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Can Fiscal Policy Explain Cross-Country Differences in Labor Market Performance and Inequality?

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Academic Year 2018-2019

Master in Economics – 60 credits

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Acknowledgements

My gratitude goes out to my family and friends for their continuous support and patience during the realization of this thesis. I would also like to thank the many professors that have inspired me over the years with their passionate teaching and enduring love for the field.
Economics, to me, is about the foundations of society and life in general: creating prosperity and opportunities, building sustainable structures and understanding human behavior. It has been a privilege to partake in it the past 5 years. Now, I look forward to what comes next.

Mieke Dujardin,
August 2019

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The ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood. Indeed the world is ruled by little else.

- John Maynard Keynes -

Can Fiscal Policy Explain Cross-Country Differences in Labor Market Performance and Inequality?

1 Introduction

Labor market performance differs widely across OECD countries. In recent years, understanding the factors generating these differences has stood high on the agenda of researchers and policy makers. Being able to manage employment effectively can serve as a powerful tool for governments to face the increasing pressure on government budgets caused by the financial crisis, aging and globalization. However, increased sensitivity in society to rising inequality imposes additional restrictions on the options that policy makers have to face this challenge. Both economic effects and social effects of government interventions matters.

A large body of literature has named fiscal policy as an important factor that influences both employment and inequality. Taxes and transfers distort the economy, changing incentives for households' labor supply decision. At the same time, however, these fiscal programs often have a redistributive purpose and serve as an insurance mechanism against bad times for many individuals. This is the well-known trade-off between efficiency and equity that governments are faced with. In this context, it is important to learn if (and which) fiscal policies within the governments' toolbox are responsible for the realizations of employment and inequality observed in reality. That is what this dissertation sets out to do.

This thesis adds to the research that studies the role of fiscal policy to account for cross-country variations in employment and inequality. In this literature, two strands of models are used: complete market models and incomplete market models.

The complete markets, neoclassical growth model with a stand-in household is the main analytic framework in modern macroeconomics. As such, it is the natural starting point to investigate the effects of fiscal policy on aggregate statistics. However, using a representative agent (RA)

excludes heterogeneity among households, necessary to study inequality. More recently, a new framework that is especially fit to deal with inequality, has gotten increased attention in the literature. These incomplete market models, first introduced by Hugget (1993) and Aiyagari (1994), are marked by borrowing constraints and heterogeneous agents (HA) subject to idiosyncratic labor productivity shocks. They are called 'incomplete', because agents can not fully insure themselves against this idiosyncratic risk.
Another group of models that lend themselves well to study inequality, are Overlapping Generation (OLG) Models. This framework, pioneered by Samuelson (1958) and Diamond (1965), rejects the hypothesis of infinite life and allows several generations of people to be alive and interact at the same moment in time. Finite time horizons will influence the agent's decisions concerning work, consumption and saving. It is therefore not surprising that the OLG framework has frequently been included in RA and HA models studying the impact of policy changes in numerous fields of economic study.

Throughout this work, we ask ourselves the question: can fiscal policy explain cross-country differences in aggregate employment and income inequality?
In terms of methodology, we make use of three intermediate models to answer this research question. The first model is a standard RBC representative agent model in the spirit of Prescott (2004). The model encompasses an endogenous labor-leisure decision and a complete tax and transfer program. This simple model lets us take a first look at the power of fiscal policy to explain cross-country variations in employment. In the second model, heterogeneous agents and incomplete markets are introduced, allowing us to also investigate the inequality generated by the model. The framework is largely based on Floden and Lindé (2001). In the third version, a life-cycle component is added, permitting policies such as pensions, bequests and progressive taxation to be incorporated.
We always model a closed economy, calibrated on the United States. Data for performance (employment and inequality) and policy (taxes and transfers) variables are taken from the OECD Statistics Database for the period 2013-2018. For each of the three models, we compare the models predicted hours worked and Gini coefficient for labor earnings, wealth, market income and disposable income with the actual data for each of the 17 OECD countries under investigation: Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, the United Kingdom and the United States.

The main findings of this dissertation are the following: (1) a simple representative agent model can account for 40% of employment differences through country-specific fiscal policy. 10 ad-

ditional percentage points can be explained by heterogeneous preferences for leisure. (2) The heterogeneous agents framework generates similar, but more dispersed cross-country differences compared to the RA model. This is in line with existing literature. (3) The HA model cannot explain any of the variation in disposable income inequality. The reason is twofold: the model does not produce correct market income inequality and fiscal policy performs only 40% of real redistribution efforts. (4) Variations in country-specific wage-processes can strongly improve the first failure, while the inclusion of pensions and bequest taxation can amend the second. (5) Surprisingly, replacing linear labor taxation with progressive labor taxation has no effect on employment and inequality estimations. (6) In fact, fiscal policy can generally explain only around half of employment and inequality variations.
The primary conclusion to be drawn from these findings is that caution should be invoked when interpreting policy recommendations about employment, inequality and welfare based on standard macro-economic models. The simple mechanisms in these frameworks that determine inequality and employment might be confounded and dominated by other relevant factors in reality.

The next chapter provides an overview of the literature relevant for this dissertation. It also highlights the contributions of this work to this literature. Chapter 3 gives insight in the reality behind the employment and inequality differences that exist across countries. These are the variables that the model will try to recreate. Chapter 4-6 build the three models discussed in this work. Each time, the first section describes the mathematical equations specified in the model. The second section concerns the parametrization, while the third section presents the results. Chapter 7 concludes.

2 Literature Review and Contribution

In this section, we discuss the literature on cross-country differences in employment and inequality, as well as the dissertation's contribution to this literature.

Academic research on the influence of fiscal policy on employment has expanded extensively over the past few decades. It was Prescott (2004) that first stated that the difference in hours worked between the United States and continental Europe could almost fully be explained by the difference in labor tax rates. Very quickly, authors such as Rogerson (2007) elaborated on this statement, proving that transfers and productive government spending matter too. Since

then, many studies, both empirical (e.g. Nickell et al. (2004), Bassanini & Duval (2006) and Nymoen & Sparrman (2015)) and theoretical (e.g. Ohanian et al. (2008) and Rogerson & Wallenius (2009)) have confirmed the negative effects of too high labor and capital taxes and the importance of the allocation of government revenue.

An important innovation in the literature was the possibility of heterogeneity among agents, both in terms of skill and in terms of age. The data show that there are large disparities in labor supply between age cohorts and groups of different education levels. Adding overlapping generations and incomplete markets allowed to account for these differences, and showed they highly matter to explain cross-country differences.

In terms of government policies, research was expanded in the following ways: Jacobs (2009) shows that education programs are important to explain differences in employment for young workers, while Erosa et al. (2012), Wallenius (2013), and Alonso-Ortiz (2014) prove that retirement, social security, health and disablity policies help explain variations in the labor supply of older workers. Guvenen et al. (2013) show that progressive taxation also has a large role to play. More recently, the (in)complete markets framework has been extended to include many other expansions such as unemployment (e.g. Kitao (2014)) and heterogeneous houeshold compositions (Guner et al. (2011)).

With the introduction of heterogeneous agent models opposed to representative agent models, the question posed itself whether these frameworks yield different assessments of the influence of fiscal policy on employment and welfare. Alonso-Ortiz & Rogerson (2010) find that the effects of labor taxes are often similar but stronger in HA models compared to RA models[1]. This is because dynamics are slightly different in HA models. In the incomplete markets framework with endogenous labor, agents may choose to insure themselves against productivity shocks through labor supply instead of through asset holdings[2]. Government programs such as taxes and transfers are of great importance as they can serve as a stabilizer, mitigating productivity shocks through redistribution. By lowering idiosyncratic risk, taxation and transfers elicit an insurance effect on top of their normal distortionary effects, causing a greater adjustment in labor supply by households.

