and 1980. Thus, I have a first panel base of 1 million filers from 1979 to 1981. This section explains in detail the steps necessary for the creation of the final panel sample.

New Tax Filers

In the first exercise, I control for the incorporation of new filers to the sample. This is especially important for the period 1980, since the number of tax filers increases by 14.74% with respect to 1979. For 1981, the number of filers increases more modestly,

[3]More specifically, the variable credits included here account for around 65-70% of the total variable credits collected in the years 1979 to 1981 (see Sánchez et al. (1986)).

by 4.25% over 1980 (Sánchez et al., 1986). Up to this point, I have a three-year sample of 1 million taxpayers with values identical to those of 1981. In this section, I explain how I decrease the sample for the previous two years (1979, 1980) so that it gives rise to the annual increase in filers observed at the national level. In this way, I ensure that the synthetic panel is similar to the 1982-1987 ”expanded” panel, which incorporates a sample of new filers annually.

As already mentioned in the main text, I do not have detailed information on how these filers were incorporated based on their place in the income distribution. The only detailed information I can extract corresponds to the PDIRPF panel, which covers the later period 1982-1987. This panel includes a ”pure” version that follows 123,599 filers up to 1987. However, to avoid representativeness problems, a subsample of new filers is incorporated each year to ensure that the sample is robust to this increase in taxpayers over time. Of this expanded panel, 13% of the sample belongs to the group of new filers. This percentage does not correspond to the national increase in filers over the period, which is around 2% on average (Sánchez et al., 1986, p. 464). However, it does allow us to analyze the way in which new filers were incorporated throughout the distribution of (gross) income. Thus, for the period 1983-1987, I calculate the average percentage of new filers for each income percentile (figure A.1).

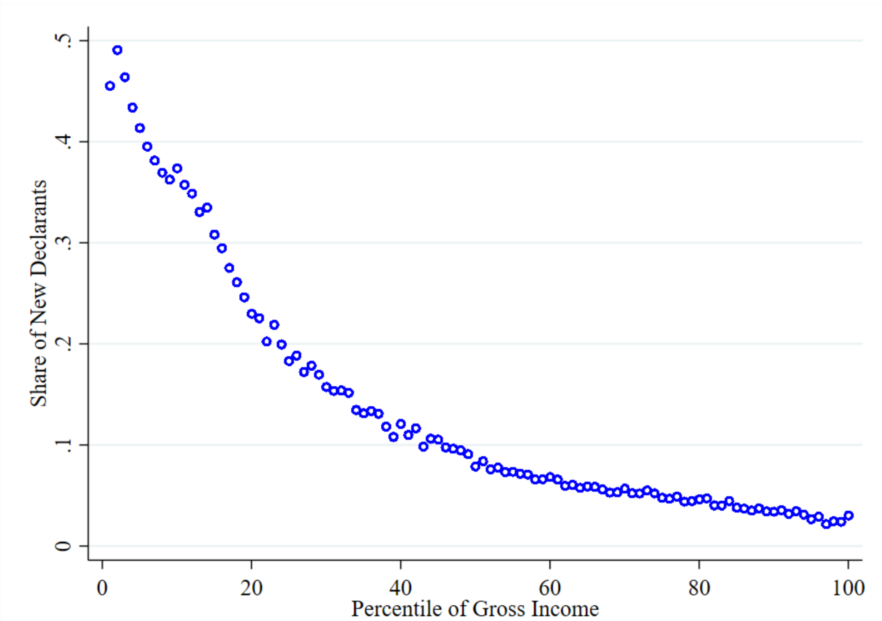

Figure A.1: Average Percentage of New Tax Filers per Percentile (1983-1987)

As can be seen, the average incorporation of filers comes mainly from the lower part of the distribution. In fact, the percentage of new filers incorporated into the sample is almost 50% for the lower percentiles, while it drops to 2% for the top bracket with the highest reported income. This shape of the function remained practically constant during the 1983-1987 period (Figure A.2):

This function remained constant from 1982 to 1987 despite the fact that the legal

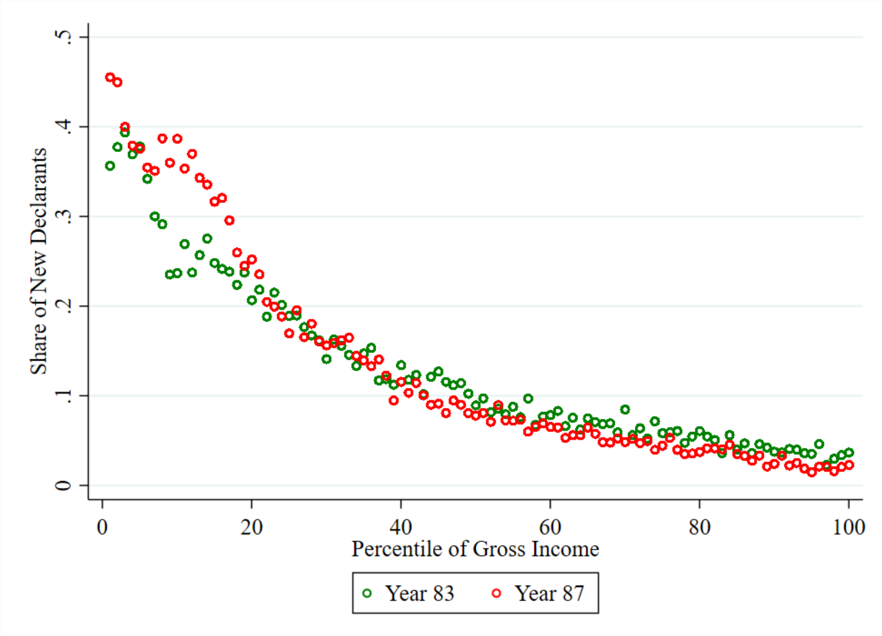

Figure A.2: Percentage of New Tax Filers per Percentile (1983 vs 1987)

minimum (marked by the general deduction) doubled from 1984 to 1985, from 100,000 to 200,000 pesetas. It is true, however, that the minimum exempt from compulsory report was higher than the previous one and remained constant and equal to 500,000 pesetas during the whole period. This mandatory minimum went from 300,000 in 1982 to 500,000 in 1983 (Ferrari Herrero and Revilla Pedraza, 1988, p. 21).[4] Therefore, this estimate should be taken with some caution, since it is possible that the estimated function for the period after 1982 is slightly different from that of 1979-1981.

Next, I have to correct the estimated parameters in Figure A.1 to match the increase in filers in each of the years. This function assumes a 13% addition of new filers, while in reality they increased by 14.74% in 1979-1980 and 4.25% in 1980-1981. Formally:

$$\theta_{i,t}^{p} = \theta_i^0 \cdot \frac{1}{\Theta_i^0} \cdot \frac{1+\Theta_{i,t}}{\Theta_{i,t}}$$

where θ_i^0 is the average percentage of new filers joining for the i percentile observed in the 1983-1987 sample, Θ_i^0 is the average total percentage of new filers joining (0.13), Θ_t is the mean total percentage of actual incorporation in year $t+1$ with respect to t (0.1474 for 1979 and 0.0425 for 1980) and finally $\theta_{i,t}^{p}$ is the parameter that predicts the percentage of incorporation of new filers for the i percentile from year t to $t+1$.

