EVOLUTION OF FISCAL SYSTEMS: CONVERGENCE OR DIVERGENCE?

Paloma Péligry

Xavier Ragot

ABOUT THE AUTHORS

Paloma Péligry, ENS Paris-Saclay.
Email Address: paloma.peligry@ens-paris-saclay.fr

Xavier Ragot, Sciences Po-OFCE and CNRS.
Email Address: xavier.ragot@sciencespo.fr

ABSTRACT

The purpose of this article is to analyze, more than ten years after the financial crisis of 2007, the convergence or divergence of the diversity of capitalism, focusing on the fiscal systems. Studying 29 countries, we first analyse the evolution of the taxation of households, firms, labour, consumption and capital. Then we use recent statistical method to indentify three types of fiscal systems: liberal, intermediate, and social-democratic, which can be ranked in ascending order of tax rates, confirming known typologies in the diversity of capitalism literature.

The first result of this analysis is that only the tax rate on corporate profits shows signs of downward convergence over the period. The other tax rates, on labour or capital tax on households, show rather signs of divergence. Second, we show the divergence of the liberal and social-democratic group over the period. The European countries are converging towards the social-democratic model, with the exception of Great Britain, which is moving towards the liberal model over the period. Hence, the analysis shows that the divergence of fiscal systems is compatible with the convergence of certain taxes on the most mobile factors during a strong period of trade internationalization. Thus, the financial crisis does not seem to contribute to the convergence, but to the divergence of fiscal systems.

KEYWORDS

Fiscal systems, globalization, capital taxation.

JEL

H12, H6, P43.

Evolution of fiscal systems: convergence or divergence?

Paloma Péligry   Xavier Ragot*

January 17, 2022

Abstract

The purpose of this article is to analyze, more than ten years after the financial crisis of 2007, the convergence or divergence of the diversity of capitalism, focusing on the fiscal systems. Studying 29 countries, we first analyse the evolution of the taxation of households, firms, labour, consumption and capital. Then we use recent statistical method to indentify three types of fiscal systems: liberal, intermediate, and social-democratic, which can be ranked in ascending order of tax rates, confirming known typologies in the diversity of capitalism literature.

The first result of this analysis is that only the tax rate on corporate profits shows signs of downward convergence over the period. The other tax rates, on labour or capital tax on households, show rather signs of divergence. Second, we show the divergence of the liberal and social-democratic group over the period. The European countries are converging towards the social-democratic model, with the exception of Great Britain, which is moving towards the liberal model over the period. Hence, the analysis shows that the divergence of fiscal systems is compatible with the convergence of certain taxes on the most mobile factors during a strong period of trade internationalization. Thus, the financial crisis does not seem to contribute to the convergence, but to the divergence of fiscal systems.

Keywords: fiscal systems, globalization, capital taxation
JEL codes: H12, H6, P43

1   Introduction

Major economic crises contribute to important changes in taxation. While it will take many years to identify the effects of the Covid-19 health crisis, we can now analyze the medium-term effects of the 2007 financial crisis by tracking the evolution of fiscal systems over a ten-year period. The 2007 crisis is indeed one of the most severe in the post-World War II era. It led to an unprecedented increase in public debt. This historical perspective allows us to reexamine essential

questions about the coherence of fiscal systems and the notion of diversity of capitalism. Has there been a convergence of fiscal systems, in terms of capital, labour, household and corporate taxation, as a result of trade globalization? Conversely, can we identify consistent types of fiscal systems that have persisted after the crisis, despite common constraints such as the increase in public debt or the growth of international trade?

Before specifying the theoretical and empirical approach, the notion of a fiscal system must therefore be clarified, since it refers to different types of analysis. First, empirical work has systematically broken down the revenues of countries, since the work of Musgrave (1981). As Fullerton and Metcalf (2002) note, we can now identify five decompositions of countries' taxation. The first distinction separates the actors taxed: most oftently between firms and households. The second identifies the type of goods taxed: we distinguish between taxation on consumption, on labour and on capital. This three-factor decomposition is presented by Mendoza et al. (1994), and is used in many institutional analyses, such as the European Union's Taxation Trends report (2020). Then, household taxation can be decomposed by its characteristics, such as education, income or wealth. The fourth representation focuses on the territorial dimension of inequalities within a country, between regions or urban areas for example. Finally, the fifth approach compares the countries themselves, by tax rates, for example.

In addition to this first approach, which could be described as "accounting decomposition", the notion of fiscal system also refers to institutionalist analysis, which provides a typology of social states. Esping-Andersen (1990)'s typology of welfare states in three ideal-types leads to different tax structures, even if the typology is more general than just differences in tax structures, because it integrates the regulation and political economy of social states. Similarly, the literature on the typology of capitalisms, such as the regulation approach (Amable et al. (1997) ou Amable (2005)), emphasizes that the diversity of capitalisms is associated with a diversity of social states and their financing. This second approach apprehends the complementarity within the fiscal system and between the fiscal system with other institutions of capitalist economies.

The purpose of this article is to follow the evolution of national fiscal systems after the 2007 crisis using these two approaches. The first, empirical and descriptive, compares the evolution of taxes in many countries to identify convergences and divergences. First, we distinguish between corporate and household taxation. Then we consider the taxation of capital and labour for each of these actors. Finally, we consider the taxation of consumption, which by construction affects only households. These distinctions are statistical and distinguish the actors or factors of production directly concerned (**?**). More specifically, we use data from the OECD Revenue Statistics, but also individual household data from the Luxembourg Income Study (LIS) to identify redistributive effects, following the lessons of the work of Amoureux et al. (2018) and Rousselon and Viennot (2020), and additional data such as the decommodification index proposed by Esping-Andersen (1990).

The second approach constructs a typology of fiscal systems from these empirical data.

Following the literature on institutional complementarities or types of capitalism (Amable et al. (1997) ou Amable (2005) for pioneering contributions), we use statistical tools to identify country consistencies by studying nine tax series per country. While most works use principal component analysis (PCA), we use more recent machine learning tools of automatic clustering, which allow a more direct interpretation of the results. In particular, we use the $K-means$ method, which is shown to be efficient and robust.

This two-stage analysis delivers different results. A first set of results concerns the dynamics of taxes across countries after the 2007-2008 crisis. We find a global convergence on the taxation of corporate capital income. However, we find persistent and sometimes increasing differences in the taxation on labour, and divergences in the evolution of the taxation on capital stocks. The taxation on the capital stock mainly concerns the taxation of real estate, which is a non-mobile factor. Thus, these trends confirm an intuition that the tax rate on mobile factors tends to converge due to international competition (taxation of corporate capital income), confirming the results of Antonin et al. (2014), and show that the tax rates on other factors of production do not converge. Finally, we observe a convergence of consumption tax rates across European countries, which is not surprising given European regulatory constraints.

The statistical approach to identifying coherence leads to the distinction of three fiscal models that can easily be characterized: a social-democratic model, composed of the large European countries; a liberal model, with the United States, the United Kingdom and Ireland in particular; and an "intermediate" model, composed of Japan and other European countries, potentially in transition to the social-democratic model over the period. The dynamic analysis shows the existence of two main models, which gradually differ into two divergent models and a third model of intermediate countries. Between these models, we observe a correlation between the tax revenues over GDP and the amount of redistribution within countries.

In particular, it is interesting to note the divergence of Great Britain from the social-democratic model towards which European countries were converging, well before the Brexit vote. This typology of countries, based solely on the taxation of countries, is consistent but a little bit different from the typology of welfare states of Esping-Andersen (1990), which consider other forms of State regulation, and not only the fiscal system.This analysis shows that the effects of the 2007 crisis, far from having led to convergence towards a single model, has led to a divergence of fiscal systems, although it highlights the convergence of corporate capital taxation over the period towards a low level.

This article is part of the work studying the diversity of social states and fiscal systems. This work first takes a general comparative approach within the framework of the diversity of capitalisms. Work on the variety (Hall and Soskice (2001), Schneider and Paunescu (2012), Jessop (2012)) or diversity of capitalisms, including regulationist work (Amable (2005), Boyer (2007)), finds that the diversity of capitalisms corresponds to a diversity of social states and therefore a diversity of fiscal systems. A recent study compatible with these analyses is Hasse

et al. (2020), which draws up a typology of growth regimes in relation to the reforms of social states in developed countries.

The diversity of social states, or forms of welfare states, has been studied by Esping-Andersen (1990) who produced a typology of three types of welfare states. Fiscal systems are a component of welfare states and show systematic differences. Thus, Prasad and Deng (2009) study the progressiveness of taxation according to Esping-Andersen's typology of welfare states, and the results show that the taxation system is rather progressive in liberal countries (with the exception of the United Kingdom) and regressive in social-democratic countries. This is explained in particular by the importance of consumption taxes in social democratic countries, which allow a tax base that is not very sensitive to competition and globalization, and ensure the stability of the welfare state.

More empirical work decomposes social systems descriptively across tax types, such as the Taxation Trends report (2020) mentioned above, which is based on academic contributions defining decomposition methods, such as Mendoza et al. (1994). Finally, studies of fiscal systems focus on differences in progressivity by analyzing household taxation. Piketty's work was pioneering in building historical databases (Piketty and Saez (2003), Piketty (2003), Piketty (2014)), more recent works study components of taxation by extending the levies studied, such as social contributions or public expenditures (Amoureux et al. (2018), Rousselon and Viennot (2020), Causa and Hermansen (2018)). Within this work, our contribution is to mobilize a large number of series on national fiscal systems and their progressivity, using empirical work to construct typologies of social states, which we perceive as being at the heart of a typology of capitalisms. This typology is deliberately statistical and descriptive. It must be seen as an empirical study, necessarily complementary to studies identifying the political, social and economic forces at work in the coherence of social systems and in the observed divergence of the latter.

The presentation of the article is as follows. The second section presents the accounting breakdown of the state budget, in order to identify all the components and explain the series. The trends in the main tax rates are then described. The third section presents the comparison of the redistributive effects of fiscal systems on individual data. The fourth section presents the results of the clustering and typology of fiscal systems. The fifth section is the conclusion.