To study cross-country differences in inequality, it is important to understand how income inequality is generated. Income is composed out of two main factors: earnings out of labor, i.e. wages, and income out of capital, i.e. rents and interest payments. Both factors are taxed,

[1]Other seminal papers in the complete markets versus incomplete markets debate are Ljungqvist & Sargent (2006), Chang & Kim (2006) and Pijoan-Mass (2006).

[2]Pijoan-Mass (2006) shows that in result, HA models often portray inefficiently high labor supply compared to RA models. Dependence on labor supply as insurance against shocks rises with the IES and size of idiosyncratic risk.

producing a difference between market income (pre-taxes) and disposable income (post-taxes). Many authors (see De Nardi (2015) and Guvenen (2011) for full surveys of this literature) have tried to match the distribution and Gini coefficient of income and wealth of the United States through different mechanisms that affect these two factors. Shocks to labor productivity or human capital accumulation, different preferences for labor or bequeathing, differences in entrepreneurial skill or just simple luck are only a few examples. Fiscal policy has also been a popular explanatory factor. Castaneda et al. (2003) and Cagetti & De Nardi (2009) find that estate and wealth taxes can substantially reduce inequality. Moreover, labor and capital taxes should no longer be zero to reach optimal welfare (Conesa & Krueger (2006), Conesa et al. (2009)), as they play an important redistributive role. Buyse et al. (2017) finds that an efficient design of the pension system can reduce income inequality as well.

However, few of these theoretical studies take a cross-country perspective. There are some studies on cross-country wage inequality, e.g. Krueger et al. (2010) and Guvenen et al. (2013)[3], but mostly the focus of this literature has been on the underlying factors that can generate an unequal distribution of (factor) income, and not on the cross-country differences in this distribution. Luckily, a large body of empirical literature has investigated the drives of the diversity in inequality in OECD countries. Interesting summary surveys are Förster & Pearson (2002) and Atkinson (2007). Country-specific factors that influence the inequality of wages, wealth and income are the strength of labor unions and other labor institutions, the share of employment in different industries and their exposure to skill-biased-technology change, the demographic composition of the population and the rise of female employment, the shift in remuneration for top earners, vested political interests and off course, fiscal policy[4]. Regarding this last factor, studies find that transfers (more specifically unemployment benefits and pensions) are more powerfull to mitigate inequality than taxes. Of all taxes considered, (progressive) labor taxation is seen as the most influential tool to mollify inequality. Prominent papers in this strand of research are Mahler & Jesuit (2006), Fuest et al. (2010) and Wang et al. (2012).

With this dissertation, we add to the vast literature reviewed above. We contribute to it by being the first cross-country study that analyses cross-country differences in inequality in a DSGE framework, something that, to our knowledge, has not been done before. Moreover, we analyze cross-country differences in employment in the same model, which allows us to identify whether the right mechanisms are present in the model to match both variables at the same

[3]Other exceptions in the literature are De Nardi (2004) and Floden and Lindé (2001). They attempt to reproduce the distribution of income for the US and Sweden.

[4]Papers that investigate the specific factors named above are: Kenworhty & Pontusson (2005), Checci & Garcia-Penalosa (2008), Esping-Andersen & Myles (2009) and OECD (2011).

time. Furthermore, we study 17 OECD countries, making this one of the most elaborate cross-country studies performed in the literature. By using recent data, from the period 2013-2018, we can also shed a light on how much of cross-country differences fiscal policy can explain in current times, and which underlying taxes and transfers have gained importance. Finally, we compare a complete markets model with an incomplete markets model, allowing us to investigate whether the aggregation over individual agents (moving from RA to HA) matters for employment statistics and welfare.

3 Cross-country Differences in Aggregate Labor Market Performance and Inequality

In this section, we discuss the main facts and findings concerning country variations in employment and inequality. We consider 17 OECD countries, grouped in four 'country groups': Western Europe (WE), consisting out of Austria, Belgium, France, Germany, Luxembourg and the Netherlands; Northern Europe (NE), composed out of Denmark, Finland, Norway and Sweden; Southern Europe (SE), comprising Italy, Portugal and Spain and finally the Anglo-Saxon countries (AS), i.e. Canada, Ireland, the United Kingdom (UK) and the United States (USA). We discuss the following indicators: aggregate labor supply, hours worked and the employment rate plus the Gini coefficient of labor earnings, wealth, market income and disposable income. Appendix A contains information on the calculation and sources of these performance variables.

Table 3.1 shows the first variable of interest: labor supply. Both the extensive margin, i.e. the employment rate in persons, and the intensive margin, i.e. hours worked per employed as a fraction of total time endowment, are considered, respectively in columns 1 and 2. Column 3 shows the product of both margins. This will be the relevant labor supply variable (ℓ) that will be approximated by the model in later sections.

When looking at the employment rate, we see strong differences across country groups. Southern Europe has the lowest rates, followed by Western Europe and the Anglo-Saxon countries respectively. Northern Europe displays much higher employment rates, with a maximum of 75.9% for Sweden. Regarding hours worked, we see a different pattern. Here, the Nordic countries show the lowest numbers, with the core euro area a close second, while the South of Europe and the Anglo-Saxon area supply many more hours per worker. Outliers are Germany and the United States, with respectively the lowest and the highest hours worked.

Consequentially, all countries on the European Continent lie closely together when looking at

Table 3.1: Decomposition of total labor supply: the employment rate and hours worked per employed[1][2]

	Employment rate	hours worked per employed	total labor supply (ℓ)
Austria	71.7	51.8	37.2
Belgium	*62.6*	53.0	*33.2*
France	64.3	52.1	*33.5*
Germany	74.5	*46.7*	34.8
Luxembourg	66.2	51.8	34.3
Netherlands	**74.8**	48.9	36.6
WE average	69.0	50.7	34.9
Denmark	73.9	*48.4*	35.8
Finland	69.5	53.5	37.2
Norway	**74.8**	*48.6*	36.4
Sweden	**75.9**	50.4	38.3
NE average	73.5	50.2	36.9
Italy	*56.9*	**58.9**	*33.5*
Portugal	65.0	**58.9**	38.3
Spain	*58.6*	58.1	34.0
SE average	60.2	58.6	35.3
Canada	72.8	58.4	**42.6**
Ireland	65.4	**59.4**	**38.8**
UK	72.9	52.8	38.5
USA	69.1	**61.0**	**42.2**
SA average	70.1	57.9	40.5
Total average	68.8	53.7	36.8

[1] Data are retrieved from the OECD and concern 2013-2018. All data are expressed in percentages. For the exact calculation, see appendix A.
[2] The lowest three values in each column are set in italic, while the highest three are put in bold.

total labor supply in column 3, although due to different underlying reasons. Western Europe performs close to the average for both the employment rate and hours worked, the Nordics have a high employment rate but low hours worked while for Southern Europe, the reverse is true. The Anglo-Saxon countries, the United States and Canada especially, outperform the others through a combination of an above average employment rate and high hours worked per person.

Besides disparities in labor supply, the country groups also display vast differences in inequality. Table 3.2 displays the Gini coefficient for different definitions of income. The first two columns discuss inequality in the components of total income, labor earnings and wealth, while columns 3 and 4 describe inequality in income both before transfers, i.e. market income, and after transfers, i.e. disposable income.