The ratio between θ_i^0 and Θ_i^0 results in the average incorporation of filers in the i percentile when the aggregate increase of filers is equal to 1%. To get the percentage of filers to increase by x%, the above value has to be multiplied by the ratio $\frac{1+\Theta_t}{\Theta_t}$. This ratio is derived from the following system of two equations:

[4]For 1983, this minimum of 500,000 pesetas was set only for labor income, while the level of 300,000 pesetas was maintained for income from other sources. It was in 1984 when the minimum for other sources was also raised to 500,000 pesetas (Ferrari Herrero and Revilla Pedraza, 1988, p. 21).

$$n_t + n_{t+1} = 1$$

$$\frac{n_{t+1}}{n_t} = \Theta_t$$

where n_t is the percentage of filers observed at t and n_{t+1} represents the percentage of new filers in the t sample whose first observation actually occurs at $t+1$. By subtracting n_t in the second equation, this equation becomes: $n_t = \frac{n_{t+1}}{\Theta_t}$. After including this ratio in the first equation, it is equal to $\frac{n_{t+1}}{\Theta_t} + n_{t+1} = 1$. Finally, clearing n_{t+1}, the percentage of new filers whose first observation occurs in $t+1$ is equal to $n_{t+1} = \frac{\Theta_t}{1+\Theta_t}$.

Thus, to predict an increase of 4.25% from 1980 to 1981, I set n_{t+1} equal to 0.0408 ($\frac{0.0425}{1+0.0425}$). Thus, 4.08% of the 1980 observations will be identified as actually observed in 1981, with the remaining 95.92% remaining. Applying this correction, the parameters for each percentile i for 1980 are shown in Figure A.3. I replicate the exercise for 1979, for which I set n_{t+1} equal to 0.1285 ($\frac{0.1474}{1+0.1474}$) (Figure A.5).

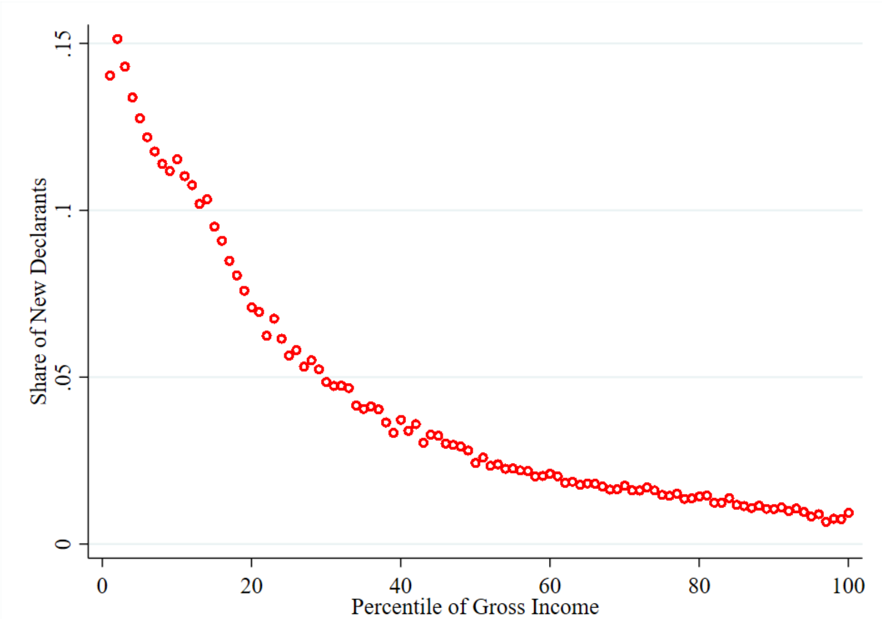

Figure A.3: Predicted Percentage of New Tax Filers per Percentile (1980)

Starting with 1981 as a baseline, I retrospectively modify the 1980 and 1979 samples. For 1980, using these parameters, I generate 100 binomial distributions, one for each income percentile. These binomial distributions have as mean the parameter calculated for each percentile. Formally:

$$P(n) = \sum P(\{(e_1, \ldots, e_N)\}) = \binom{N_i}{k_i} \cdot p_i^k \cdot q_i^{N_i - k_i}$$

where N_i is the number of tax filers in percentile i,k_i is the number of tax filers whose observation is predicted for next year and p_i is the probability for an individual

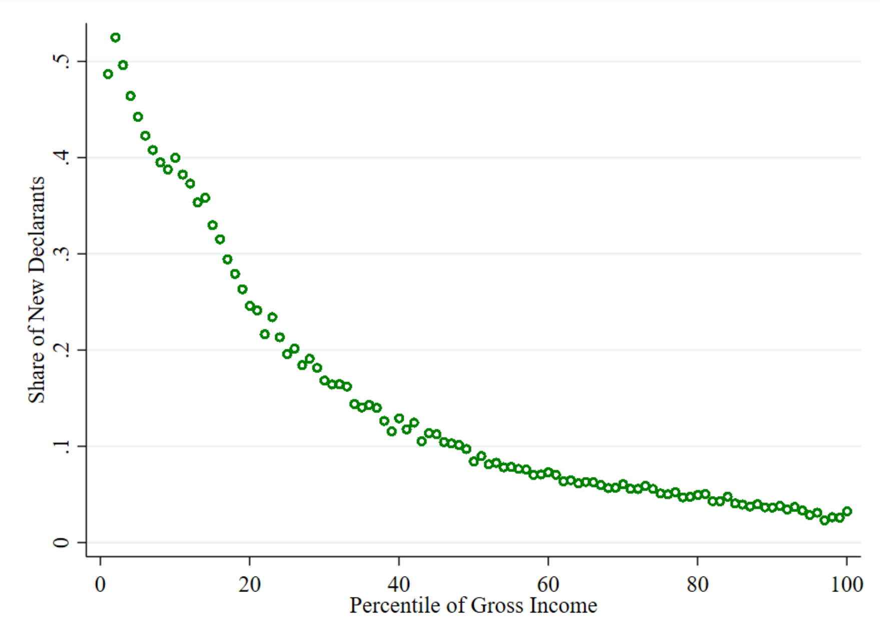

Figure A.4: Predicted Percentage of New Tax Filers per Percentile (1979)

of the percentile i to have her first observation next year.

This formula generates an indicator variable (0,1) depending on whether the filer is identified as new or not. In this case, it identifies 40,680 individuals as new. This subgroup is eliminated from the sample, since it identifies those individuals from 1980 whose first observation is identified in 1981. Thus, the sample the corrected 1980 sample yields 959,320 tax filers for 1980. For 1979, I re-run the same exercise as for 1980 (to eliminate new filers in 1981). For the remaining subsample, I replicate the exercise correcting for the parameters observed for 1979. To do this, I again generate 100 binomial distributions in which I identify the group of new filers for 1980 that should not be present in 1979. This subgroup is equal to 124,594 filers. I eliminate these individuals for the 1979 sample, since their first observation is predicted for 1980. This results in 834,726 filers for whom the first observation corresponds to 1979.

This formula generates an indicator variable (0,1) depending on whether the filer is identified as new or not. For the 1980 sample, it identifies 40,680 individuals as new (their first observation would be in the following year, 1981). This subgroup is eliminated from the sample, since it identifies 1980 individuals whose first observation is identified in 1981. Thus, the corrected 1980 sample yields 959,320 tax-fillers for 1980. For 1979, I again perform the same exercise as for 1980 (to eliminate the new filers in 1981). For the rest of the subsample, I repeat the exercise using the parameters observed for 1979. To do this, I again generate 100 binomial distributions in which I identify the group of new filers that should not be present in 1979 (first observation in 1980). This subgroup is equal to 124,594 filers. The result is 834726 filers whose first observation corresponds to 1979.

This process generates a panel sample of one million individuals, of which 834,726 are observed for the first time in 1979, 124,594 in 1980 and 40680 in 1981. These numbers result in an increase of 14.9% (124,594/834,726) for the period 1979-1980 (14.74% in reality) and 4.24% (40,680/959,320) for the period 1980-1981 (4.25% in reality).

Growth Incidence Curves

So far, the panel sample of filers collects the same information for taxpayers over the years, since it comes from tripling the 1981 sample. In this section I explain how I modify the 1980 and 1979 values.