2 Structure of the State budget

We first decompose the government budget in order to compare the tax structure between countries. This approach is based on comparable international data (OECD, Taxation Trends report of the European Comission (2020) among others), derived from national accounts. Simple accounting equalities allow a disaggregation of the state budget, both in terms of resources and expenditures. Government resources come from tax revenues (O) and the budget deficit (noted

ΔB). Government expenditures are composed of government final consumption expenditures (health, education, civil servants' salaries, etc.), noted G, interest payments on government debt rB (where r is the apparent interest rate on government debt and B is the total amount of government debt) and transfers to households and firms, noted Tr. These transfers are measured net of taxes and other contributions. For each country i and each year t, we can therefore represent the government budget constraint as

$$G_{i,t} + r_{i,t}B_{i,t} + Tr_{i,t} = T_{i,t} + \Delta B_{i,t} \qquad (1)$$

Then, the tax rates $T_{i,t}$ can be decomposed according to the contribution of different taxes. As mentioned in the introduction, many decompositions of the tax structure are possible. Following the recent literature, we decompose the fiscal system by distinguishing between taxes on the factors of production, capital and labour, and on consumption. This first traditional decomposition (Mendoza et al. (1994)) aggregates economic transactions into three main markets to analyze redistributive effects. Next, we decompose taxes by the payers, firms or households. This second decomposition between consumers and producers is also common (e.g. Taxation Trends (2020)) because the impact of taxes could be different in case of differentiated financial constraints[1]. Finally, for the taxation of capital, we distinguish between the taxation of capital income (e.g. tax on dividends) and the taxation of capital stock (e.g. tax on real estate) because the incidence of these taxes may also be different. For example, real estate ownership is immobile, whereas capital income may move between countries depending on the tax residence of the household. Unfortunately, it is not possible to distinguish in our data the share of capital stock taxation paid by corporations from that paid by households. Finally, consumption taxation concerns only households. We therefore consider six taxes: consumption tax (T_C), tax on labour paid by households ($T_{L\,hou}$) or by corporations and the self-employed ($T_{L\,corp\,SE}$), tax on capital income paid by households ($T_{K\,inc\,hou}$) or by corporations and the self-employed ($T_{K\,inc\,corp\,SE}$) and tax on capital stock ($T_{K\,sto}$).

$$T = T_L + T_K + T_C = T_{L\,hou} + T_{L\,corp\,SE} + T_{K\,inc\,hou} + T_{K\,inc\,corp\,SE} + T_{K\,sto} + T_C \qquad (2)$$

The analysis is based on OECD Revenue Statistics data, which allows us to study 29 countries, including 7 non-EU members (Canada, USA, Japan, Switzerland, Korea, New Zealand, Norway), between 2006 and 2018. They were complemented by Eurostat data, in particular by using micro-data to allocate taxes on household income between labour and capital. In order to allocate

---

[1]A traditional example is the difference between the taxation of dividends received by households and the taxation of corporate profits. Both taxes are on the capital factor. If firms reinvest all their profits, then the first tax does not affect investment, while the second reduces it.

taxes between the aggregates labour, capital, consumption and business, households, we use the method described in the European Commission's Taxation Trends (2020) report, derived from the article by Mendoza et al. (1994) and completed by Carey and Tchilinguirian (2000). The initial aim of this method is to associate the yields of taxes on capital, labour and consumption with their tax base, in order to calculate average rates, known as implicit rates. This makes it possible to better represent and compare the tax burden on each factor. The origin of the data and their construction are described in more detail in the Appendix.

2.1   The structure of the State budget: Evolution of some aggregates

International comparisons first allow us to identify the main differences between the ways in which governments finance themselves. The decomposition of the state budget for countries, according to the components of the equation (1) for each year is presented in the Appendix to this article.

We first present a global average of the main aggregates for the year 2006 and 2018. The first column indicates the year considered, either 2006 or 2018. The second column shows for each year considered, the average of the variables and then the standard deviation of the variable across countries for the year considered (cross-section heterogeneity). The other columns indicate the aggregates considered. The column rB indicates the average interest burden on public debt relative to GDP across countries in 2018. The average is 1.6% in 2018 compared to 2.2% in 2006, which is due to the decrease in interest rates over the period. Column G represents government final consumption expenditure. Column ΔB is the change in debt relative to GDP. This average turns out to be close to zero for the two years considered (but not over the whole period). Column Tr shows transfers to households. The T column is the overall tax rate. Finally, the last three columns break down the tax rate into three components: the yield from the consumption tax (C), the labour tax (L) and the capital tax (K). Thus, the sum of the columns rB, G and Tr is equal to the sum of the columns ΔB and T, and the sum of the last three columns is equal to the column T, for each country and each year.

Year		rB	G	Tr	(=)	ΔB	T	(=)	C	L	K
2018	Mean	1.62	19.29	15.01		0.00	35.92		10.92	18.58	6.42
	Standart dev.	1.07	3.42	4.19		2.47	6.11		2.99	4.66	2.19
2006	Mean	2.19	18.93	13.89		-0.02	34.99		10.55	17.43	7.01
	Standart dev.	1.25	3.10	4.54		4.83	6.29		2.66	4.80	2.65

Table 1: State budget and tax rates (mean and standart deviation)

The analysis of this table shows, first of all, the high average of tax rate, around 35% of GDP, which increased slightly between 2006 and 2018. The variation in the tax rate between countries

is high, with a standard deviation of over 6%. A first reading of this table therefore indicates a relative stability of taxes and their structures between 2006 and 2018, as well as heterogeneity between countries.

Howerver, this stability is illusory and the result of misleading aggregation. Before a systematic analysis, we present the results for two of the most different countries in our sample: the United States and France. As shown in the Appendix, the United States has the lowest tax rate in the sample, and France the highest over the period 2006-2018. To simplify the reading, the table 2 represents the same variables in columns. The difference in tax rates between the two countries is explained by higher transfers and public spending. It is known that these differences are mainly due to the pay-as-you-go pension system and the largely public financing of health care in France. The purpose of this article is not so much to explain these differences in financing methods as to analyze their evolution over time. The composition of taxes is very different between the two countries. France, like the European countries, uses taxes on consumption (VAT), which are very low in the United States. Second, labour taxes are higher in France than in the United States. This is also the case, but to a lesser extent, for the taxation of capital.

Year	Country	rB	G	Tr	(=)	ΔB	T	(=)	C	L	K
2018	FRA	1.71	23.28	23.60		-2.29	46.30		12.08	25.52	8.70
	USA	3.91	14.11	13.02		-6.60	24.45		4.02	14.47	5.96
2006	FRA	2.60	22.76	21.38		-2.44	44.30		10.69	24.16	9.45
	USA	3.98	15.01	11.13		-3.33	26.78		4.10	14.33	8.34

Table 2: State budget and tax rates (France and the United States)

Finally, the difference between France and the United States has increased over the period 2006-2018. The tax rate has increased in France while it has decreased in the United States. In both countries, however, the taxation of capital has decreased. These first indications are based on two singular countries. The following analysis will show that these trends reveal divergences in fiscal systems, common to groups of countries.

2.2 Analysis of tax revenues

This section focuses on the structure of the tax burden based on the decomposition of the equation (2). We provide the decomposition for each country in the Tables in the Appendix. As an introduction to the analysis, the Figure 1 represents the structure of taxation for five significant countries and the 28-member European Union, in 2006 and 2018, decomposing the tax revenues into the six taxes. The ordinates are percentages of annual GDP. The size of each tax thus represents the yield of the tax as a percentage of each country's GDP in that year.

First of all, we observe that some countries, such as Germany, France and Japan, have seen
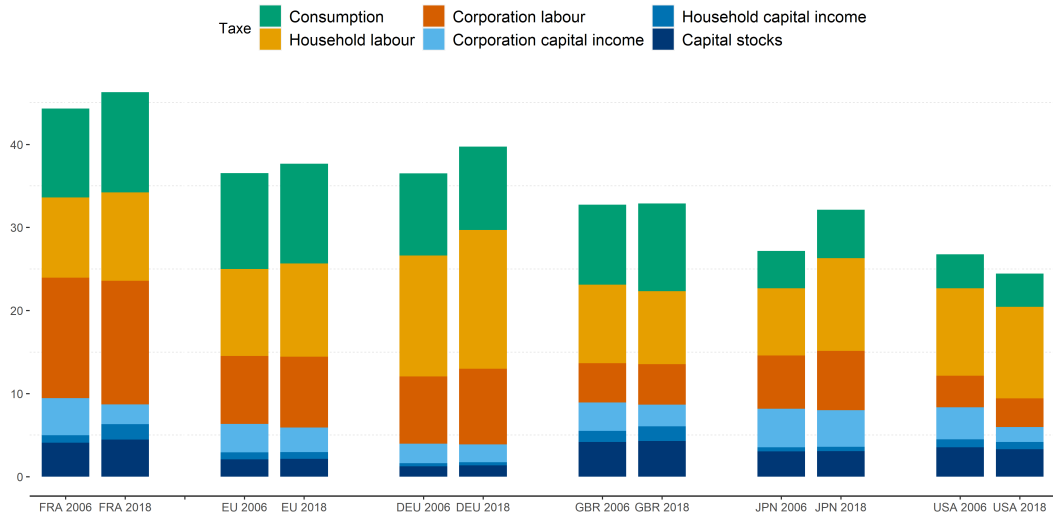
Figure 1: Taxation structure

their tax rates increase, while the United States has seen its tax rates decrease. Countries with a high tax burden in 2006, such as France, have seen an increase in their tax rates, while countries with a low tax burden in 2006, such as the United States, have seen their tax rates decrease. We also observe a diversity of taxes used, as well as their variation.

This figure contains a lot of information, which we break down into main results, focusing on the key trends in tax dynamics. We present the results in the form of six stylized facts in order to identify consistencies.

Fact 1: Heterogeneity in the dynamics of tax revenues

The evolution of tax rates suggests strong heterogeneity in the responses to the crisis from 2006 to 2018. Indeed, it seems difficult to find consistency between the variation in the tax rate over the period and its level in 2006. In our sample, the average tax revenues over GDP increased from 35% to 36% from 2006 to 2018, and heterogeneity, measured by standard deviation, decreased from 6.29 to 6.11 over the period. This slight aggregate convergence hides notable divergences, as shown in Figure 1. The tax burdens of Denmark, Sweden, and Spain decreased by two points[2]. In contrast, for Germany and Greece, the tax rate increased by three and eight points respectively, rising for Greece from 30.6% in 2006 to 38.4% percent in 2018.