Considering labor earnings, we see that the Nordic countries show the lowest inequality, followed by Western Europe (with Luxembourg and Belgium being clear exceptions). The Southern and Anglo-Saxon countries show much higher coefficients. Looking at the other income factor,

Table 3.2: Inequality summary statistics[1][2]

	Labor earnings Gini	Wealth Gini	Market income Gini	Disposable income Gini
Austria	0.51	0.76	0.50	0.28
Belgium	**0.55**	*0.66*	0.50	0.27
France	0.52	*0.69*	0.51	0.29
Germany	0.52	0.82	0.50	0.29
Luxembourg	**0.54**	*0.66*	0.47	0.31
Netherlands	0.52	0.74	0.45	0.29
WE average	0.52	0.72	0.49	0.29
Denmark	*0.42*	**0.84**	0.45	*0.26*
Finland	0.45	0.77	0.50	*0.26*
Norway	*0.44*	0.79	*0.42*	*0.26*
Sweden	*0.43*	**0.87**	*0.43*	0.28
NE average	0.44	0.81	0.45	0.26
Italy	**0.55**	*0.69*	**0.52**	0.33
Portugal		0.74	**0.54**	**0.34**
Spain	0.53	0.70	**0.52**	**0.34**
SE average	0.54	0.71	0.53	0.34
Canada	**0.54**	0.73	*0.43*	0.31
Ireland	**0.55**	0.83	**0.56**	0.30
UK	**0.56**	0.75	**0.52**	**0.36**
USA	**0.55**	**0.85**	0.51	**0.39**
SA average	0.55	0.79	0.50	0.34
Total average	0.51	0.76	0.49	0.30

[1] Data are retrieved from the OECD and the Global Wealth Databook. Data concern 2013-2018, except for labor earnings which are calculated of over the mid-2000s. For the exact calculation, see appendix A.
[2] The lowest three values in each column are set in italic, while the highest three are put in bold.

wealth, we find a different order. Now it are the Southern and Western countries in Europe that display the lowest numbers (except for Germany), while Scandinavia, together with the United States and Ireland, portray the coefficients closest to 1.

We now turn to the total income variables: market income and disposable income. From column 3, we can conclude that the market income distribution is dominated by labor earnings, as a similar pattern arises for the market income Gini as was present for the labor earnings Gini[5]. Moreover, the market income Ginis are close to those of labor earnings, while they are much lower than the wealth Ginis (0.27 points on average). Finally, the transformation from market income to disposable income is particularly interesting. Although the ranking of country groups is generally speaking the same as for market income inequality, i.e. Northern and Western Europe generate low inequality and the South of Europe and the Anglo-Saxon countries exhibit high inequality, there are strong differences in redistribution between countries. The average

[5]The average of the SA countries is pulled down by Canada's market income Gini. The fact that Canada shows such low market income inequality is remarkable, as both labor earnings and wealth inequality are relatively high.

Table 3.3: The distribution of wealth and income by population quintile[1]

	Fraction by population quintile				
	1	2	3	4	5
Wealth	-0.76	2.56	7.73	15.94	74.85
Market Income	5.74	10.99	15.48	21.49	46.30
Disposable Income	7.83	12.63	16.60	21.76	41.19

[1] Data are retrieved from the WID, the Worldbank and the Global Wealth Databook. They are percentage shares and concern 2013-2018. For the exact calculation, see appendix A.

Table 3.4: Summary table on fiscal policy: consumption taxation (τ_c), capital taxation (τ_k), labor taxation (τ_ℓ), government consumption (g), inheritance taxation (h) and pensions (p) . [12]

	τ_c	τ_k	τ_ℓ	g	h	p
Western Europe	Average	High	High	Average	High	High
Northern europe	High	Low	Average	High	Average	Average
Southern Europe	Average	High	Average	Low	Low	High
Anglo-Saxon area	Low	Low	Low	Low	Average	Low

[1] The exact calculation for each specific country can be found in appendix A.

redistribution ameliorates inequality with 0.19 points, with Ireland (0.25 points), Finland (0.24 points) and Belgium (0.23 points) being the best performers and Canada and the US the worst (0.12 points each).

Why are there such wide differences in the Gini coefficients of wealth, market income and disposable income? Table 3.3 shows the distribution of these three variables for the average of the 17 OECD countries discussed, which permits to assess where the disparities are formed in the distribution[6]. The wealth distribution is highly concentrated: while the bottom 20% of the wealth distribution portrays a negative number, the top quintile possesses on average 75% of total wealth, which is almost double of what is found for the income distributions. From row 2 and row 3, we can derive that disposable income is less dispersed at the extremes compared to market income.

In the next sections, the models considered will attempt to reproduce these numbers and trends. They will do so using country-specific fiscal policy parameters. The exact data and calculation for each country are shown in Appendix A. Here, a short summary table is presented with the main findings for each country group. One last note, relevant for all three tables discussed in this section, is that even though there are country-group trends that can be isolated, there is a lot of heterogeneity within country-groups, too. Allowing for country-specific fiscal policy parameters will therefore be important to match this fact.

[6]Data on the distribution of labor earnings was not available. Non of the big institutions (e.g. OECD or the Worldbank) provide this information, nor do there exist papers that discuss all of the examined countries in this dissertation.

4 A Representative Agent Model

The problem considered by the infinitely lived, representative agent is largely based on Prescott (2004)[7]. The agent derives utility from consumption and leisure, both decided endogenously in the model. Firms produce output on competitive markets and use capital and labor with Cobb-Douglass technology to do so. Household consumption, assets and labor are taxed by the government, which spends its revenue on government consumption and transfers to the household.

The first subsection presents the underlying equations of the model, while subsection 2 handles the parametrization. In the final subsection, the results of the cross-country comparisons are presented.

4.1 The Model

The problem of the stand-in household can be summarized by the following equations:

$$\sum_{t=0}^{\infty} \beta^t [\frac{(c_t^{\gamma}(1-\ell_t)^{1-\gamma})^{1-\theta}}{1-\theta}] \tag{1}$$

Subject to

$$(1+\tau_c)c_t + a_{t+1} = (1-\tau_\ell)w\ell_t + [1+r(1-\tau_a)]a_t + Tr_t \tag{2}$$

with $c \geq 0$ and $0 \leq \ell \leq 1$

Equation 1 describes the time separable CES utility function with unit elasticity between consumption c and leisure $(1-\ell)$, constant coefficient of relative risk aversion θ, taste for leisure γ and discount rate β. The agents budget constraint is presented in equation 2. The Left-hand side is total income, that can be divided between consumption, augmented with a consumption tax τ_c, and savings for the next period a_{t+1}. The agent is endowed with 1 unit of time, of which he spends ℓ on the labor market and $(1-\ell)$ having leisure. For his labor, the agent earns a wage w, that is taxed at a linear rate τ_l. Savings a_t are remunerated at a net interest rate $r(1-\tau_a)$. Moreover, the agent receives a lump-sum transfer Tr from the government.

Firms use a standard Neoclassical production function (eq. 3). As there is no uncertainty over the business cycle, aggregate labor supply (in efficiency units) L_t, aggregate capital stock K_t, the wage rate w and the interest rate r are constant. Since this is a representative agent framework,

[7]The main differences are a different utility function and the fact that there is no investment tax included.