First, the simplest modification refers to the tax credits, which are of a fixed amount. Thus, I simply replace the 1981 values with the values established for each year, 1979 and 1980. More problematic are the other variables, which do not represent a fixed amount depending on the tax year. These are: reported income, gross income, and variable returns. To predict the value of these for the years 1979 and 1980, I propose the estimation of Growth Incidence Curves (Ravallion and Chen, 2003; Grimm, 2007; Lakner and Milanovic, 2015). These curves graphically capture the growth rate of per capita income for each percentile of the income distribution between two points in time. Using them, I can retrospectively predict the value of these variables for the years 1980 and 1979.

For the generation of the GICs, I use the cross-sectional sample simulated in the previous section. This sample covers 1 million filers for each year, 1979, 1980 and 1981. Before estimating the GICs, I have to reduce the samples as foreseen in the previous subsection. In this way, the percentage growth of the variables will not be biased by the addition of new filers. Once this first step is done, I can estimate the GICs for the periods 1979-1980 and 1980-1981. The parameters of these GICs yield the annual growth rate of each variable for each income percentile between t and $t+1$. It is important to mention that these GICs represent nominal growth rates. I am not interested in real income growth, since I will use these rates to predict past periods. For this prediction, price increases must be taken into account to predict nominal values for 1980 and 1979. For 1980, the estimated GIC curve for gross income, the result is as follows (Figure A.5):

and for 1979:

As we can see, the GICs predict a certain reduction in income inequality for the period 1979-1981. For the low 0-20 percentiles, the predicted nominal growth rates are above 15%. These stabilize at values close to 13% for intermediate percentiles, while they fall to values below 10% for the highest income percentiles. Our findings are similar to those of earlier research on wage inequality in the early 1980s.[5] Analyses using household budget surveys show a decline in wage inequality in the early 1980s

[5] We are aware that this literature deals with both a different concept (wage vs. gross income) and a different population (workers vs. filers). Therefore, we recommend caution in concluding similarities between these analyses.

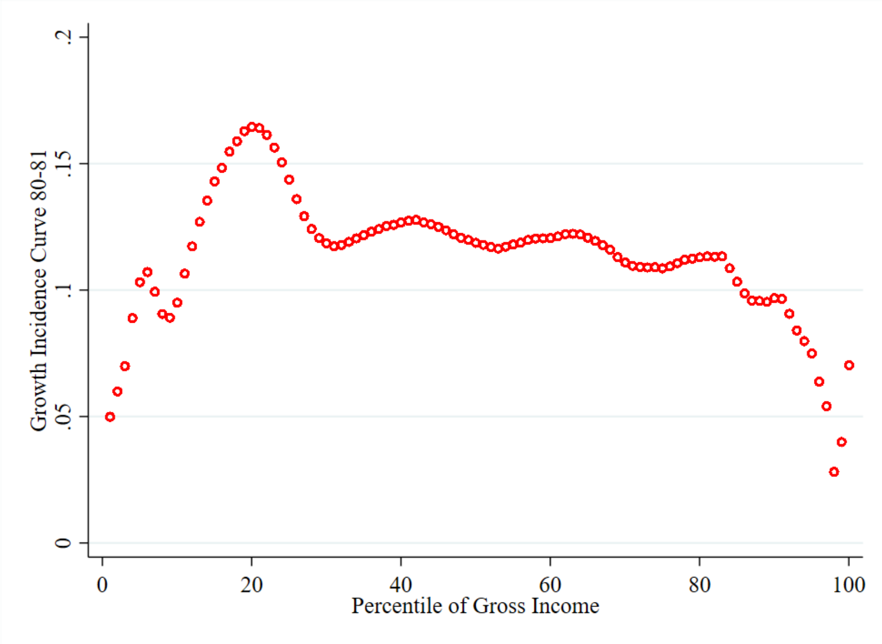

Figure A.5: Growth Incidence Curve (1980-1981)

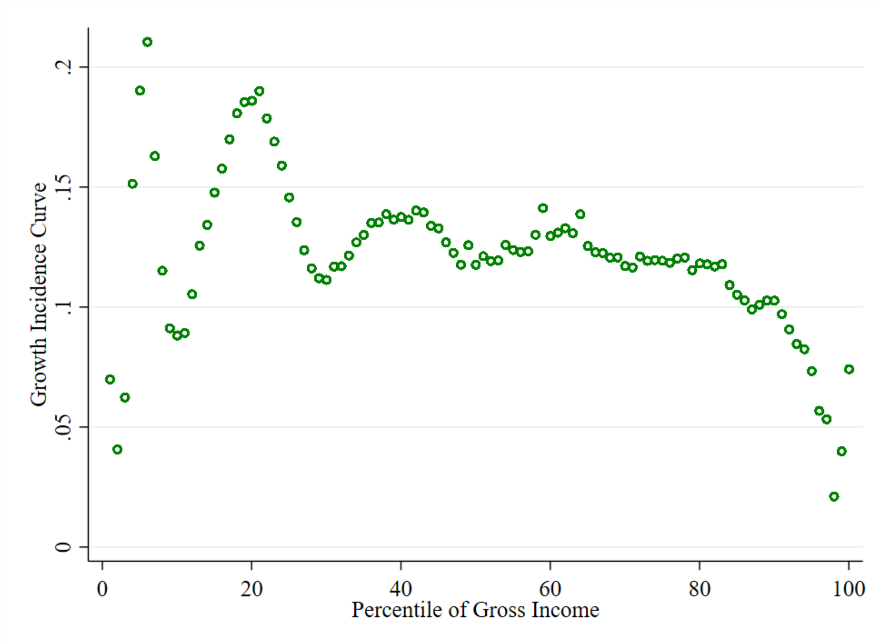

Figure A.6: Growth Incidence Curve (1979-1980)

(Abadie, 1997; Pérez, 2010). Other analyses using Social Security data find that wage inequality increased mainly in the second decade of the 1980s (Bover et al., 2002). Still, the aim of this paper is not to discuss the evolution of income inequality for this period in Spain, a matter of long debate in the literature (Pena et al., 1996; Gradín et al., 2002; Torregrosa-Hetland, 2016). In addition, it is also important to note that these GICs represent nominal income growth. Correcting for inflation in these two years (15%), this exercise predicts slightly negative real growth for the vast majority of the distribution (in line with the crisis at that time), with the exception of some lower percentiles.

I replicate this exercise for the rest of the variables that are not fixed (taxable income and variable deductions). The results are similar to those shown for gross income (not included here). In a second step, I use these growth rates as parameters to retrospectively predict the value of these variables for 1980 and 1979. To do this, I go back to the initial sample for which I have three years with values equal to 1981. First, I modify the observations for 1980 by dividing the values by the growth rates for each percentile. Formally, for an taxpayer j:

$$z^j_{i,t-1} = \frac{z^j_{i,t}}{1 + \gamma_{i,t-1}}$$

where $\gamma_{i,t-1}$ is the average growth rate for percentile i from $t-1$ to t.

For the year 1979, I first modify the sample in the same way as I have done for the year 1980. Thus, I start from 1980 as the reference year to apply the growth rates for 1980 values and apply to this modified sample the growth rate predicted for 1979. For the 1982 to 1987 panel sample, I replicate this exercise, retrospectively simulating both the percentage of new filers and the percentage of observed taxpayer income for the post-1981 period.

As can be seen, this methodology assumes that the income (and all other variables) of all taxpayers belonging to the same i percentile grows at the same rate. In other words, I assume total homogeneity within each income percentile. Although this is an important limitation, it provides some degree of flexibility in the face of changes in the income distribution over time. After this process, I obtain a simulated panel sample of 1 million individuals that corrects for both new filers and changes in the income distribution.