At the European scale, countries adopted divergent strategies between 2006 and 2010, as explained in Antonin et al. (2014), particularly for the management of the crisis, where fiscal austerity resulted in lower public spending or higher taxes. Thus, the European tax rate decreased

---

[2]Ireland's tax rate has fallen by almost nine points, from 31.4% in 2006 to 24.7% in 2018. However, this drop does not correspond to a drastic fall in tax revenues, but to an accounting change in GDP: between 2014 and 2015, GDP grew by 25.2% and tax rate decreased by six points.

between 2006 and 2010 to reach 35.7%, but has been increasing almost constantly since, and in 2018 it is higher than in 2006, at 37.7% of GDP.

Fact 2: Importance of labour tax share

A comparison of the structure of taxation across countries shows the importance of taxes on labour in government revenues. It represents on average 51% of tax revenues in 2018. However, the average labour tax yield increased more than the tax burden yield from 2006 to 2018, from 17.4% to 18.6%, which shows the stability and continuity of the use of this tax base. Sweden has the highest yield, yet it decreased from 27.5% to 26.4% over the period. In contrast, Korea's labour tax yield, the lowest in 2006 at 7.9%, has risen to 11.3% in 2018.

Fact 3: Heterogeneity of distribution of the tax burden between households and corporations

Interestingly, countries differ in the fraction of taxes paid by households or by corporations. The average tax rate paid by households is 23.5% of GDP in 2018. In our sample, we observe a slight shift in taxation from corporations, whose yields decrease by 0.4 percentage points from 2006 to 2018 to reach 12.4%, to households, whose yields increase by 1.3 percentage points. The increase in household taxation comes from consumption (+0.4 points) but especially from the taxation of household labour (+0.8 points).

Fact 4: Convergence of corporations capital income taxation

The relative heterogeneity of tax rate, however, hides convergence in some taxes. Thus, there is convergence in the taxation of corporate capital income, as shown in Figure 2.

Except for Japan, which in 2018 is almost at its pre-crisis level, the rest of the countries have sharply reduced taxation on corporate capital income (taxation on profits). While the purpose of this article is deliberately descriptive, it is easy to understand the economic logic of such convergence. Corporate capital income is indeed one of the most mobile tax bases. As a result, international competition, without coordination of rates, leads to a decrease in the taxation of this factor. It should be noted, however, that the amounts of taxation remain at a low level, amounting to 3.3% of GDP in 2018, or 9% of average tax revenues.

Fact 5: Divergence on capital stock taxation

The convergence of the taxation of capital income contrasts with the divergence of the taxation of the capital stock, as shown in Figure 3.

This divergence indicates that the capital stock is perceived as a factor with little mobility, and is therefore likely to be taxed differently across countries. Unfortunately, the data do not
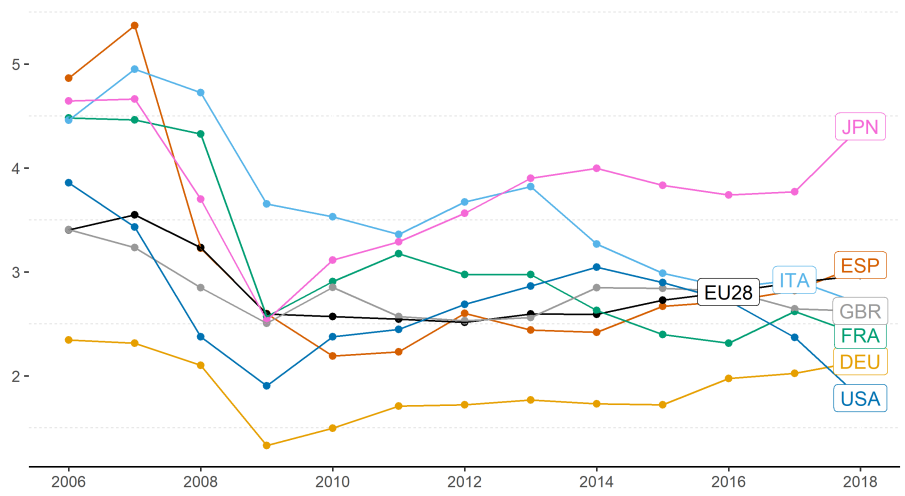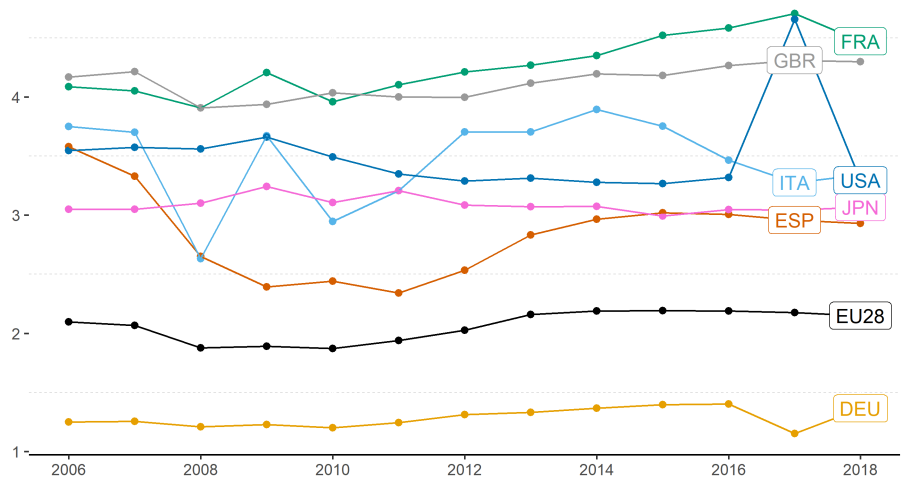
Figure 2: Taxes on corporate capital income

Figure 3: Taxes on capital stocks (corporations and households)

10

allow us to distinguish between taxation of household wealth (e.g. property taxes or wealth tax) and corporate wealth (taxes on production). Taxation of the capital stock is rather low in Germany (1.4% of GDP in 2018) and particularly high in France (4.5%). In this respect, France is close to Great Britain (4.3%)[3].

Fact 6: European convergence on consumption taxation

Finally, we find European convergence in consumption taxation. It is the result of a political choice to harmonize the definition of bases and then rates, and is part of the desire to build a single market and avoid relative price differences for tax reasons alone, as noted by Chatelais (2011). This convergence is taking place towards relatively high levels of VAT in Europe, compared to the United States for example.

3   Redistribution of fiscal systems

The previous section analyzed the state budget and considered different taxes. This section focuses on households only in order to consider the effects of taxes and transfers on income inequality. This approach makes it possible to analyze the redistributive effects of fiscal systems between households. It is based on microeconomic data of a different nature from those provided by the national accounts in the previous section. The use of sometimes heterogeneous micro data reduces the number of countries, years and sometimes tax instruments that can be analyzed. We rely on the LIS (Luxembourg Income Study) microdata, collected by national sample and harmonized. Among the 29 countries studied in the previous section, the redistributive effects of 17 of them are analyzed, between 2006 and 2016, some of them over several years, which constitutes a total of 48 observations. The temporal evolution of redistributive effects cannot be studied exhaustively due to the lack of data. However, this database allows us to compare the redistributive effects on household disposable income (by standard of living percentile) of a set of levies and transfers. Thus, in the decomposition (1), the redistributive effects of the components of $Tr_{i,t}$ and $T_{i,t}$ can be analyzed. While this database is among the most exhaustive in international comparison, it suffers from weaknesses that must be identified in order to clarify the limits of the analysis.

First, and in line with the literature, we compare income inequalities before and after taxes and transfers. The limitations of this methodology are well identified: it does not allow us to measure the redistributive effects of taxes on consumption, which would require data on the consumption structure of each household (see Andre and Biotteau (2019) for a discussion). Second, this income analysis does not include taxes on household wealth, whose effects remain negligible

---

[3]The spike of the taxes on capital stocks in 2017 for the US comes from a special non recurrent tax (Tax Cuts and Jobs Act repatriation tax), which is a one-time tax on past profits of US corporations' foreign subsidiaries and should not be considered as a permanent change.

in most countries according to Rousselon and Viennot (2020). Moreover, it is important to remember that the reduction of inequalities does not only involve socio-fiscal redistribution. The final consumption of public administrations, via the provision of services (health and education in particular), the various policies to reduce unemployment and equal opportunities have a long-term impact on inequalities in primary income and household purchasing power. Finally, the impact of redistribution on firms, notably through tax credits or subsidies, is not measured, even though this has a more or less direct impact on employment, and therefore on primary inequalities.

In conclusion, our analysis only partially takes into account redistributive effects, but the scope of the taxes and transfers considered does allow us to identify significant differences between countries.

3.1 Methodology

The effect of taxes and transfers is measured by the reduction in the Gini coefficient within the country between income before taxes and transfers (primary income) and income after taxes and transfers (disposable income)[4]. Our measure of primary household income before taxes and transfers is wages plus employee and employer social security contributions, because the issue is to measure the cost of labour generated by taxation. Primary income is therefore super gross (including employee and employer contributions). Employer and sometimes employee contributions are not available in LIS, so we use data from Amoureux et al. (2018), obtained by micro-simulation, to impute social contributions by income percentile. Indeed, as Guillaud et al. (2020) show, the progressivity of taxes also comes from the progressivity induced by social contributions and exemptions on low wages.