L_t is equal to ℓ_t and K_t is equal to a_t. Factor remunerations are determined by the marginal products of capital and labor: $w = F_L(K, L)$ and $r = F_K(K, L) - \delta$.

$$F(K, L) = AK_t^{\alpha} L_t^{1-\alpha} \tag{3}$$

The government distorts the economy through the collection of taxes and allocation of resources (eq. 4). Taxes are raised on labor (τ_l), capital (τ_a) and consumption (τ_c) in a linear manner. Government consumption gY_t is expressed as a fraction of total output Y, with g the coefficient of spending on goods and services. Goods bought by the government do not bring utility to households, nor do they add to the productivity of firms. Lastly, lump-sum transfers (or taxes) Tr_t are used to close the budget, that is balanced. The economy is closed, such that domestic output is equal to domestic demand (eq. 5).

$$\tau_l w L_t + \tau_a r K_t + \tau_c C_t = gY_t + Tr_t \tag{4}$$

$$Y_t = C_t + I_t + gY_t \tag{5}$$

$$I_t = K_{t+1} - (1 - \delta)K_t \tag{6}$$

4.2 Parametrization

The simulation exercise requires to first assign values to the different parameters in the model. Some are set in line with existing literature, some are calibrated and others are calculated from real data. Table 4.1 provides an oversight of all the parameters in the model.

The policy parameters are specific to each country. The benchmark economy is calibrated with data for the United States. The parameters consist out of three tax rates, $\tau_c = 3.1\%$, $\tau_l = 29.6\%$ and $\tau_a = 36.8\%$ and a spending parameter $g = 17.7\%$. We refer to Appendix A for further information on the calculation of these parameters, both for the US and the other 16 countries. For the baseline calibration, the capital share of income α is equal to 0.33, a value common in the literature (Caselli and Coleman (2006)). Furthermore, a value of 2 is chosen for the inverse of the intertemporal elasticity of substitution, θ. Although the corresponding value of 0.5 for the intertemporal elasticity of substitution is too high in comparison with the findings of micro-economic studies, there is consensus that this value can be used at the macro level (Guvenen (2006), Wallenius and Rogerson (2009), Erosa et al., (2012)).

The three final parameters, i.e. the taste for leisure γ, the depreciation rate δ and the time preference β are calibrated to match respectively hours worked in the US (42.2%), the investment-

Table 4.1: Parametrization of the RA benchmark model, US calibration[1]

τ_c	τ_ℓ	τ_a	g	θ	α	δ	γ	β
3.09	29.58	36.8	17.73	2	0.33	6.39	0.498	0.975

[1] Fiscal policy parameters and the depreciation rate are expressed in percentages. See appendix A for the calculation of the policy variables.

output ratio in the US (20.3%) and an annual interest rate of 4%. Matching these targets yields 0.50 for γ, 6,4% for δ and 0.98 for β, all values similar to what is used in the literature (See for example Prescott (2004) and Rogerson (2007)). The benchmark calibration implies a value of 3.175 for the capital-output ratio, close to the value of 3 that is usually assumed.

4.3 Results

Figure 4.1 compares the model's estimations for individual countries' aggregate employment performance with the true data (cf. Table 3.1). The red line is the 45°degree line, such that all countries above it are underestimated by the model, and all countries underneath it are overestimated. The upper left corner of the figure depicts the specification and R-squared of the linear regression that gives the best fit for the model's estimations. The linear regression line is represented by the black line in the figure.

As can be deduced from the figure, the model generally overestimates the influence of government programs on labor market performance, also demonstrated by the slope of the linear regression below 1. The mechanism driving cross-country differences in the model is the following: if a country has low tax proceeds and a high government consumption level, this leads to low transfers, which in turn, induces high labor supply. This way, different fiscal policy parameters can generate different aggregate hours worked. In general, the labor tax rate is most important in the government budget constraint: correlation between labor tax rates and employment estimations is -0.84 (versus -0.72 for actual employment and labor taxes).

The R-squared is 0.42, meaning that about 40% of the variance in employment can be explained by differences in government programs[8]. Although this is substantial, it still leaves more than half of the variation unexplained. One reason could be that the tax policies or the model itself is not elaborate enough to represent reality correctly. Potentially important tax rates and transfers such as retirement programs, inheritance taxes or unemployment benefits are omitted in this simple RA model. This issue will be adressed in the OLG model in chapter 6. First, however, we address another explanation offered in the literature, which is culture.

[8] Looking at individual countries, it are the Netherlands, Denmark, Norway and Spain that are furthest from their true data points. Without these countries, the R-squared rises to 0.70.

Figure 4.1: Aggregate labor market performance in individual countries, RA model estimations

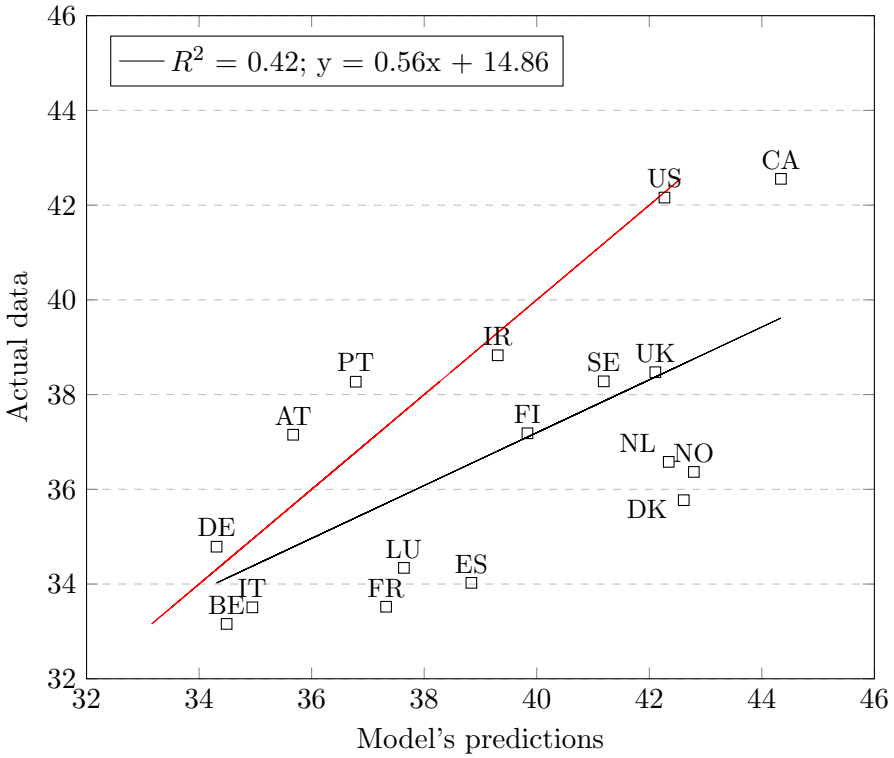
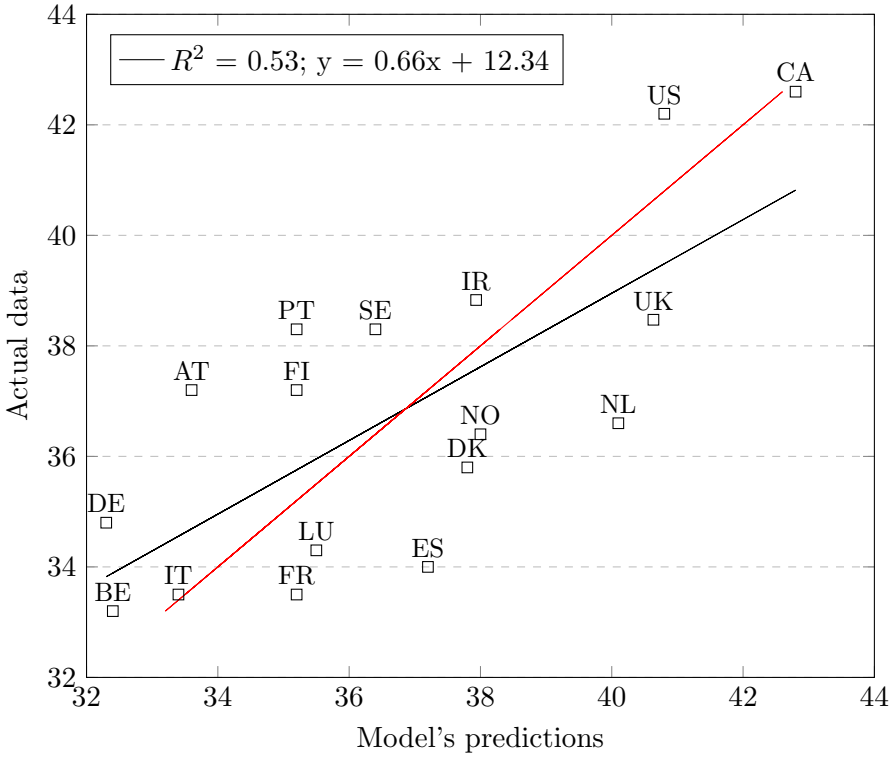