Appendix B

Elasticities: Other Estimations

B.1 The Elasticity of Heterogeneous Groups

Table B.1: Tax Reform Approach: Other Estimations

	Married	Single	With Children	Without children	Adult (45-65)	Young (25-45)	Employee	Self-employed
				Second stage IV estimation				
Taxable Income (ETI)								
$\Delta \ln(1-\tau)$	0.168*	0.303**	0.152	0.333***	0.145*	0.171**	0.285*	0.117*
	[0.02,0.31]	[0.12,0.48]	[0.00,0.30]	[0.16,0.50]	[0.01,0.28]	[0.03,0.31]	[0.15,0.42]	[-0.08,0.32]
R^2	0.409	0.293	0.396	0.349	0.445	0.451	0.378	0.338
Gross Income (EGI)								
$\Delta \ln(1-\tau)$	0.269***	0.407***	0.252**	0.446***	.207***	.219***	0.369*	0.264*
	[0.12,0.41]	[0.21,0.59]	[0.09,0.40]	[0.26,0.62]	[0.070,0.345]	[0.078,0.361]	[0.23,0.50]	[0.058,0.46]
R^2	0.380	0.257	0.364	0.319	0.431	0.445	0.346	0.309
				First stage IV estimation				
Predicted Net-of-Tax Change								
$\Delta \ln(1-\tau^p)$	0.279***	0.255***	0.276***	0.262***	0.307***	0.299***	0.271***	0.260***
	(0.00484)	(0.00548)	(0.00516)	(0.00516)	(0.00488)	(0.00468)	(0.00458)	(0.00600)
Regional FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Household Controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Base-year Income	*Splines (lags)*	*Splines (lags)*	*Splines (lags)*	*Splines (lags)*	*Splines (lags)*	*Splines (lags)*	*Splines (lags)*	*Splines (lags)*
N	180,194	112,130	157,467	134,857	142,239	137,813	186,671	105,653

This table reports regression results for the panel dataset 1982-1987 for eight different subgroups: married (vs singles), with children (vs without children), adults (vs young adults), and employees (vs self-employed/employer). The last group is created depending on the main source of income of the tax filer (labor vs business income). As we consider it the most accurate approach, all estimations are done following Weber (2014). All specifications include regional fixed effects and year fixed effects. Household controls are the type of declaration, marital status, presence (and number) of kids, presence (and number) of elderly people (more than 70 years), presence (and number) of ascendants (more than 18 and dependent on first earner's income), presence (and number) of disabled. Standard errors are clustered by household. Instead of standard errors, I include in brackets the 95% confidence interval of the estimations for the elasticities. Significance levels: *** = 1%, ** = 5% and * = 10%.

B.2 The Bunching Method

In the Elasticity of Taxable Income (ETI) framework, there is an alternative to the Tax Reform appraoch, the Bunching Method (Saez, 2010).

This alternative approach relies on a completely different identification strategy from the tax reform. The bunching method identifies the ETI relying on the density of taxpayers along the tax schedule. In the absence of any behavior in the face of tax changes, taxpayers will be continuously distributed throughout the tax scheme. However, if individuals respond to changes in the marginal rate, we can expect that there will be a buildup or bunch of taxpayers near the kinks where the marginal rate jumps. This excess of taxpayers will be the key to the estimate of the ETI following the bunching method.

For that, it relies on the same labor-supply model as the tax-reform approach. This model assumes that taxpayers maximize the following utility function:

$$U_i(c_i z_i x_i) = f^{+}(c_i) f^{-}(z_i) f(x_i) \tag{B.1}$$

Where c_i represents the level of consumption, z_i the reported taxable income and x_i taxpayers' characteristics (Kleven and Schultz, 2014, p. 282). Taxpayers' utility function will depend positively on post-tax income, proxied by c_i as individuals want to consume, and negatively on pre-tax income z_i as individuals face an effort to get this income (Saez, 2010, p. 183). Taxpayers are subject to a budget constraint given by the equation:

$$c_i = z_i - T(z_i) \tag{B.2}$$

Where $T(z_i)$ represents the tax liability from applying the tax schedule to a taxable income equal to z_i. In an optimization framework, taxpayers maximize the taxable income declared (and the amount of effort in order to get that income) according to their consumption preferences, individual characteristics, and the shape of the tax schedule they face. Thus, changes in the tax scheme $T(.)$ will give rise to taxpayers' responses as they try to optimize their utility in the face of these tax shifts. This behavioral response involves reactions in the labor market (work less/more hours) and reactions in the tax return (report less/more income). Formally, the literature captures the ETI by analyzing the elasticity of taxable income with respect to marginal net-of-tax rates. Marginal net-of-tax rates $(1 - \tau)$ represent the inverse of the marginal tax rate (τ). Thus, counterintuitively, a negative relationship between marginal tax rates and taxable income will be captured by a *positive* ETI. As an example, an ETI equal to 0.5 indicates that an increase by 1% of the marginal net-of-tax rate (a decrease in the marginal tax rate) will predict an increase by 0.5% in the taxable income.

Formally, Saez (2010) derives the ETI using the following isoelastic utility function:

$$U(c_i, z_i) = c_i - \frac{n_i}{1 + 1/\varepsilon} * \frac{z_i}{n_i}^{\frac{1}{1+\varepsilon}} \tag{B.3}$$

Where n_i is the parameter that proxies the heterogeneity in earnings z_i and captures any difference between individuals' utility functions due to personal preferences, socioeconomic background, ability, etc. The distribution of this parameter n_i is unobserved. Assuming that n_i is normally distributed, Saez (2010) derives the following formula to calculate the ETI from the bunching of taxpayers:

$$B = z^* \left[\left(\frac{1-\tau_0}{1-\tau_1} \right)^{\varepsilon} - 1 \right] * \left[\frac{h(s^*)_- + h(s^*)_+}{2 * \left(\frac{1-\tau_0}{1-\tau_1} \right)^{\varepsilon}} \right] \tag{B.4}$$

Where B represents the bunching (excess mass of taxpayers), z^* income level at the kink, t_0 is the marginal tax rate below the kink, t_1 is the marginal tax rate above the kink, $h(s^*)_- + h(s^*)_+$ are the density of individuals surrounding the kink and ε is the elasticity, ETI.

The normality assumption on n_i has been largely criticized in the literature, being Saez' results really sensitive to changes in the assumption of the distribution of n_i (Bertanha et al., 2021). Due to that, I follow the extension by Bertanha et al. (2021) that proposes weaker assumptions on the distribution of the unobservable n_i, allowing us to estimate the ETI following two more flexible approaches: a non-parametric and a semi-parametric one.

The first approach extends the method by Saez (2010) showing an upper and lower bound of this estimation. The estimation of upper and lower bounds is non-parametric: we do not impose any shape on the probability distribution function (PDF) of n_i. The lower and upper bound will depend on the assumption of the slope magnitude of the PDF of n_i (M). Following this method, I will compute the evolution of the lower and upper bounds for an increasing function of M.

In addition, Bertanha et al. (2021) propose a second method that point-identifies the elasticity instead of giving upper and lower bounds. This is a semi-parametric approach, in which we use covariates (individual characteristics x_i) to predict n_i. This approach transforms bunching into a censored regression model around the kink: the Tobit model (Heckman, 1979).[1] What the Tobit model assumes is that the distribution of the unobserved variable is normal conditionally to the set of variables. Bertanha et al. (2021) rely on a weaker assumption (demonstrating that is consistent with Heckman (1979)). Their method assumes that the unobserved variable n_i is distributed following a mixture of normal distributions averaged over the distribution of covariates, not imposing a specific shape on the unconditional PDF of n_i. In simpler words, following this method, I will rely on the part n_i predicted by the covariates to estimate the PDF

[1] The only difference here is that the censored point is neither at the maximum nor at the minimum, but in the middle (the kink).

of the former.