Before presenting the results, it is worth focusing on the status of retired households, whose treatment method can considerably change the results. Indeed, the difference in pension systems between countries changes the nature of pensions, which are sometimes considered as market income in funded systems or as transfers in pay-as-you-go systems. It would be logical *a priori* to include pensions in transfers to households, and thus not to assign them to intial income. Indeed, public pensions are attributed by national accounts to social benefit expenditures, which are included in transfers. They are also considered in many social protection systems as an intergenerational transfer. Moreover, the pension system has a significant impact on inequality, through the minimum old age pension and the ceiling on pensions. However, not allocating them to income before taxes and transfers would mean granting almost zero income to the retired population in countries with a pay-as-you-go system, and would greatly and artificially increase primary inequalities. Some studies choose to place only old-age benefits as transfers, but this seems insufficient to represent the relative redistribution of pension systems. Since we do not

---

[4]Other measures of inequality can be used. The Gini coefficient on income is the most widely used indicator.

wish to overestimate inequalities before taxes and transfers or to minimize the measurement of the redistributive effects of pensions, we have chosen to exclude the retired population from our samples, in order to focus more precisely on the analysis of the redistributive effects of working people alone. The amount of transfer by the public pension system will therefore be considered from a macroeconomic perspective in Section 4, by the total amount of transfers.

3.2 Results: Analysis of redistributive effects

Table 3 presents the numerical results. The first column shows the country. The second column shows the date of data collection. The third column presents the Gini coefficient of income before taxes and transfers (primary income). The fourth column is the Gini coefficient of income after transfers and before taxes (gross income). The fifth column is the Gini coefficient of income after taxes and transfers (disposable income). The sixth column presents the reduction in the Gini achieved by taxes and transfers. It corresponds to the percentage change between column (3) and column (5). Column (6) thus measures the reduction in inequality induced by the social and fiscal system.

Country	Year	Primary inc. Gini	Gross inc. Gini	Disp. inc. Gini	Var. Gini (%)
		(Before Tr and T)	(After Tr before T)	(After Tr and T)	
(1)	(2)	(3)	(4)	(5)	(6)=(5)/(3)-1
AUT	2013	38.18	35.10	29.14	-23.68
CHE	2013	29.35	26.90	25.91	-11.72
CZE	2013	34.68	32.35	25.28	-27.12
DEU	2013	37.54	33.07	26.16	-30.31
DNK	2013	32.61	28.16	25.03	-23.26
ESP	2013	44.87	41.60	37.14	-17.24
EST	2013	40.91	39.12	33.85	-17.25
FIN	2013	35.37	29.60	23.02	-34.90
FRA	2010	34.75	31.49	23.85	-31.35
GBR	2013	43.07	36.46	31.13	-27.72
GRC	2013	42.43	41.23	36.20	-14.67
IRL	2010	53.31	42.50	34.48	-35.33
ITA	2014	41.60	41.20	35.15	-15.51
LUX	2013	39.43	35.67	31.14	-21.03
NLD	2013	44.64	39.88	33.24	-25.53
SVK	2013	35.07	32.75	28.39	-19.06
USA	2016	41.48	39.18	34.80	-16.09

Table 3: Redistributive effects (last year by country). Tr is for transfers, T is for taxes.

This table provides several results. First, there is no correlation between primary inequality and the reduction in income inequality. In other words, high primary inequality (before taxes
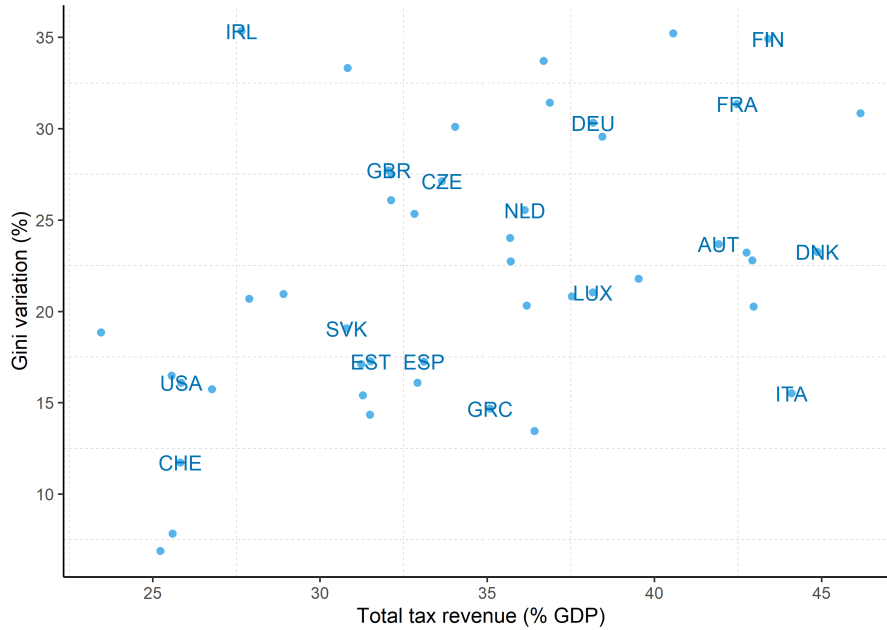
Figure 4: Tax revenues over GDP - Gini variation

and transfers) is not associated with a greater reduction in inequality. Similarly, we do not find a significant correlation between the amount of primary inequality and the size of the socio-fiscal system, as measured by the tax revenue over GDP. Thus, there is a strong dispersion of primary inequality (before taxes and transfers) and a weak correlation with the tax rate. For example, the Gini index reaches its minimum at 0.27 for Switzerland and its maximum at 0.53 for Ireland in 2010, which have similar tax revenues over GDP: 25.6% and 27.6% of GDP respectively. The correlation between tax rates and the Gini index of primary income is -26.2%, but not very significant (p-value of 0.075). Thus, a high reduction in inequality through the social fiscal system is not a corrective instrument for high primary inequality, but rather the result of national preferences for a reduction in inequality. Following Chang et al. (2018), social preferences should therefore be considered as an explanatory factor for the heterogeneity of fiscal systems.

It can be observed that the reduction in inequality induced by the socio-fiscal system is positively correlated with the tax revenues over GDP. The correlation between the latter and the variation in the Gini is 47.3% and is significant at the 0.1% level: the higher the tax rate is, the greater the reduction in the Gini. The following graph 4 presents these results graphically. On the x-axis is the amount of tax revenues relative to GDP for each country. The ordinate shows the absolute change in the Gini (Column 6).

There is a clear positive correlation between the amount of tax revenues and the reduction of inequalities. The case of Ireland is singular, as noted in other studies (Guillaud et al. (2020),Rousselon and Viennot (2020)), and deserves discussion. Despite a relatively low tax rate of 27.6%, Ireland is the second most inequality-reducing country with a variation of -35.3%.

This result is explained by the very high level of primary inequality in Ireland (interdecile ratio of primary income: 23.9 and 7.1 for the European median), by targeted taxation of income (significant share of income from the 40th decile onwards) and by a volume of transfers to households that is higher than their rate of compulsory deductions (due to low consumption by public administrations). The interdecile ratio of disposable income is then 3.2 for Ireland and 3.4 for the European median according to Rousselon and Viennot (2020). Thus, without taking Ireland into account in the sample, the correlation between the tax rate and the variation in the gini reaches 58.4%.

4 Coherence of socio-fiscal systems

The previous sections analyzed the dynamics of each of the tax instruments and redistribution within each country. We are interested here in the statistical identification of coherence between these instruments, in order to distinguish and analyze fiscal systems. This coherence may be the result of national preferences or of economic complementarity between the instruments. The methodological choice is to use statistical tools to identify coherences in an "agnostic" way and then to discuss the economic coherence of the types of fiscal systems identified. As mentioned in the introduction, this approach is common in the literature on the variety of capitalisms, as tax tools are strongly interdependent in their effect on redistribution. We use a machine learning algorithm, which is the $K-means$, explained below, that allows us to perform this type of clustering with a large number of variables[5]. The interest of this strategy is confirmed by the identification of groups of countries in a manner consistent with the literature on the variety of capitalisms (Amable et al. (1997) and Amable (2005)).

The $K-means$ algorithm is an unsupervised non-hierarchical clustering algorithm. It allows to group data (here countries) into a finite number of sets based on the provided characteristics (here variables describing the socio-fiscal systems). Intuitively, from a given number of clusters, the algorithm provides the groups of countries that minimize the distance within clusters (see Kassambara (2017) for a presentation of the algorithm and its implementation). For each exercise we determine the number of clusters endogenously by the *gap statistics* method, which minimizes the heterogeneity between clusters. The economic discussion will show the consistency of the results, both in the composition of the clusters and their number.

We perform this exercise in 2006 and 2018, in order to identify clusters before the 2008 crisis and clusters in 2018. This allows us to discuss both the dynamics of clusters and countries within clusters and to identify the permanence or not of clusterings after the 2008 crisis. Finally, we perform the exercise with two sets of variables. The main results discussed in this Section are

---

[5]Initial work uses principal component analysis (Amable (2005)). The use of machine learning methods proves to be more powerful to identify the coherences and then discuss the variables that determine these coherences, as the number of clusters can be made endogenous.

realized with the ten variables presented in Section 2. These are the six taxes identified in the discussion of the equation (2) as a share of total taxation, the tax revenues over GDP, the total amount of transfers over GDP and the implicit tax rates on capital and labour income. Although the comparison of implicit rates (especially on capital) is unreliable, we have nevertheless chosen to include them in our aggregation. We preferred to include the implicit rate on capital income, because it better reflects the reality of the average tax rate (see Appendix). This rate allows us to distinguish between different sizes of tax bases across countries. Thus, in 2018, the yields from capital income taxation amount to 7.7% of GDP in Luxembourg and 4.2% in France, while the implicit rate on capital income in Luxembourg is 7.2% and in France is 22.8%.

The use of these macroeconomic variables allows us to consider 29 countries. We also perform clustering by introducing distributional variables such as inequality reduction, using the LIS data discussed in Section 3. Data availability leads us to consider only 17 countries in different years. As the results are very similar[6] we use the variables that allow us to treat the largest number of countries and present the results with redistribution in Appendix C.2.1[7].

4.1 Three socio-fiscal systems

The statistical analysis for 2006 and 2018 indicates the existence of two clusters in 2006 and three in 2018. Figure 5 presents the results by indicating the clusters in the same color and representing the countries in a plane formed by the tax revenues on the x-axis and the implicit tax rate on lbour on the y-axis. The choice of these two variables is made on a statistical basis, as they have the greatest weight in the formation of the groups.