Figure 4.2: Aggregate labor market performance in individual countries with a country-group taste for leisure parameter, RA model estimations



Blanchard (2004) and Alesina et al. (2005) suggest that a different preference for work can lie at the basis of cross-country differences in employment. Could it be that individuals in Anglo-Saxon countries work more because they have a lower taste for leisure? To find out, the estimation exercise is repeated with a different γ parameter per country group, calibrated on the country group average for total labor supply[9]. The results are shown in Figure 4.2. We find that the R-squared rises to 0.53, meaning that about 10% of the variance can be attributed to different preferences for leisure. The higher slope of 0.66 indicates that, although still overestimating the influence of taxes, the inflation is less severe in the new specification. Still, culture and fiscal policy can explain only half of the cross-country variations in hours worked. One reason could be that cultural differences do not manifest themselves geographically. Calibrating on country groups instead of finding an individual country proxy for the taste for leisure might not be the correct way to account for preference differences. These proxies, however, are practically non-existent.

We now turn to an incomplete markets model with agents that have heterogeneous labor productivity to investigate the model's explanatory power when it comes to cross-country inequality variations.

5 A Heterogeneous Agent Model

In this chapter, we extend the RA model from the previous chapter to an incomplete markets context. More specifically, we introduce heterogeneous agents that differ in their productivity levels through fixed effects and idiosyncratic labor shocks. Moreover, It is assumed that they cannot insure themselves against uncertainty causing agents to be borrowing constrained. For firms and government, nothing has changed. As a whole, the model is closely related to Floden and Lindé (2001).

Subsection 1 describes the formal specification of the model. We represent the problem through Bellman equations as this format is more suited to deal with borrowing constraints and uncertainty. As before, subsections 2 and 3 deal with respectively the parametrization and the results.

[9]The values for γ for Western Europe, Northern Europe, Southern Europe and the Anglo-Saxon countries are 0.479, 0.456, 0.485 and 0.489.

5.1 The Model

A continuum of agents, normalized to 1, is present in the model. They are endowed a specific level of productivity q_t, which consists out of a permanent component η and temporary component z_t. The temporary component follows and AR(1) process with ρ being the degree of persistence and ε_t the uncertain shock. Both ε_t and η are drawn from a normal distribution with mean zero and variances σ_η^2 and σ_ϵ^2.

$$q_t = e^{\eta + z_t} \tag{7}$$
$$\text{with } z_t = \rho z_{t-1} + \varepsilon_t$$

The problem faced by the household is highly similar to the one in the RA model. Let V be the value function for an agent with assets a and productivity q. The Bellman equation is:

$$V(a,q) = \ max\ u(c,\ell) + \beta E V(a',q') \tag{8}$$
$$\text{Subject to}$$
$$(1+\tau_c)c + a' = (1-\tau_\ell)wq_t\ell + [1 + r(1-\tau_a)]a + Tr \tag{9}$$
$$a' \geq 0;\ c \geq 0;\ 0 \leq (1-\ell) \leq 1 \tag{10}$$

The main difference in equations 8 and 9 compared to equations 1 and 2, is the fact that the agent now has to anticipate his productivity level, which is also part of his wage $(1-\tau_\ell)wq$. Moreover, a non-negative borrowing constraint is assumed: assets cannot drop below zero (eq 10).

Firms and government behave in exactly the same way as before. The equations are repeated below for completeness. We denote with $\lambda(a,q)$ the measure of agents over the state space with assets a and productivity q.

$$F(K,L) = AK^\alpha L^{1-\alpha}$$
$$T = \int [\tau_l wq\ell + \tau_a ra + \tau_c c] d\lambda(a,q)$$
$$G = gY + \int [Tr] d\lambda(a,q)$$

Finally, the stationary equilibrium is given by a constant interest rate r and wage rate w, constant government tax rates and transfers $(\tau_\ell,\ \tau_c,\ \tau_a,\ b,\ g)$, time invariant decision rules

$c(a, q, \tau, b, g, r, w)$, $a'(a, q, \tau, b, g, r, w)$, $\ell(a, q, \tau, b, g, r, w)$ and a measure of agents over the state space $\lambda(a, q)$ such that:

1. The decision rules for consumption, savings and labor solve the agent's maximization problem specified above.
2. Tax revenues equal government expenditures, i.e. $T = G$.
3. Aggregate supply of savings and labor is equal to firms' demand for capital and labor. Also, factor markets clear.

$$L = \int q\ell d\lambda \text{ and } K = \int a(a, q)d\lambda$$
$$w = F_L(K, L) \text{ and } r = F_K(K, L) - \delta$$

4. the measure of the state space $\lambda(a, q)$ is invariant over time, given individual decisions.

5.2 Parametrization and Computation of the Equilibrium

To solve the agents recursive problem, we use a method taken from Floden and Lindé (2001). The state space is discretized over a grid of 50 values for assets. Piecewise linear approximations are used between the grid points. As consumption and labor are solved as functions of assets, they are allowed to be non-linear approximations between these grid points. Concerning the productivity process, we follow Floden and Lindé (2001) in applying 1 high and 1 low value for the permanent shock, but model only 5 values for the temporary shock. The AR(1) process is approximated using an algorithm based on Tauchen (1986)[10].
The algorithm that is used to solve for the equilibrium, is based on Huggett (1993) and Aiyagari (1994). First, we set the tax rates and calibration targets for the interest rate and average hours of labor supply. We introduce initial guesses for β and γ, based on which we solve the problem through value function iteration and obtain the optimal policy rules $c(a, q, \tau, b, p, r, w)$, $a'(a, q, \tau, b, g, r, w)$ and $\ell(a, q, \tau, b, g, r, w)$. The economy is then simulated[11] and demand for capital and labor are calculated. If the derived interest rate or labor supply is different from the targets, the values for β and γ are updated and the process is iterated until there is convergence.

Regarding the parametrization, we apply the same policy parameters and values from the literature as before. As mentioned above, we re-calibrate β and γ to match an interest rate of 4% and

[10] The spread for the productivity grid is $3\sigma_\epsilon/(1-\rho)^{0.5}$.
[11] We simulate 100 agents of low productivity and 100 agents of high productivity for 2500 periods. The first 500 periods are discarded before calculating aggregate statistics.