For the second approach, I have first to correct for the presence of frictional errors. Frictional errors occur when individuals reach suboptimal outcomes in their declaration as they face some constraints and limitations in their behavior (see Chetty et al. (2011). As already mentioned in the main text, taxpayers might not be able to reduce the hours worked or switch to full/part-time work in response to the different tax rates or they may lack the possibility for tax planning because they do not have enough knowledge of the tax system, because of legislative constraints limiting tax planning or because of unexpected discretional changes in tax policies, etc. Due to that, taxpayers might not optimally adapt their behavior, bunching perfectly at the kink. On the contrary, they will more likely cluster or hump around those points. To correct this issue, I follow Chetty et al. (2011)). These authors solve frictional errors by filtering the distribution fitting a seventh-order polynomial to the empirical CDF.[2]

To compute this second approach, I use the Stata package "bunching" from Bertanha et al. (2022). Graphically, there seems to be no evidence of bunching. Taxpayers distribute continuously over the whole sample. This is in line with Chetty et al. (2011) argument that in tax schedules with narrower brackets in which the jump from one threshold to another represents a small change in the tax rate, individuals would not be fully aware of the potential jump. Indeed, Chetty et al. (2011) show that bigger kinks generate a disproportionately larger response than small kinks: tax filers do not pay as much attention to small tax changes as they do to large changes. As we have seen in the previous case, this was the case in Spain in the 1980s, where the tax schedule presented 34 brackets for which the tax rate increases smoothly with jumps of around 1%. There was an exception already highlighted: the top of the distribution. Due to a legal limit in effective taxation (0.42/0.45/0.46), the marginal tax rates of taxpayers on the top of the distribution fell from 70% to that limit (42, 45, 46%). Unfortunately, the amount of taxpayers at this part of the distribution is not big enough to consistently estimate the elasticity using the bunching method.

However, there was a break in the continuity of the tax schedule in 1985. As we have seen before, this reform was especially progressive at the middle of the distribution. Marginal tax rates increased from 21% to 27% when the taxable income reached 800.000 pesetas. In the same line, it jumped from 27 to 33% at the following bracket, 1.000.000 pesetas. Finally, at 1.200.000 pesetas, the marginal tax rates fell from 33 to 22%. Here I include the estimation using the 800.000-pesetas kink. Two reasons for this. First, we observe a clearer bunching behavior at this kink (Figure B.1). This bunching is contrary to what we should expect, as there is a clear bunch right above the jump and not below.

[2]The filtering is consistent under the following conditions: (i) frictions only affect bunching individuals additively; (ii) friction error is independent of unobserved heterogeneity n (ability) and has known support containing zero; (iii) the CDF of y is represented by a seventh-order polynomial with an intercept change at the kink (Bertanha et al., 2021).

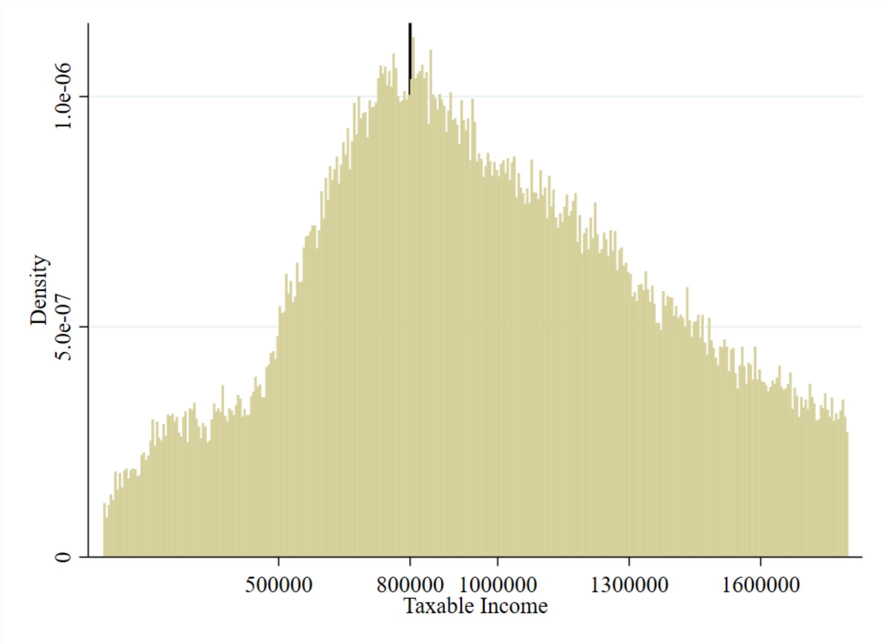

Figure B.1: Histogram: bunching evidence

This might be because of the frictional errors mentioned before. Second, the estimation for this kink is less likely to be affected by the shape of the PDF. Contrary to the clear negative slope of the PDF for the following two kinks (1.000.000 and 1.200.000), around 800.000 pesetas the distribution is relatively flat. Thus, focusing on 800.000 we avoid identifying as bunching what is just the downward slope of the PDF. Thus, it is important to mention that this bunching method does not control for all the kinks. Indeed, a necessary condition for this identification is the presence of some bunching. Indeed, the literature on ETI generally focuses on some specific kinks for which some bunching behavior is observed (Saez, 2010). As we observe in the histogram, it does not seem to be the case for other kinks apart from the 800.000, in which we observe an excess mass of taxpayers just above this threshold (Figure B.1).

Following the paper by (Saez, 2010), the estimation of the elasticity comes from a trapezoidal approximation that assumes that n_i is normally distributed. This approach gives an elasticity equal to 0.19. Second, the non-parametric approach (Bertanha et al., 2022) set an upper bound at 0.37 and a lower bound at 0.16 assuming the maximum slope of the PDF (Figure B.2). As we see, with smaller slopes the confidence interval is reduced around Saez (2010) estimation.

Finally, to conduct the semi-parametric approach (Bertanha et al., 2022), I rely on two covariates to proxy ability and individual preferences: the region of the individual and the type of declaration (simplified vs ordinary). This approach identifies the elasticity at 0.25, with a confidence interval really close to that value. As a robustness, I replicate the estimation for smaller samples, reaching values from 0.25 to 0.19. Indeed, after the sample is reduced by 10%, the elasticity remains constant and equal to 0.19 (Figure B.3).