Before commenting on these results, it should be noted that this clustering is robust to the analysis of tax variables alone (without transfers) and to the inclusion of redistribution variables.

The groups of countries can therefore be differentiated mainly by the tax revenues and the implicit tax rate on labour. In 2006, a first group of countries has low values for these two variables (Korea, United States, Canada among others). A second group of countries has high values for these two variables (Sweden, Finland, Germany, Austria among others). In 2018, a third intermediate group appears, clustering countries with intermediate values for these two variables (Spain, Japan, Portugal among others). To simplify the discussion, we refer to the three groups as "low" (USA, Canada), "high" (Sweden, Finland, Belgium) and "intermediate" (Spain, Japan), designating their amount of tax revenues over GDP in 2018.

These results call for some initial observations. The consistency of the groups is greater in 2018 than in 2006. This result is not only due to the larger number of groups, but to the

---

[6]The similiarity of the results comes from the correlation between the Gini reduction and the tax revenues over GDP discussed in Section 3, so the redistributive effects are largely captured by the macro variables.

[7]In Appendix, we also provide results where we use the Esping-Andersen (1990) index of *decommodification*. Obviously many other variables could be used in this clustering exercise. Focusing on fiscal variables is here made to focus on "local" consistency of fiscal systems. The relationship of these consistency with other variables characterizing the variety of capitalism is left for future work.
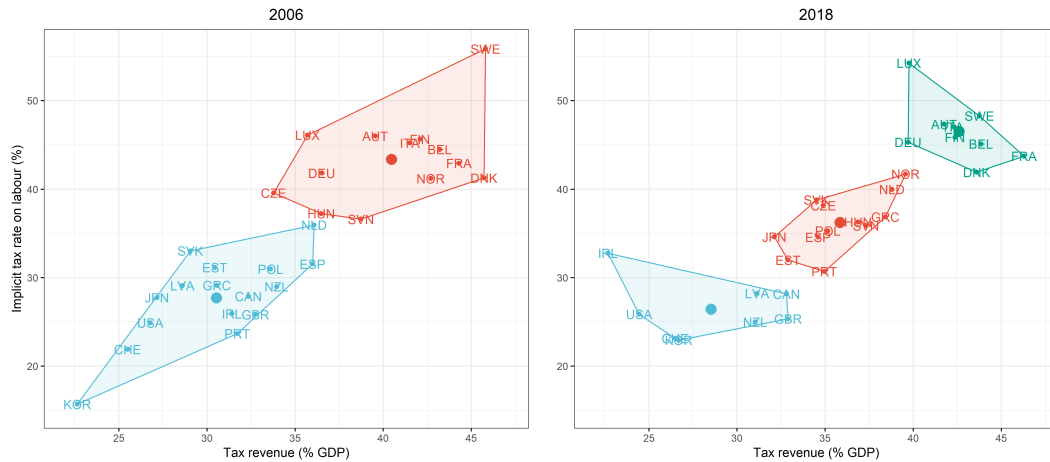
16

Figure 5: Clustering: tax and transfer variables

dynamics of the countries. Thus, a large number of countries are found with high and close taxation in 2018, like Sweden, France, Belgium, Germany in particular. Low tax countries are also more consistent in 2018, such as the US, UK, Canada or Korea. Similarly, "intermediate" tax countries in 2018 show strong consistency.

This analysis is deliberately statistical. It can now be compared to the literature on the variety of capitalisms that proposes classifications of countries or welfare state systems. Esping-Andersen (1990) suggests in particular a typology of welfare states in three groups. He distinguishes between the liberal regime, the social-democratic regime and the corporatist regime. Our statistical partition partly overlaps with this typology. The liberal regime corresponds to the "low-tax" group, the social-democratic group to the high-tax group, and the corporatist model to the intermediate-tax group (which includes Greece and Spain, Portugal and Japan). However, a more detailed comparison of the clusterings leads to important nuances. For example, our statistical classification leads us to consider countries that Esping-Andersen (1990) defines as corporatist in the social-democratic group. It should be noted, however, that Esping-Andersen (1990)'s classification corresponds to a description of welfare states thirty years before the classification proposed in 2018. Moreover, institutional analyses are more precise on the details of social legislation, whereas we choose an essentially budgetary economic approach. In the literature on the variety of capitalisms, often two subgroups are distinguished within the social-democratic group. For example, Amable (2005) distinguishes between the social-democratic model and the continental European model. Focusing on the fiscal and tax side only, we find a homogeneous social democratic group.

Based on this proximity to the literature on the diversity of social models, we call countries with low taxation "liberal", countries with high taxation "social democratic" and countries with intermediate taxation "intermediate", with the understanding that these labels are not value judgments and are descriptive.
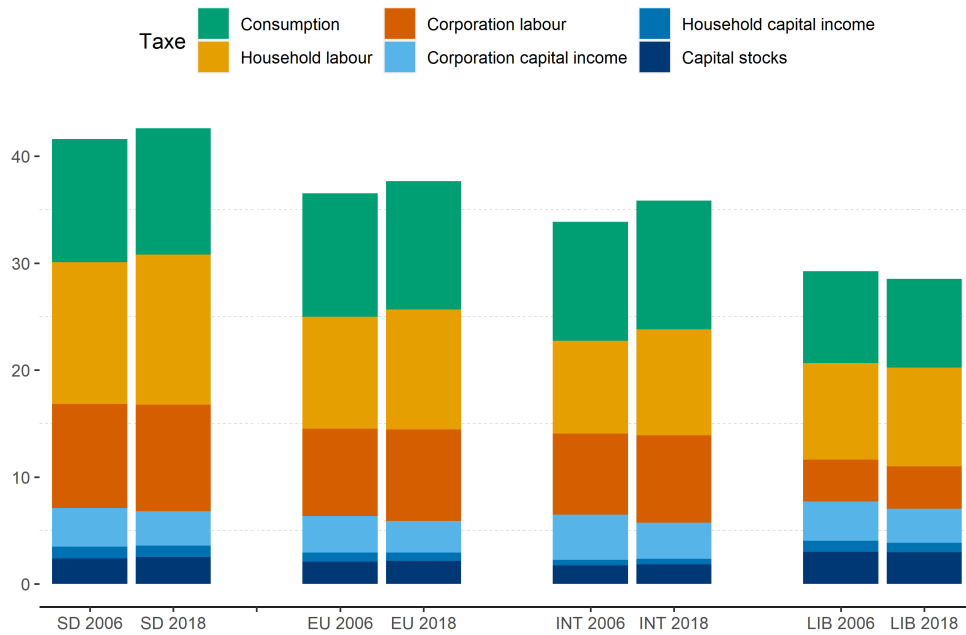
17

Figure 6: Tax structure by cluster and European Union

4.2 Identification of three models of socio-fiscal systems

The statistical clustering method must now lead to an economic analysis to understand the economic meaning of the results obtained. In order to show the dynamics of the countries between 2006 and 2018, we use the 2018 clustering, which leads to end-of-period consistency. Beyond simple economic identification, we identify common economic trends.

First, the three groups are distinguished by the amount of tax revenues over GDP. We now plot the average tax liability rates by country group in 2006 and 2018 (thus considering the 2018 cluster classification). Figure 6 presents the results by showing the tax liability rate by country group, by date (as well as the composition by tax instrument, for the six instruments identified). We now describe the statistical regularities.

The social-democratic model is characterized by a high tax rate, taxation of labour and transfers. The group referred to as social-democratic includes nine European countries: Belgium, Denmark, Finland, France, Italy, Sweden, Luxembourg, Germany and Austria. The characteristics of this group are based on a high rate of tax revenues, high taxation of labour and a high level of transfers. This is enough to give this group a strong coherence around the large size of the state. However, this group remains quite heterogeneous in terms of the taxation of capital and the distribution between taxation of household labour (income tax and employee contributions) and corporation (employer contributions).

18

The liberal model is characterized by relatively high capital taxation, low tax rate and low labour taxation   In contrast, the liberal model is characterized by low taxation, particularly on labour and consumption. The low taxation of consumption is explained in particular by the high proportion of non-European countries in this group: the United States, Switzerland, New Zealand, Canada and Korea. Only Ireland and Latvia (and the UK) are members of the European Union. All countries belonging to this group in 2018 were already present in 2006. Finally, it should be noted that these countries are distinguished by a high taxation of capital stocks as a proportion of total tax revenues, already noted by Amable (2005), at 3.0% of GDP in 2018, compared with 1.8% for the intermediate group, and 2.5% for the social democrats.

The intermediate model finds coherence, potentially from the influence of international competition in the tax structure   The intermediate group is by nature more difficult to characterize. It is composed of twelve countries: Estonia, Spain, Greece, Japan, Netherlands, Poland, Portugal, Slovakia, as well as Norway, the Czech Republic, Hungary and Slovenia. The first eight are from the group with the lowest tax burden in 2006, while the rest belonged to the group with a higher tax burden. However, this group manages to find consistency in its tax structure. The most discriminating variable is the high share of taxes on consumption in the tax revenues. This is explained by the predominance of European countries in the group, apart from Japan and Norway. Consumption taxation allows for a stable tax base, an immobile factor, and thus a relatively high tax revenues without weighing on production factors. There is a particularly low level of taxation on capital, which may appear to be a way of adapting more to international competition. This intermediate group includes countries that are relatively small in terms of population (or in a highly open economic zone, such as Japan in competition with China), which are more likely to adopt a strategy of tax competition, see Chatelais (2011).

If this group appears to be rather new compared to 2006, it is appropriate to question its stability: is it the creation of a new socio-fiscal system? Or is it a model in transition? To help answer this question, we now study the dynamics of the fiscal systems more explicitly.

4.3   Dynamics of fiscal systems in the crisis

We now study the temporal evolution of tax rates in order to identify the tax trends across groups. In this exercise, we also represent the average of the 28-country European Union (22 countries including the United Kingdom) in order to identify whether the European Union is close to an identified group.