Table 5.1: Parametrization of the HA benchmark model, US calibration[1]

τ_c	τ_ℓ	τ_a	g	θ	α	δ	γ	β	ρ	σ_η^2	σ_ϵ^2
3.09	29.58	36.8	17.73	2	0.33	6.39	**0.542**	**0.958**	**0.93**	**0.055**	**0.04**

[1] Changed or new parameters compared to table 4.1 are in bold. See appendix A for the calculation of the policy variables. The former are expressed in percentages, as is δ.

Table 5.2: Distributional implications of the HA benchmark model[1]

	Fraction by population quintile					Gini
	1	2	3	4	5	coefficient
Wealth						
Data	-0.6	0.7	3.0	9.1	87.9	0.85
model	0	0.4	4.1	19.8	76.4	0.75
Market income						
Data	1.7	6.1	11.3	19.2	61.7	0.51
model	4.2	9.1	14.0	21.4	51.3	0.46
Disposable income						
Data	4.0	9.1	13.7	20.0	53.2	0.39
model	6.3	10.6	14.8	21.32	47.0	0.39

[1] Data are retrieved from the OECD, the WID, the Worldbank and the Global Wealth Databook. They are percentage shares and concern 2013-2018. For the exact calculation, see appendix A.

labor supply of 42.2%. The new parameters are respectively 0.54 and 0.96. δ can be calculated outside of the calibration, and remains the same. Furthermore, we need to pick values for the persistence of the productivity process ρ and variances σ_η^2 and σ_ϵ^2. We take respective values of 0.93, 0.04 and 0.055, close to other values used by authors such as Blundell & Etheridge (2009) Alonso-Ortiz & Rogerson (2010) and Heathcote et al. (2010). Table 5.1 provides an oversight of the parametrization, with the changed and new parameters in bold.

Given these values, the model generates a distributions and Gini coefficient for wealth, market income and disposable income[12]. Table 5.2 shows the simulated distributions and the real distributions for the USA, the country which the benchmark economy is designed to replicate. The model correctly predicts disposable income inequality, although it is reached through too low market income inequality and thus too little redistribution. Moreover, both income distributions are slightly less skewed than reality shows. The model also underestimates wealth inequality. It does not succeed in matching the high concentration of wealth at the top, a problem common to this strand of literature. Including entrepreneurial skills or bequeathing could ameliorate this shortcoming (cf. De Nardi (2015)), however, for the purpose of this paper, the model performs well enough.

[12] It also generates these figures for labor earnings. However, as we do not have up-to-date numbers on the real distribution of labor earnings for the countries investigated in this thesis, we do now show these numbers.

5.3 Results

This section proceeds with showing the models' predictive power for employment and inequality in terms of cross-country differences. Figure 5.1 and 5.2 show respectively aggregate average labor supply and the disposable income Gini for the 17 countries under investigation. Correlations between reality and predictions for employment, labor earnings inequality, wealth inequality, market income inequality and disposable income inequality are shown in Table 5.3.

Looking at employment, we find the same R-squared but a greater slope of the regression line. This indicates that the HA model inflates the effects of fiscal policy compared to the RA model. This is in line with the literature (Pijoan-Mass (2006) and Alonso-Ortiz & Rogerson (2010)).
The reason is the fact that agents use labor supply as a smoothing mechanism against productivity shocks. In this simple tax model, an increase in the size of taxes leads to a higher transfer being returned to the household. This higher transfer serves as a partial substitute for missing insurance market and helps individuals smooth consumption over time. Consequentially, because idiosyncratic risk is lower, there is less need to work and accumulate assets and individuals decrease labor supply more than originally for-seen. In summary, households are more responsive to a change in taxes because on top of the normal distortions (substitution and income effects) there is also the insurance effect.

Compared to labor market performance, the predictions for the income Ginis are horrible. Figure 5.2 shows that the model fails strongly in explaining cross-country differences in disposable income inequality: the R-squared is 0 and the regression line is flat.
The system that generates cross-country differences inequality in the model is explained next. When a country exhibits lower than average employment caused by high taxes and transfers, it are mostly individuals with low ability that supply less hours and hold less assets. Poor agents rely on transfers instead of labor and capital income to consume. This brings about a more dispersed labor earnings and wealth distribution. In result, the market income Gini is high in countries with low labor market performance. However, these countries are marked by high

Table 5.3: Correlations of employment (EMP), labor earnings (LE), wealth (WTH), market income (MI), disposable income (DI) and redistribustion (RDIST) [1]

	EMP	LE	WTH	MI	DI	(RDIST)
Benchmark	0.65	0.28	-0.44	0.15	0	0.61
Benchmark+WI[2]	0.55	0.84	-0.36	0.67	0.73	0.49

[1] The measure for (factor) income variables is the Gini coefficient.
[2] WI stands for country-group specific productivity processes.

Figure 5.1: Aggregate labor market performance in individual countries, HA model estimations

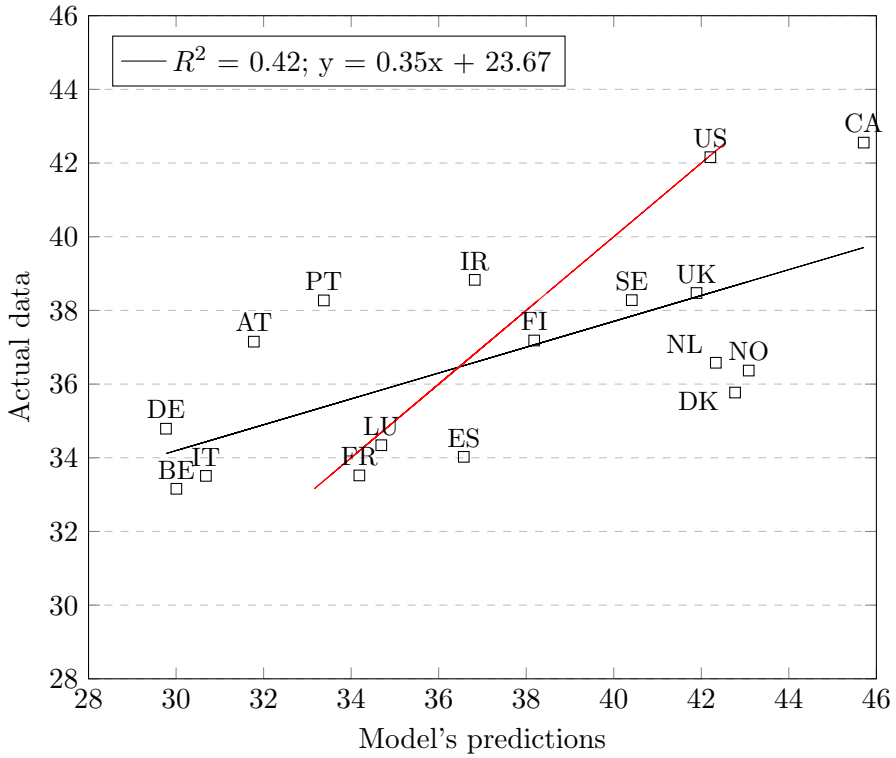
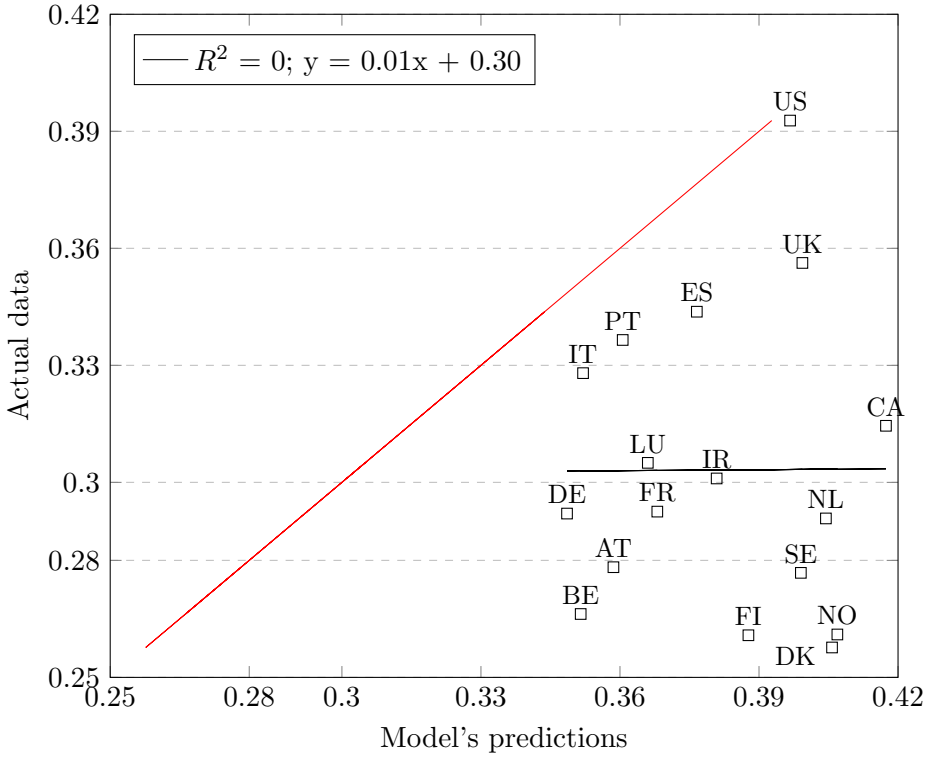