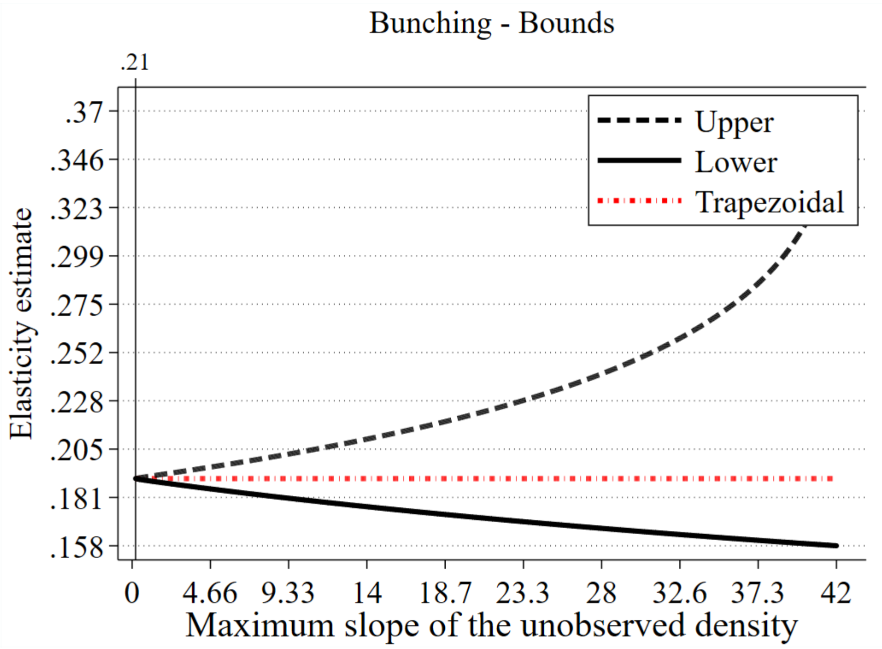

Figure B.2: Bunching Method: non-parametric approach

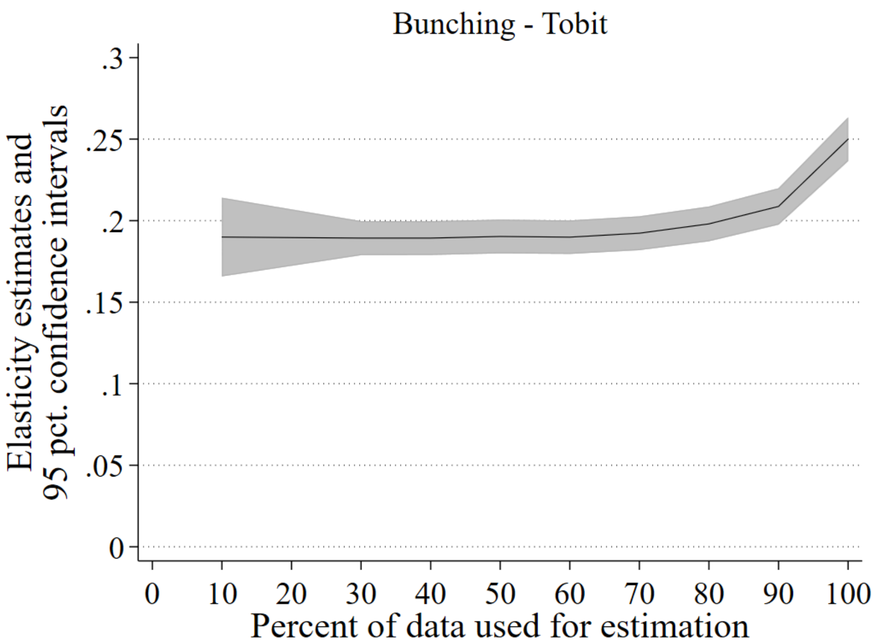

Figure B.3: Bunching Method: semi-parametric approach

As we observe, the seminal estimation together with the semi-parametric and the non-parametric approach lead to almost identical results. According to Bertanha et al. (2021), if the estimations are really close to each other we have evidence supporting the lack of relevance of the underlying identification strategy. This estimation (0.19) together with the lower and upper bounds (0.16-0.37) are almost identical to the assumptions in the main analysis (0.2 with 0.10-.40).