Figure 7 presents for each group and the European Union the dynamics of taxes on consumption, labour and capital (top three graphs) as well as the standard deviation of these three variables between countries and for each year within each group (bottom three graphs), in order
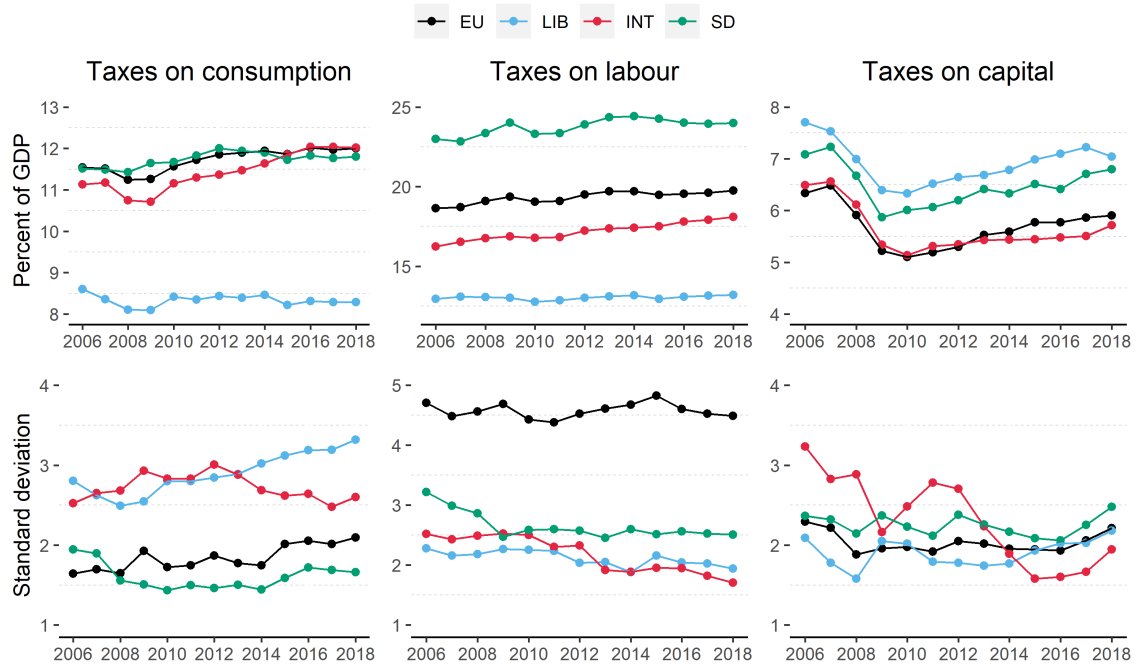
19

Figure 7: Evolution, by cluster, of consumption, labour and capital taxation and heterogeneity

to study the stability and dynamics of intra-group heterogeneity[8].

Stability of the social-democratic model   The social-democratic model appears to be a very stable group, with low relative dispersion in consumption and labour taxation. The heterogeneity of capital taxation (income and stocks) is slightly increasing and relatively high, there is no group consistency in capital taxation. For example, yields amount to 3.9% in Germany in 2018 to 11.7% in Luxembourg. The average tax rate increased slightly from 41.6% in 2006 to 42.6% in 2018 and the heterogeneity decreased (from 3.7 to 2.1). The decrease in taxation on capital (-0.3 points of percentage) was offset by an increase in taxation on labour (+1.0 points) and on consumption (+0.3 points).

Dynamics of the intermediate group   In contrast, the intermediate group appears more heterogeneous than the social-democratic model, which is explained by its new formation (eight countries from the low-tax group in 2006, and four from the other group). But this does not justify the taxation trends and the formation of a strong intra-group consistency. Indeed, between 2006 and 2018, the tax ratio increased from 33.9% to 35.8% of GDP, and the standard deviation fell from 4.4 to 2.3. This increase is due to the rise in the tax on consumption (+0.9 points)

---

[8]The measurement of the evolution of the standard deviation is of course biased since the three groups were formed in the year 2018, so it is normal to find rather a decrease in the standard deviation. This is why we use it mostly in comparison between the groups, or when it increases.

and labour (+1.9 points), which again offsets the fall in the tax on capital (-0.8 points), which amounted to 5.7% in 2018. This low rate is a feature of the middle group, with a standard deviation of 1.9 in 2018, hence the analysis of a group of small open economies. But the increases in labour and consumption taxation lead the intermediate group to move closer to the social-democratic model, both in its structure and in its level of taxation, with capital taxation being a heterogeneity factor in this model anyway.

Heterogeneity but coherence of the liberal model This group of countries is characterized by an overall decrease in the tax rate. Most of the countries in the group have lowered their tax rate slightly, with the exception of Ireland, which has lowered its tax revenues over GDP by nine points over the period.[9] In contrast, Latvia's tax rate increased by two points, due to higher taxes on labour and consumption, and Korea's by four points, mainly due to higher taxes on labour. There is strong intra-group heterogeneity in tax rate, with a standard deviation of 3.9 in 2018, compared to 2.3 in the intermediate group and 2.1 for the social democratic model. For all that, tax rate seem to have stagnated over the period, taxation on capital has decreased as for the other groups and taxation on labour has decreased here too. Thus, while the countries did not move much closer together over the period, each of them (with the possible exception of Latvia and Korea) moved towards a continuation of the logic of low taxation.

A common trend: substitution of the tax from capital to labour? It is worth noting that all groups have decreased their taxation of capital (-0.6 points), which comes mainly from the decrease in taxation on corporate capital income. However, this was accompanied by overcompensation by an increase in taxation on labour in the social democratic (+1.0 points) and intermediate (+1.9 points) models. In the liberal model, on the other hand, labour taxation increased slightly (+0.3 points). This recent trend confirms the finding of Carey and Tchilinguirian (2000) that there was a shift from capital to labour taxation in the 1990s.

4.4 The beginning of European convergence?

To conclude, we now study the dynamics of European taxation. The European Union countries we consider belong to all three models. Great Britain, Ireland and Latvia belong to the liberal model. Portugal, Greece and Spain belong to the intermediate model, while Germany, France and Austria correspond to the social-democratic model. However, taken as a whole, Europe is closer to the social-democratic model than to the liberal model, as can be seen in Figure 6. Over the period 2006-2018, the European tax rate increased (+1.3 points), as for the social democratic model, while it decreased for the liberal model. Second, European countries have a similar tax structure. First of all, they have, on average, a high consumption tax. This result is the result

---

[9]see sufra note

of the desire for harmonization within the single market, and is therefore more political than economic in origin, but it is a powerful factor of convergence. Second, European countries are characterized by high labour taxes (52.4% of tax revenues).

Figure 7 shows that the heterogeneity of the European fiscal system concerns mainly the taxation of labour. Heterogeneity in capital taxation is also important, but the amounts are small in the tax rate structure.

Finally, European heterogeneity is increased by the inclusion of the United Kingdom and Ireland. The exit of the UK from the European Union in 2021 therefore mechanically increases the proximity of the remaining countries of the European Union. Finally, the case of Ireland is special, because of its small liberal open economy tax structure, far from the intermediary model. As an example, the standard deviation in 2018 of the tax rate between European countries falls from 5.4 if we consider the UK and Ireland to 4.2 when we exclude these two countries.

5 Conclusion

The study of the coherence of tax structure and public budgets between 2006 and 2018 shows differentiated results in terms of the convergence of fiscal systems. There is a global convergence of tax rates on corporate capital income, as well as a European convergence of consumption taxation. The analysis shows that while the composition of the tax structure is important, the total amount of tax revenues ratio captures much of the heterogeneity between countries. In particular, redistributive effects, such as the reduction of income inequality, is correlated with the amount of tax revenues. We do not find a correlation between primary inequality and the total amount of taxes or the reduction of inequality induced by the social fiscal system. In this sense, the tax revenues is more the result of national preference than of a direct effect of correcting inequalities.

The analysis of the proximity of fiscal systems within countries using statistical tools of machine learning (clustering) shows the existence of three groups of countries in 2018, qualified as social-democratic, liberal and finally a third group of countries between these two models, qualified as intermediate. This statistical typology is close to that highlighted in the literature on the variety of capitalisms or welfare states. The liberal model pursues a logic of a low tax burden in the economy. The social-democratic model is more consistent, and most of the countries in this group have stabilized their tax rate at around 42%.

The intermediate model raises questions. Two interpretations are possible. In the first, this group can be analyzed as a model in transition, which is gradually moving towards the social-democratic model. A second interpretation of this intermediary model consists in considering it as a structure of small open economies, characterized by a low taxation of capital. This group includes economies that are highly open to international trade. Our study, which is deliberately descriptive, does not allow us to distinguish between these alternative hypotheses,

which are not necessarily incompatible, since the taxation of capital is very heterogeneous within the social-democratic and European model, and the low taxation of capital does not exclude rapprochement with the social-democratic model.

Finally, a European fiscal convergence seems to be emerging, which would be closer to the social democratic model. A first element is the convergence on consumption taxation. A second element is the convergence of labour taxation. The heterogeneity of capital taxation is significant, but concerns small amounts in the tax structure. It should be noted, however, that the absence of tax coordination seems to lead to a downward trend in this tax rate, which may not be desired by the countries. Finally, this European convergence increases significantly when we do not consider the United Kingdom in the set of European countries, which is now the new European reality. As a hypothesis, we can suggest that the singularity of the British model, identified as liberal, may be one cause, among others, of the British refusal of European integration. In this sense, the Brexit is in continuity with the continuation in the own dynamics of the liberal model.

The analysis of the trajectory of countries during the subprime crisis does not show convergence, but rather a divergence of models. However, there is a relative convergence of European countries, increased by the Brexit. It is likely that the Covid-19 crisis will similarly increase model divergence, or lead to accelerated convergence within models. The effect on convergence among European countries will depend as much on economic forces as on political agendas. The election of Joe Biden in the United States and finally the agreement on the minimum corporate tax rate are perhaps the first elements of international convergence. However, the present study shows that the diversity of fiscal systems can co-exist with a convergence of corporate taxation. Therefore, the working hypothesis should be that the difference in fiscal systems remains.

References

AMABLE, B. (2005): "Les cinq capitalismes - Diversité des systèmes économiques et sociaux dans la mondialisation," Paris: Seuil.