Figure 5.2: Income inequality in individual countries, HA model estimations



taxes and transfer levels, allowing fiscal policy to strongly mitigate market inequality, reversing the correlation: low employment goes together with low disposable income inequality. On the other hand, for countries with low transfers - and high employment - fiscal policy can barely mitigate market income inequality, leading to high disposable income inequality.

Why does this mechanism not yield correct predictions for cross-country differences in disposable income inequality? One reason could be that the behavioral assumptions underlying the model are incorrect, or dominated by others. However, there is no need to give op on this strand of models yet. Two other factors could explain the failure of the model: fiscal policy or wage inequality.

Regarding the former, the model actually performs well: column 7 of Table 5.3 shows that the correlation is 0.61[13] for redistribution, i.e. the difference in market income inequality and disposable income inequality. The fiscal policy in the model reduces the market gini with 0.10 points on average, about half of what is seen in reality. In the next section, we look for fiscal policies that could improve this measure. Several government programs that have strong redistributive capabilities such as pensions and progressive taxation, are ignored in this model. Moreover, these policies will also help to better estimate the wealth and earnings distribution, as the model also strongly fails at this point (cf. Table 5.3). Getting the wealth and earnings distribution right will in turn help to correctly predict the income Ginis and redistribution.

First, we look at another factor that could improve the earnings distribution. There might be cross-country differences in the underlying wage processes. Labor earnings are calculated as $qw\ell$, with w and ℓ country-specific variables, subject to country-specific fiscal policy parameters. In reality, the wage process q could be a country-specific variable as well, being influenced by institutions and fiscal policy[14]. Therefore, we extend the model described above to include heterogeneous wage profiles per country group. However, data on these wage profiles are scarce. Krueger et al. (2010) summarize the available estimations for different countries. We use data for the UK as a proxy for the entire SA and WE country groups, data for Spain for the SE country group and Swedish data for the NE country group. Table 5.4 provides an overview of the parameter values and source.

The results are shown in Figure 5.3 and 5.4 and Table 5.3. Correlation for earnings is 0.84, drastically improving the correlation for market income and disposable income inequality. Even though we display only a primitive approximation of the real wage dispersion that exists between

[13] The corresponding R-squared is 0.37.

[14] An example: countries that subsidize education, might have less dispersed wages because education is 'cheap', and at the same time high taxation to fund the subsidization. This way, fiscal policy influences the wage distribution.

Table 5.4: Parametrization of the productivity process in the HA model with country-group wage inequality differences

Country	Proxy for	σ_η^2	σ_ϵ^2	Source
UK	Western Europe and the Anglo Saxon countries	0.055	0.04	Blundell & Etheridge (2009)
Spain	Southern Europe	0.05	0.07	Pijoan-Mass & Sanchez-Marcos (2010)
Sweden	Northern Europe	0.04	0.01	Domeij & Floden (2010)

countries, the model proves much more successful. Cross-country differences in wage inequality are clearly one of the most important drives of general income inequality. One drawback, however, is the reduction of the explanatory power in employment and redistribution, perhaps caused by the low quality of our data.

6 An Overlapping Generations Model

In this final model, we extend the RA model in another way. By adding overlapping generations we can investigate more fiscal programs such as pensions, inheritance taxation and progressive taxation. However, to preserve parsimony and technical feasibility, we return to the complete markets framework.

As in the previous sections, we have three subsections: the model, the parametrization and the results.

6.1 The Model

The basic set-up of the model is as follows: individuals enter the model at the age of 20 and live for 12 periods of 5 years, until they are 80 years old. The first 9 periods, between the age of 20 and 65, individuals participate on the labor market. For their performed labor, workers receive an income that they can consume or save, the latter earning them an extra interest income in the next period. The last 3 periods (65-79), all individuals are retired and receive a pension on top of their interest income. When individuals die, they can leave bequests to their children, who have the same skill level as their parents. Children receive this bequest in period 7 of their life, when they are 50 years old. This means that we assume that individuals have children at the age of 30. In the spirit of De Nardi (2004), the utility from bequests is modelled as $\phi(1+h)^{1-\theta}$ where ϕ_1 represents the altruism of parents towards their children. Agents maximize utility over

Figure 5.3: Aggregate labor market performance in individual countries with a country-group productivity process, HA model estimations