Appendix C

Other Estimations

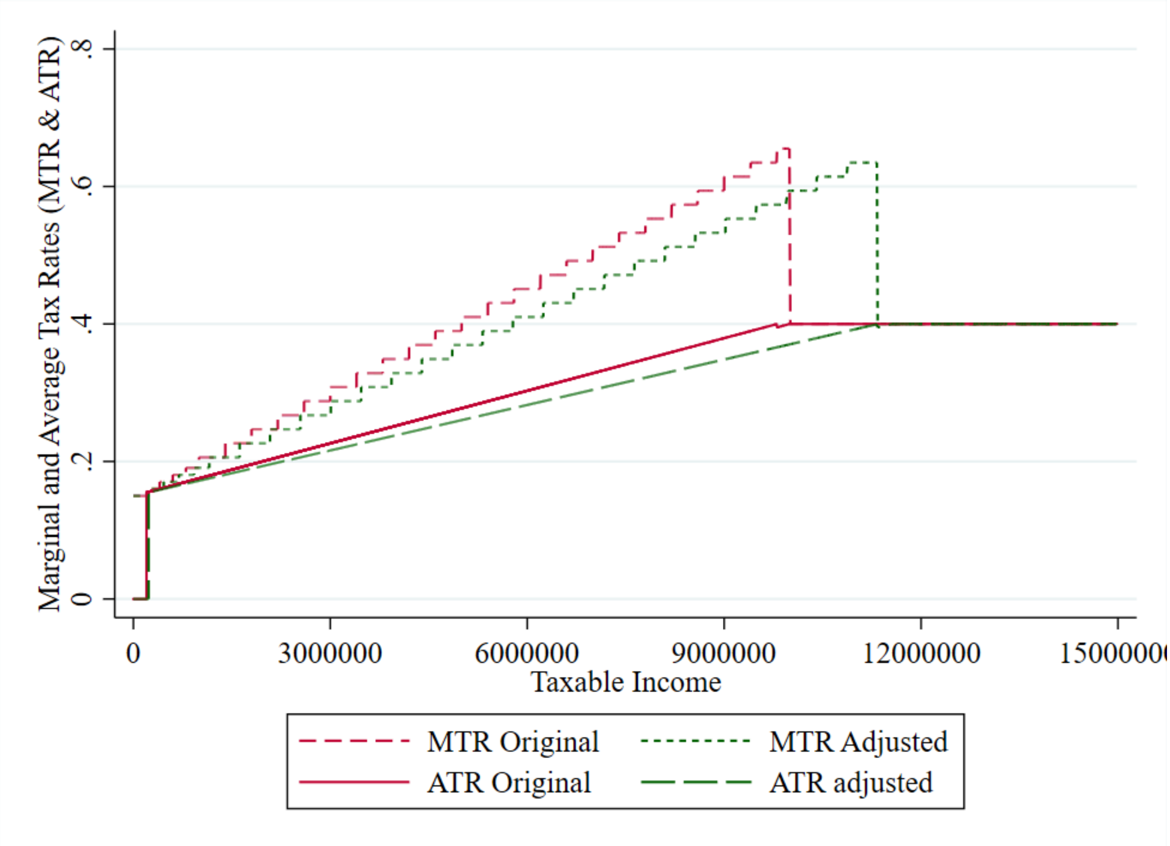

Figure C.1: Personal Income Tax, 1980: actual vs simulated

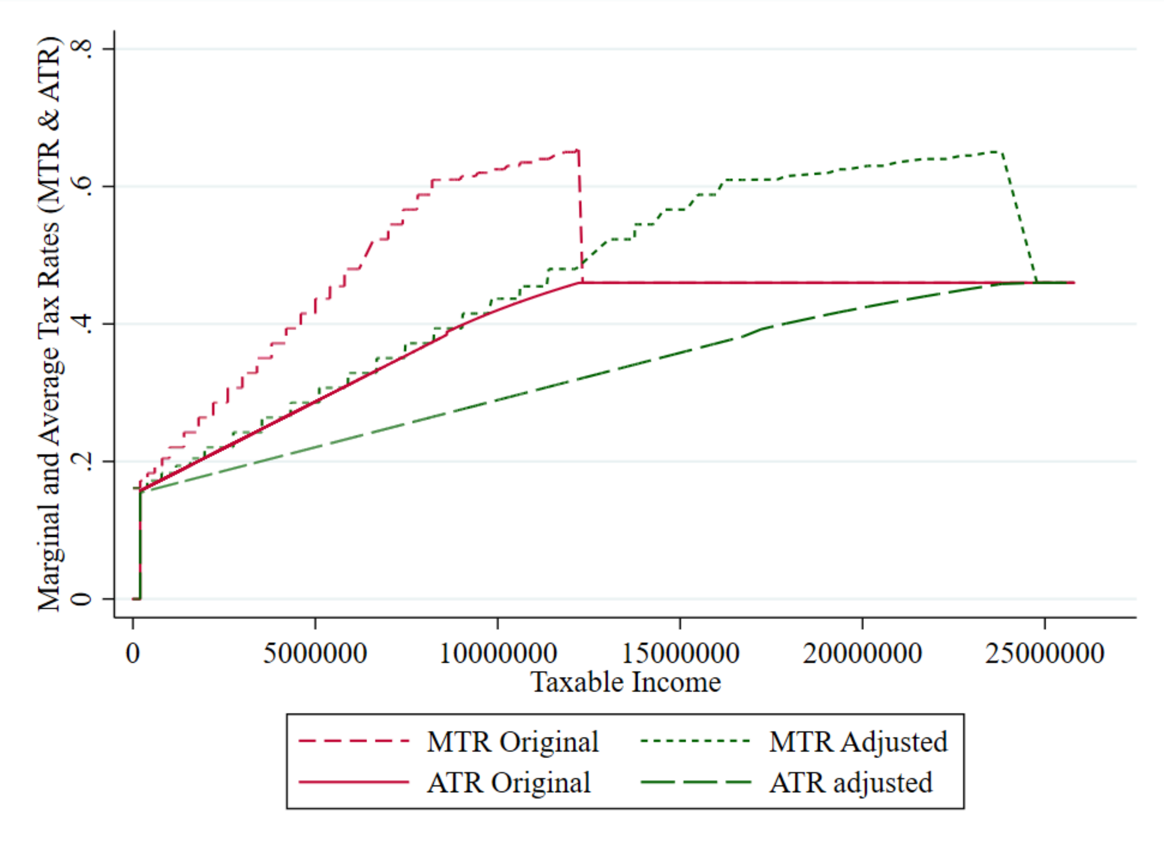

Figure C.2: Personal Income Tax, 1984: actual vs simulated

Table C.1: Kakwani Progressivity Index

Year	Original		Total Adjustment		Bracket Adjustment		Credit Adjusment	
	Index	*1979 = 100*	*Index*	*1979 = 100*	*Index*	*1979 = 100*	*Index*	*1979 = 100*
1979	0.1488	100	0.1488	100	0.1488	100	0.1488	100
1980	0.1528	102.69	0.1497	100.60	0.1464	98.39	0.1560	104.84
1981	0.1615	108.53	0.1582	106.32	0.1468	98.66	0.1724	115.86
1982	0.1777	119.42	0.1789	120.22	0.1625	109.21	0.1929	129.64
1983	0.1816	122.04	0.1787	120.09	0.1599	107.46	0.1986	133.47
1984	0.2015	135.42	0.2051	137.83	0.1794	120.56	0.2242	150.67
1985	0.2683	180.31	0.2563	172.24	0.2257	151.68	0.2953	198.45
1986	0.2574	172.98	0.2663	178.96	0.2282	153.36	0.2905	195.23
1987	0.2487	167.14	0.2644	177.69	0.2240	150.54	0.2837	190.66

Table C.2: Reynolds-Smolensky Redistribution Index

Year	Original		Total Adjustment		Bracket Adjustment		Credit Adjusment	
	Index	*1979 = 100*	*Index*	*1979 = 100*	*Index*	*1979 = 100*	*Index*	*1979 = 100*
1979	0.0205	100	0.0205	100	0.0205	100	0.0205	100
1980	0.0203	99.02	0.0189	92.19 0.	0.0186	90.73	0.0206	100.49
1981	0.0190	92.68	0.0165	80.49	0.0157	76.59	0.0199	97.07
1982	0.0217	105.85	0.0184	89.76	0.0174	84.88	0.0228	111.22
1983	0.0239	116.58	0.0188	91.71	0.0174	84.88	0.0254	123.90
1984	0.0278	135.61	0.0209	101.95	0.0194	94.63	0.0293	142.93
1985	0.0353	172.20	0.0237	115.61	0.0228	111.22	0.0360	175.61
1986	0.0361	176.10	0.0238	116.10	0.0230	112.20	0.0370	180.49
1987	0.0379	184.88	0.0253	123.41	0.0244	119.02	0.0390	190.24