AMABLE, B., R. BARRÉ, AND R. BOYER (1997): "Les systèmes d'innovation - À l'ère de la globalisation," Paris, 401.

AMOUREUX, V., E. GUILLAUD, AND M. ZEMMOUR (2018): "Le financement par cotisations freine-t-il la redistribution ? Une analyse en comparaison internationale," *Revue franqise des affaires sociales*, 34.

ANDRE, M. AND A.-L. BIOTTEAU (2019): "À moyen terme, une hausse de la TVA augmente légèrement les inégalités de niveau de vie et la pauvreté," *Insee Analyses*, 43.

ANTONIN, C., F. DE LIÈGE, AND V. TOUZÉ (2014): "Évolution de la fiscalité en Europe entre 2000 et 2012," *Les notes Ofce*, 44.

ANTONIN, C. AND V. TOUZÉ (2019): "Loi de finances 2018 et fiscalité du capital," *Revue de l'OFCE*, 161.

ATKINSON, A. B. AND J. E. STIGLITZ (1976): "The design of tax structure: Direct versus indirect taxation," *Journal of Public Economics*, 6, 55–75.

BOYER, R. (2007): "Comment concilier solidarité sociale et efficacité économique à l'ère de la globalisation : une lecture régulationniste," in *Repenser la solidarité. L'apport des sciences sociales*, ed. by S. Paugam, PUF, 887–914.

CAREY, D. AND H. TCHILINGUIRIAN (2000): "Average Effective Tax Rates on Capital, Labour and Consumption," *OECD Economics Department Working Papers*, 258.

CAUSA, O. AND M. HERMANSEN (2018): "Income Redistribution Through Taxes and Transfers across OECD Countries," *LIS Working paper Series*.

CHANG, B. H., Y. CHANG, AND S. B. KIM (2018): "Pareto weights in practice: A quantitative analysis across 32 OECD countries," *Review of Economic Dynamics*, 28, 181–204.

CHATELAIS, N. (2011): "Taille de pays et stratégie de concurrence fiscale des petits pays," Working Paper, Centre d'Économie de la Sorbonne.

DG TAXATION AND CUSTOMS UNION (2020): "Taxation Trends in the European Union," Report, European Comission.

ESPING-ANDERSEN, G. (1990): "The Three Worlds of Welfare Capitalism," Princeton University Press, 248.

FULLERTON, D. AND G. E. METCALF (2002): "Tax Incidence," in *Handbook of Public Economics*, vol. 4, 1787–1872.

GUILLAUD, E., M. OLCKERS, AND M. ZEMMOUR (2020): "Four Levers of Redistribution: The Impact of Tax and Transfer Systems on Inequality Reduction," *Review of Income and Wealth*, 66, 444–466.

GUILLAUD, E. AND M. ZEMMOUR (2017): "Les quatre leviers de la redistribution," *Regards*, 51, 233–242.

HALL, P. AND D. SOSKICE (2001): "Varieties of Capitalism: The Institutional Foundations of Comparative Advantage," Oxford University Press.

HASSE, A., B. PALIER, AND S. AVLIJAS (2020): "The pursuit of growth. Growth regimes, growth strategies and welfare reforms in advanced capitalist economies," *Stato e mercato*.

JESSOP, B. (2012): "Rethinking the diversity of capitalism: varieties of capitalism, variegated capitalism, and the world market," in *Capitalist diversity and diversity within capitalism*, ed. by G. Wood and C. Lane, London:Routledge, 209–237.

KASSAMBARA, A. (2017): "Practical Guide to Cluster Analysis in R: Unsupervised Machine Learning: Volume 1 (Multivariate Analysis," CreateSpace Independent Publishing Platform.

MENDOZA, E., A. RAZIN, AND L. TESAR (1994): "Effective Tax Rates in Macroeconomics: Cross-Country Estimates of Tax Rates on Factor Incomes and Consumption," *Journal of Monetary Economics*, 34, 297–323.

MIRRLEES, J. A. (1971): "An Exploration in the Theory of Optimum Income Taxation," *Welfare, Incentives, and Taxation*, 38.

MUSGRAVE, R. A. (1981): "Fiscal Systems," 397.

PIKETTY, T. (2003): "Income inequality in France, 1901-1998," *Journal of political economy*, 111, 1004–1042.

——— (2014): "Capital in the 21st century," Harvard University Press, 698.

PIKETTY, T. AND E. SAEZ (2003): "Income inequality in the United States, 1913-1998," *Quarterly journal of economics*, 112.

PRASAD, M. AND Y. DENG (2009): "Taxation and the worlds of welfare," *Socio-Economic Review*, 7, 431–457.

ROUSSELON, J. AND M. VIENNOT (2020): "Inégalités primaires, redistribution : une comparaison européenne," Working Paper, France Strategie.

SCHNEIDER, M. R. AND M. PAUNESCU (2012): "Changing varieties of capitalism and revealed comparative advantages from 1990 to 2005: a test of the Hall and Soskice claims," *Socio-Economic Review*, 10, 731–753.

STRATÉGIE, F. (2020): "Comité dévaluation des réformes de la fiscalité du capital," Rapport d'évaluation France Stratégie, France Stratégie.

TIBSHIRANI, R., G. WALTHER, AND T. HASTIE (2001): "Estimating the number of clusters in a data set via the gap statistic," *Journal of the Royal Statistical Society: Series B (Statistical Methodology)*, 63, 411–423.

Appendix

This appendix presents the sources and construction of the data. All of the databases constructed are provided in the technical appendix, available upon request.

A Breakdown of taxation

A.1 Database

We use mainly OECD data, to allow for international comparison. Tax data are taken from Revenue Statistics 2020, and national accounts data from National Accounts 2020. Some have been supplemented for European countries by Eurostat accounting data, when OECD data were not available. In particular, we use data on the distribution of taxes on household income between labour, capital, and the self-employed, taken from the DG Taxation and Customs Union (2020) Taxation Trends report.

The OECD tax revenue data are net of tax credits (unlike the Eurostat data following the revision of the ESA 2010 accounts). They are considered as revenue shortfalls and, in case the tax credits exceed the tax amount, the difference is recorded in government expenditure.

A.2 Methodology

The calculation of implicit rates (ITR) consists of associating tax revenues (the numerator) with their tax base (the denominator). It allows a better assessment of the tax burden on capital, labour and consumption. In the literature, they are also called *average effective tax rates* (AETR). In our study, we are mainly interested in tax yields, i.e. tax revenues (numerator) relative to GDP.

This is a method initiated by Mendoza et al. (1994), then completed by the OECD Carey and Tchilinguirian (2000). It is used annually by the European Commission in the Taxation Trends report (2020). We have used the methods of Carey and Tchilinguirian Carey and Tchilinguirian (2000) and the Taxation Trends report (2020) in a complementary way, so that each compensates for their respective limitations.

However, this combination raises the problem of the different classification of taxes: Revenue Statistics adopts the OECD classification used by Carey and Tchilinguirian (2000), while Taxation Trends uses the ESA 2010 classification (European system of national and regional accounts). It has therefore sometimes been necessary to adjust the allocation of some taxes between labour, capital and consumption. For example, we have allocated tax 6200 to consumption, as indicated by its "translation" into national accounts in the Taxation Trends report. The 6100 tax is not allocated anywhere in either method, but is paid by firms. These amounts were large in some countries, so we chose to allocate it between the labour and capital taxes of firms, without

changing the ratios, to ensure aggregate consistency. Similarly, the 2400 tax is a labour tax, which we split between household, business and self-employment labour taxes. One of the main limitations of the Carey and Tchilinguirian (2000) method is the allocation of income taxes between labour and capital. The Taxation Trends report (2020) addresses this limitation by providing micro-data on the distribution of taxes on labour, capital and self-employment income ($part_L$, $part_K$ and $part_{SE}$) by year and by country. The European average is attributed to the missing countries. We follow Carey and Tchilinguirian (2000) to allocate the different taxes on the self-employed between labour and capital, rather than attributing them only to capital. Finally, the denominators are those described in the Taxation Trends report, which also shows the decomposition of the numerators between firms and households.

The implicit consumption tax rate is as follows:

$ITR_C = \frac{5000-(5124+5125+5127+5212+5213)+6200}{P3\_S14dom+P31\_S15+P3\_S13-P3\_D1PAY}$

The implicit tax rate on labour is as follows, where the numerator is decomposed into taxation of households, firms and self-employed workers:

$ITR_L = \frac{(part_L*1100+2100+2300CN)+(3000+2200+6100_L)+(part_{SE\_L}*(part_{SE}*1100+2300CS))+2400}{D1+3000+part_{SE\_L}*B3N}$

The implicit capital tax rate is the most complex, and we have made changes to it, which we describe below.

A.3 Modification of the construction of the implicit tax rate on capital

The two studies on which we rely point to the important limitations of the implicit tax rate on capital and the problems of its international comparison. Indeed, capital taxation is complex (double taxation, tax credits, wealth tax...) and the construction of a tax base is very imperfect. To try to improve it, we rely once again on the method presented in the OECD Carey and Tchilinguirian (2000), then on the modifications made by the European Commission in the report Taxation Trends (DG Taxation and Customs Union (2020)), and on the recommendations of France Stratégie (2020).First, the choice of OECD data rather than Eurostat data allows us to obtain tax revenues "net" of tax credits, i.e., they are taken into account as less tax revenue and not as transfers to firms. The use of Eurostat's micro-data for the distribution of income between labour and capital greatly improves on the OECD's original method, which noted the inaccuracies of this distribution with macroeconomic variables. Instead of attributing all taxes on the self-employed to capital, we attribute, according to the OECD method, the share of self-employed with higher than average income to capital, and the rest to labour. In our sample, the share attributed to labour is the largest, which seems consistent because the self-employed include liberal professions (doctor, lawyer), with a higher salary than if they were employees, but above all precarious workers, who are less favored than if they were employees. Concerning the tax base, we add a suggestion from France Stratégie that it would be more representative to consider as a base the sum of capital income received by households and received by foreigners,

rather than the sum of net income received by institutional sectors. However, this measure is still very imperfect, especially for taxes on capital stocks. Indeed, it is very difficult to associate a tax base with these taxes, so that countries with high stock taxes see their implicit rate overvalued, or at least disconnected from reality. This is why we have preferred to use the implicit tax rate on capital income.