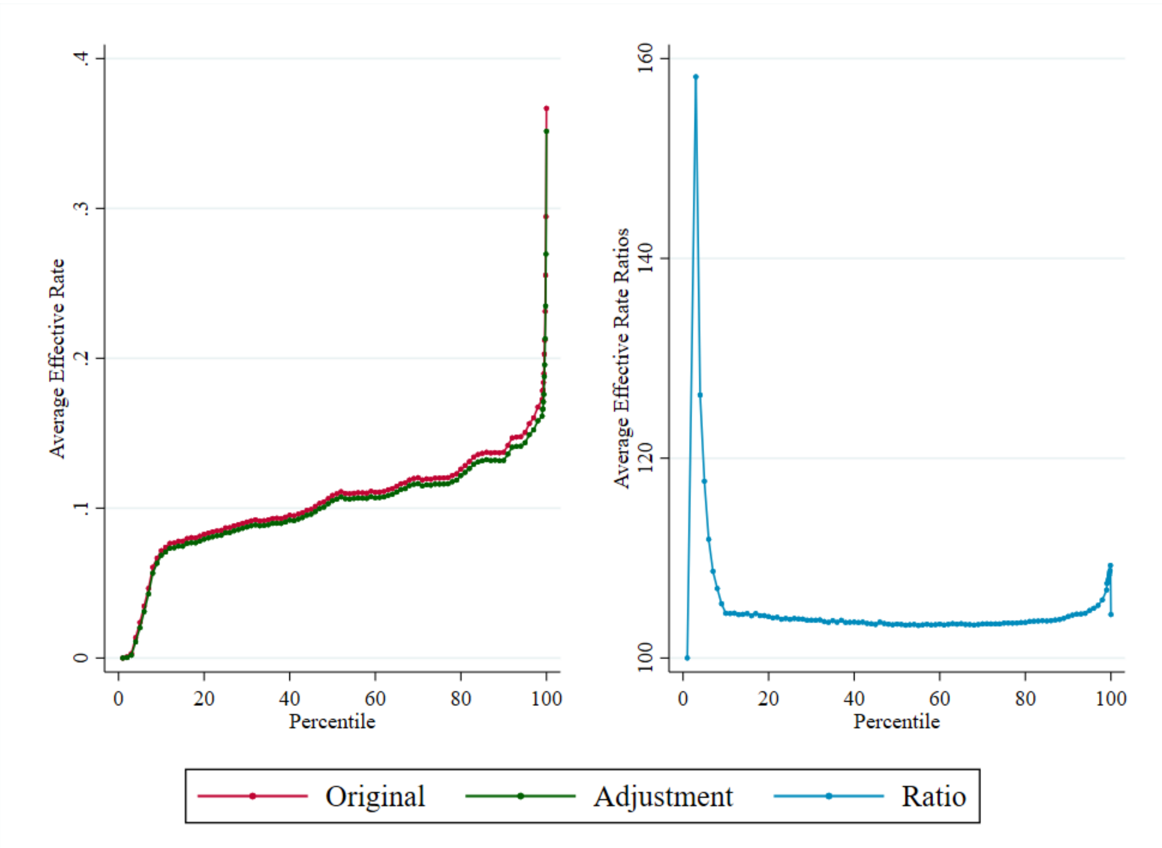

Figure C.3: Average Effective Tax Rates & Ratios, year 1980

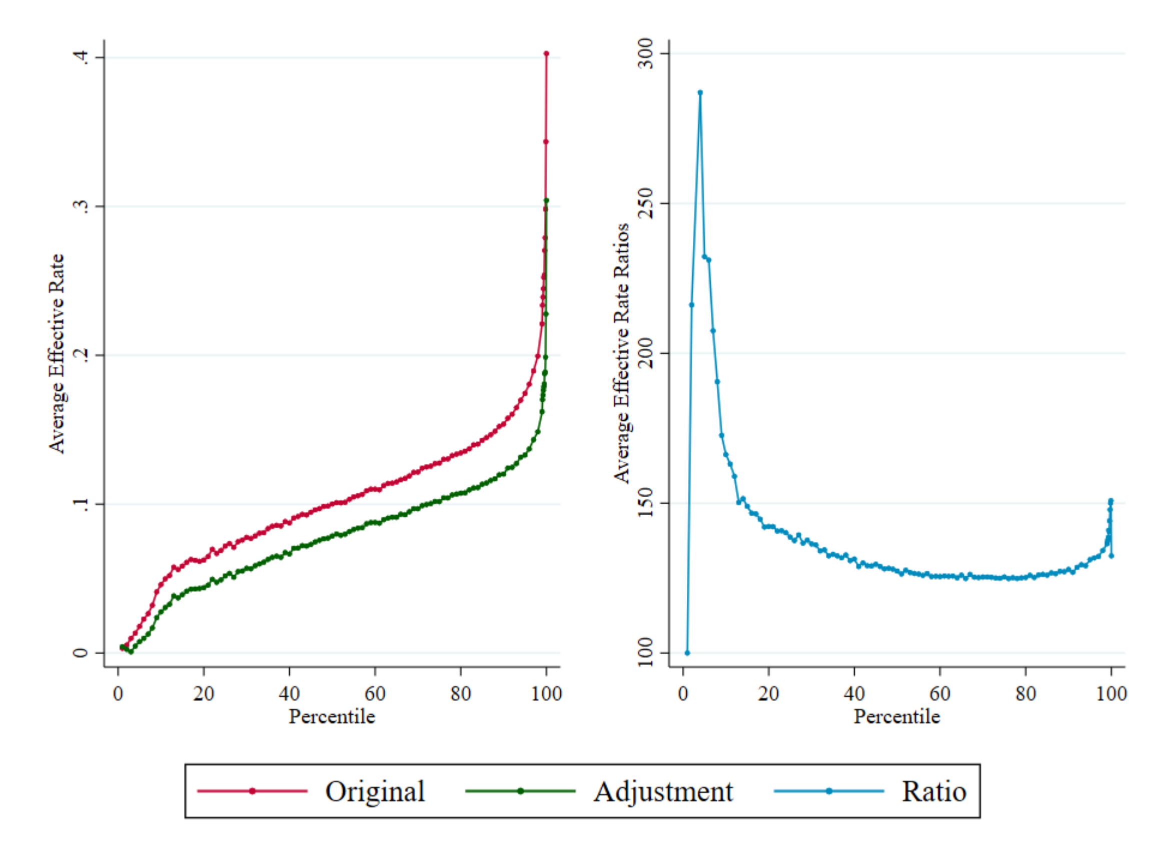

Figure C.4: Average Effective Tax Rates & Ratios, year 1984

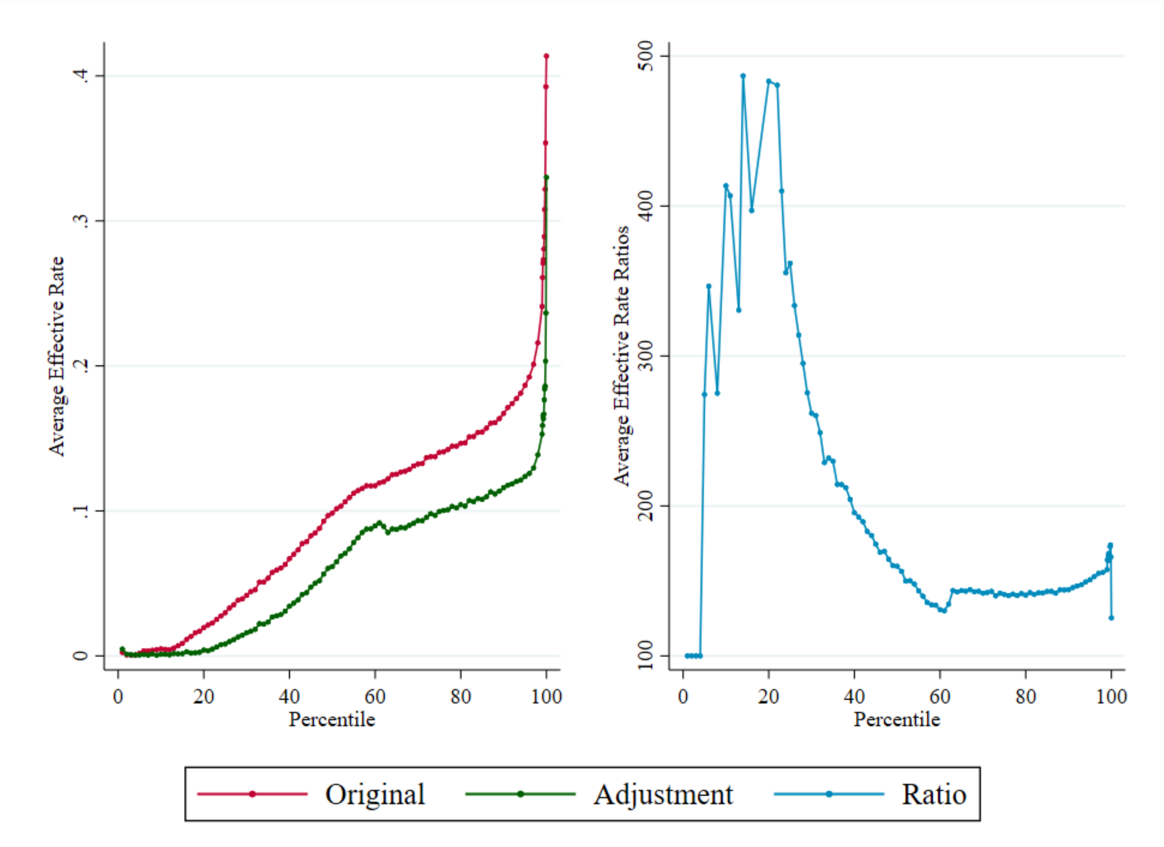

Figure C.5: Average Effective Tax Rates & Ratios, year 1987

Table C.3: Total Adjustment under Different Elasticities

Year	Tax Revenue				Progressivity				Redistribution			
	Baseline	$\varepsilon = 0.1$	$\varepsilon = 0.2$	$\varepsilon = 0.4$	*Baseline*	$\varepsilon = 0.1$	$\varepsilon = 0.2$	$\varepsilon = 0.4$	*Baseline*	$\varepsilon = 0.1$	$\varepsilon = 0.2$	$\varepsilon = 0.4$
1979	441795.7	441795.7	441795.7	441795.7	0.1488	0.1488	0.1488	0.1488	0.0205	0.0205	0.0205	0.0205
1980	646710.9	649078	651538.8	656545.4	0.1604	0.1610	0.1617	0.1629	0.0205	0.0206	0.0207	0.0211
1981	737123.9	743179.4	749710.8	763303.8	0.1606	0.1619	0.1633	0.1664	0.0181	0.0183	0.0186	0.0192
1982	799055.6	800903.3	802942.9	807123.7	0.1966	0.1967	0.1968	0.1968	0.0208	0.0208	0.0208	0.0209
1983	867451.6	871117	875171.8	883224.4	0.1964	0.1965	0.1967	0.1968	0.0216	0.0217	0.0218	0.0219
1984	1210133	1218426	1227026	1245155	0.2235	0.2239	0.2242	0.2246	0.0269	0.0271	0.0273	0.0276
1985	1369956	1381273	1393352	1418883	0.2326	0.2331	0.2332	0.2330	0.0285	0.0287	0.0289	0.0292
1986	16122201	1625682	1639980	1673909	0.2427	0.2434	0.2438	0.2448	0.02915	0.0293	0.0295	0.0300
1987	1825644	1842107	1861419	1904486	0.2345	0.2351	0.2355	0.2357	0.0288	0.0289	0.0292	0.0297