Thus, the implicit rate of capital taxation is as follows, where the numerator is decomposed into taxation of the capital income of households, firms and the self-employed and taxation of capital stocks:

$$ITR_K = \frac{(part_K*1100)+(1200)+(part_{SE\_K}*(part_{SE}*1100+2300CS))+(4000+5124+5125+5127+5212+5213)}{B2N\_S11+B2N\_S12+B2N\_S14\_15+D4R\_S14\_15+D42R\_S13+D42R\_S2+part_{SE\_K}*B3N}$$

The implicit rate of taxation on capital income is identical, except that it omits taxes on capital stocks:

$$ITR_{Kinc} = \frac{(part_K*1100)+(1200)+(part_{SE\_K}*(part_{SE}*1100+2300CS))}{B2N\_S11+B2N\_S12+B2N\_S14\_15+D4R\_S14\_15+D42R\_S13+D42R\_S2+part_{SE\_K}*B3N}$$

B Measuring redistributive effects

B.1 Database

In order to measure the redistributive effects of socio-fiscal systems, we use the Luxembourg Income Study data, which is a harmonized ex-post micro-data base derived from national surveys. This database contains data by households and individuals on the different incomes (labour, capital, private and public transfers) and levies (income tax, employee contributions, sometimes capital taxes). However, it is sometimes incomplete, as employer and sometimes employee contributions are not collected. Guillaud et al. (2020) manage to complete the social contributions at the individual level by micro-simulation, using OECD data on the rules for tax rates by country. This allows us to cover almost 54% of total tax revenues, compared to 35% with the initial LIS data. We therefore use the tax rate per income percentile from these data, calculated in Amoureux et al. (2018).

B.2 Methodological choices for household income

In LIS, we process data from 17 countries, some over multiple years, between 2006 and 2016, for a total of 48 datasets. For each dataset, we exclude the retired population, selecting only individuals between 25 and 55 years old. The transfers therefore do not include the various benefits for the elderly. Then, we group the individuals by households, and calculate the different incomes per consumption unit, according to the OECD method. We distinguish primary income (also called market income), before taxes and transfers, then income before taxes after transfers, and disposable income, after taxes and transfers.
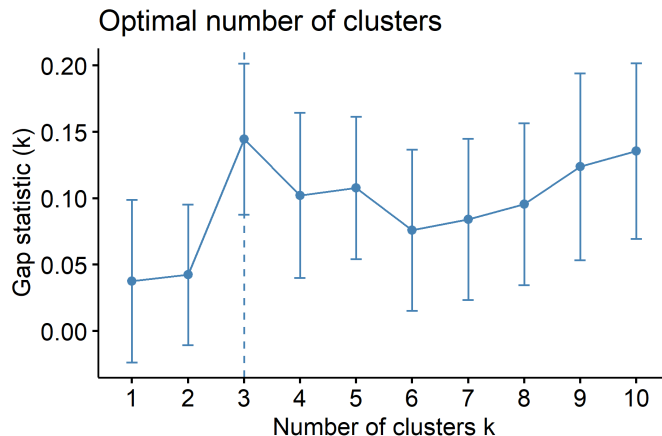
Figure 8: Gap statistics method, with 2018 data from Figure 5

C   Clustering

C.1   K-means method

We use the $K-means$ of *machine learning* which is the most widely used method to perform automatic clustering. More precisely, the $K-means$ algorithm is an unsupervised non-hierarchical clustering algorithm. It allows to group the data (here the countries) in a finite number of sets on the basis of the provided characteristics (here the variables describing the ssocio-fiscal systems). Intuitively, from a given number of clusters, the algorithm provides the groups of countries that minimize the distance within clusters (see Kassambara (2017) for a presentation of the algorithm and its implementation). The difficulty lies in choosing the optimal number of clusters. For each exercise, we determine the number of clusters endogenously by the *gap statistics* method (see Tibshirani et al. (2001)),which tests several values of k and determines the optimal number in order to maximize the statistical gap with respect to a random dispersion. We present in Figure 8 the result for the year 2018 from Figure 5, which designates three as the optimal number of clusters.

C.2   Cluster constructions

To construct the clusters in Figure 5, we consider ten variables for the years 2006 and 2018. These are transfers (Tr) and nine fiscal variables: tax revenue over GDP $(TPO_{i,t})$, the six rates as a proportion of total taxation that represents the tax structure $(T_{L\,hou}, T_{L\,corp\,SE}, T_{K\,inc\,hou}, T_{K\,inc\,corp\,SE}, T_{K\,sto}, T_C$ as a percentage of total tax revenues) and the implicit rates on labour and capital income $(ITR_L$ and $ITR_{K\,inc})$. We test their stability here. The year clusters remain unchanged if we consider only the nine tax variables, the ten initial variables and the measure of Gini change, the ten initial variables and the Esping-Andersen decommodification index. The latter
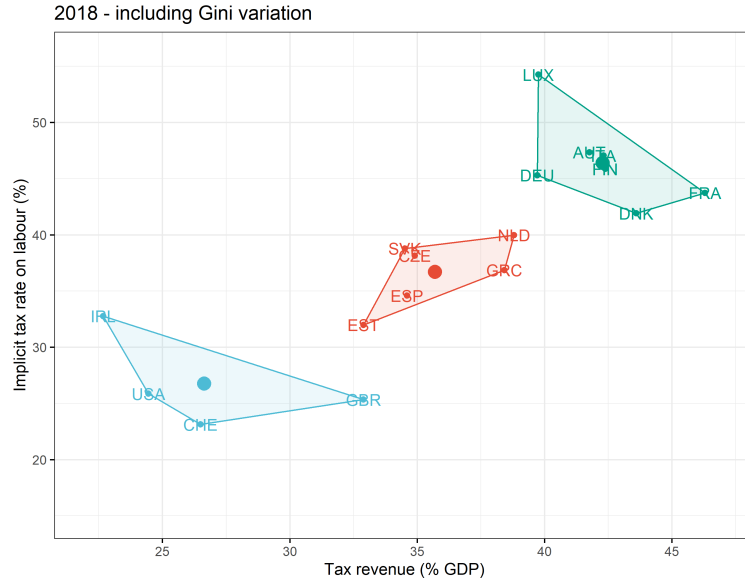
Figure 9: Clustering with redistributive effects

two clusterings are shown in Figure 9 and 10.

C.2.1   With redistributive effects

Here we add to the original ten variables the relative change in the Gini index. The methodology is described in Section 3 and the results are presented in Table 3. However, the years studied in LIS vary by country, which biases their comparison. Therefore, we chose to keep 2018 as the initial ten variables, the purpose being to test the stability of the clustering in 2018 and to add the change in the Gini from the last year. Among the 17 countries available in LIS, we find the same three clusters.

C.2.2   With Esping-Andersen decommodification index

We add here to the ten initial variables the Esping-Andersen (1990) index of *decommodification.* This index allows us to measure demarketing in the states according to several qualitative and quantitative criteria, in order to distinguish between different types of welfare state. As explained above, we keep the year 2018 for the initial variables. Among the 17 countries where the index is measured, none is in the intermediate cluster, the clustering however finds the liberal and social-democratic model.
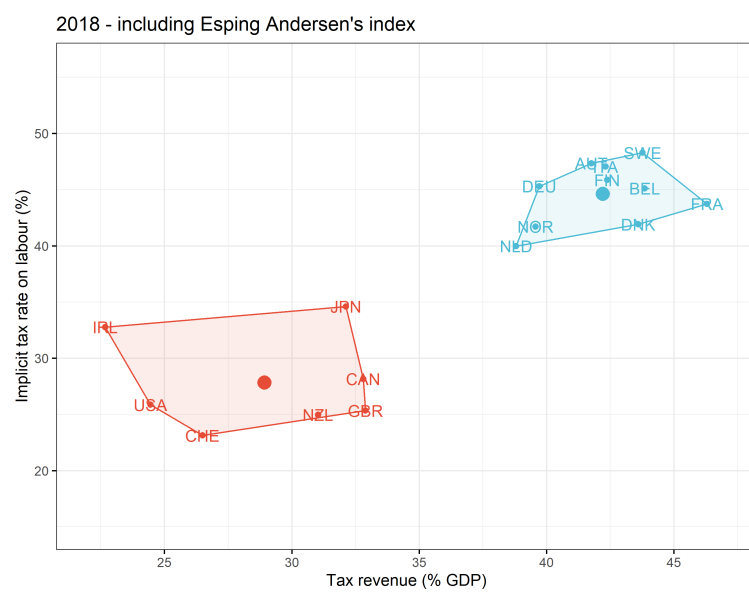
Figure 10: Clustering with Esping-Andersen *decommodification* index

ABOUT OFCE

The Paris-based Observatoire français des conjonctures économiques (OFCE), or French Economic Observatory is an independent and publicly-funded centre whose activities focus on economic research, forecasting and the evaluation of public policy.

Its 1981 founding charter established it as part of the French Fondation nationale des sciences politiques (Sciences Po), and gave it the mission is to "ensure that the fruits of scientific rigour and academic independence serve the public debate about the economy". The OFCE fulfils this mission by conducting theoretical and empirical studies, taking part in international scientific networks, and assuring a regular presence in the media through close cooperation with the French and European public authorities. The work of the OFCE covers most fields of economic analysis, from macroeconomics, growth, social welfare programmes, taxation and employment policy to sustainable development, competition, innovation and regulatory affairs.

ABOUT SCIENCES PO

Sciences Po is an institution of higher education and research in the humanities and social sciences. Its work in law, economics, history, political science and sociology is pursued through ten research units and several crosscutting programmes.
Its research community includes over two hundred twenty members and three hundred fifty PhD candidates. Recognized internationally, their work covers a wide range of topics including education, democracies, urban development, globalization and public health.
One of Sciences Po's key objectives is to make a significant contribution to methodological, epistemological and theoretical advances in the humanities and social sciences. Sciences Po's mission is also to share the results of its research with the international research community, students, and more broadly, society as a whole.

PARTNERSHIP