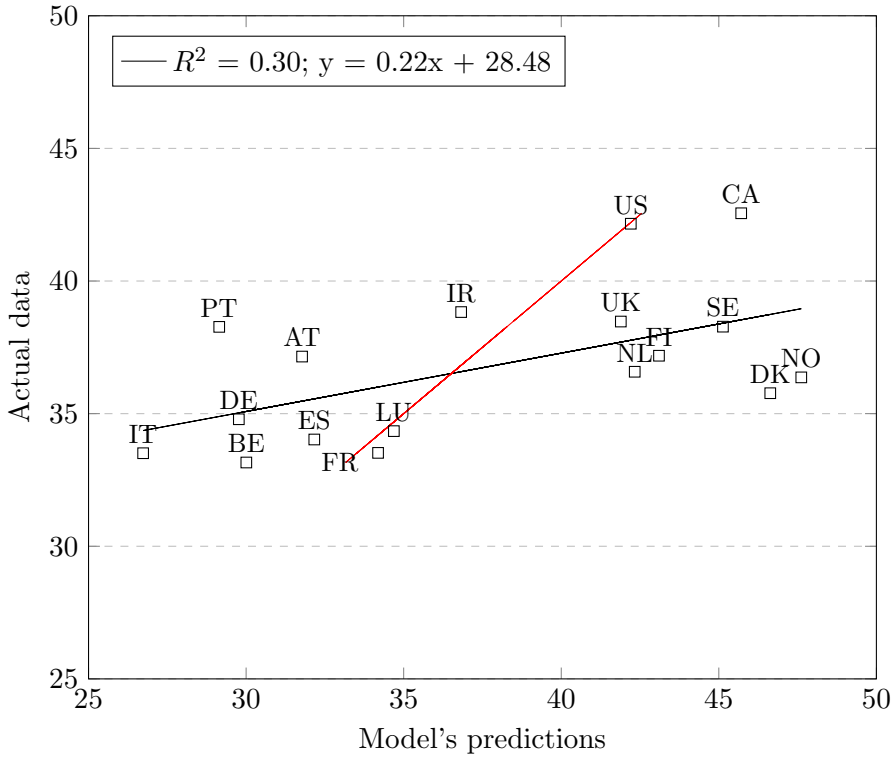
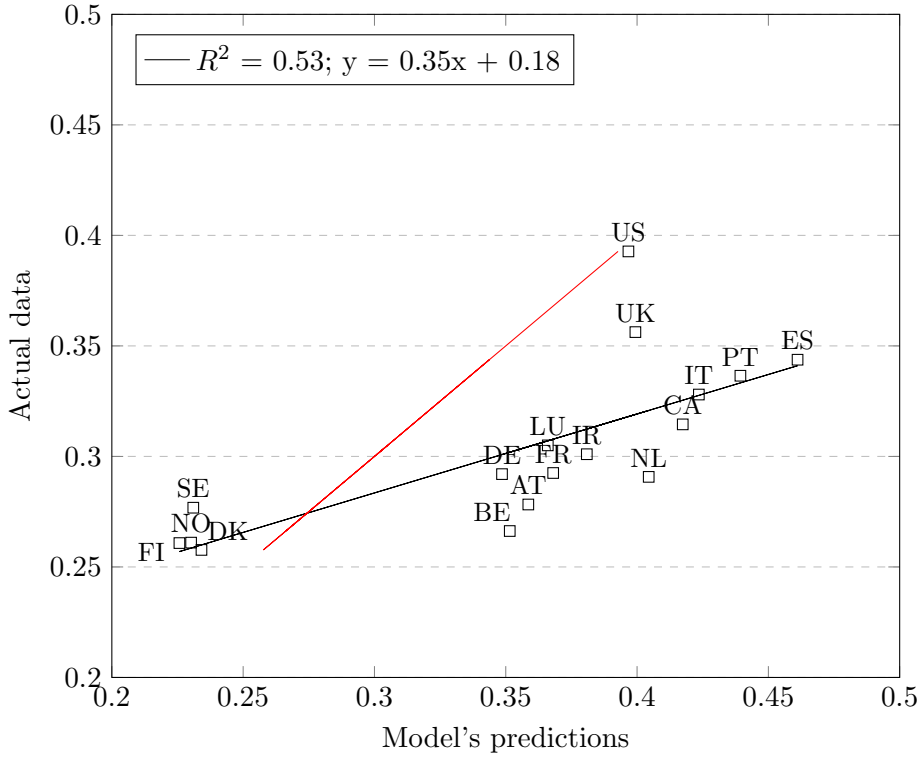


Figure 5.4: Income inequality in individual countries with a country-group productivity process, HA model estimations



their life time:

$$\sum_{i=1}^{12} \beta^t [\frac{(c_i^\gamma (1-\ell_i)^{1-\gamma})^{1-\theta}}{1-\theta}] + \beta^{12}\phi(1+h)^{1-\theta} \tag{11}$$

Subject to

$$(1+\tau_c)c_i + a_i = e_i(1-\tau_{\ell,i})w\ell_i + [1+r(1-\tau_a)]a_{i-1} + Tr \qquad \forall i \ = 1,...,6,8,9 \tag{12}$$

$$(1+\tau_c)c_i + a_i = e_i(1-\tau_{\ell,i})w\ell_i + [1+r(1-\tau_a)]a_{i-1} + Tr + h \quad \forall i \ = 7 \tag{13}$$

$$(1+\tau_c)c_i + a_i = pw\hat{\ell} + [1+r(1-\tau_a)]a_{i-1} + Tr \qquad \forall i \ = 10,...,12 \tag{14}$$

with

$$h = (1-\tau_h)(1+r(1-\tau_a))a_{12} \tag{15}$$

and $a_0 = 0,\ c_i \geq 0$ and $0 \leq \ell_i \leq 1$

We can compare eq. 12 to the budget constraints of the RA model (eq. 2). The main difference is the addition of an age specific productivity parameter e_i to the wage. Moreover, there is an age specific labor tax rate $\tau_{\ell,i}$. This allows to include progressive income taxation. Once retired (eq. 14), the wage is replaced with a pension $pw\hat{\ell}$ with p the gross pension replacement rate and $\hat{\ell}$ average hours worked by the agent over his lifetime. We use this specification to match the fact that in many OECD countries, individuals with higher wages and more hours worked during their career, also receive a higher pension. Finally, bequests are taxed at a linear rate $(1-\tau_h)$.

Looking at the aspect of firms, aggregate effective labor and aggregate capital is now the sum of individual labor supply and savings: $L = \sum_i^9 e_i\ell_i$ and $K = \sum_i^{12} a_i$. Firms still operate a neoclassical production function on competitive markets. The budget constraint of the government also needs to be aggregated over all individuals in the economy. Moreover, it includes new items: pensions are added as an expenditure, and a tax on inheritance generates new proceeds. The government budget constraint reads as follows:

$$gY + 12Tr + 3pw\hat{\ell} = w\sum_i^9 e_i\ell_i\tau_{\ell,i,j} + \tau_a r\sum_i^{12} a_i + \tau_c\sum_i^{12} c_i + \tau_h(1+r(1-\tau_a)a_{12}) \tag{16}$$

Furthermore, we now apply a progressive labor tax. It is calculated in accordance with Guvenen et al. (2013): $\tau_{\ell,i} = \lambda_0 + \lambda_1(\hat{y}_i/AY) + \lambda_2(\hat{y}_i/AY)^{\lambda_3}$, with $\hat{y}_i$ the labor earnings of the household and AY the average earnings in the economy.

Table 6.1: Parametrization of the OLG benchmark model and distributional implications, US calibration[1]

τ_c	τ_h	τ_a	g	p	λ_0	λ_1	λ_2	λ_3
3.09	**3.21**	36.80	17.73	**36.75**	**2.95**	**0**	**2.64**	**-0.03**
θ	α	δ	γ	β	ϕ			
2	0.33	**33.23**[2]	**0.39**	**0.93**	**-4.06**			

[1] Changed or new parameters compared to table 5.1 are in bold. See appendix A for the calculation of the policy variables. The former are expressed in percentages, except λ. So is δ.
[2] The time period is 5 years. This value corresponds to an annual rate of 8%.

6.2 Parametrization

This model introduces several new fiscal policy parameters: the gross pension replacement rate p, the tax rate on bequests τ_h and the components of the labor tax function, $\lambda_0, \lambda_1, \lambda_2, \lambda_3$. The values for the United States are respectively 36.8%, 3.2%, 3, 0, -2.6 and -0.03. The underlying calculations can be found in appendix A. Furthermore, the parameters of the bequest function need to be estimated. The same method as in De Nardi (2014) is used: ϕ, i.e. the 'warm glow', is calibrated to match a bequest to capital ratio of 1.28%. It is found to equal -4.06. Analogous to the HA model, we recalibrate δ, γ and β to correctly predict an interest rate of 4% (=21,6% compounded over a 5 year period), aggregate hours worked of 42,2% and a investment-output ratio of 20%. Table 6.1 shows the results. The model also generates moments for inequality for the benchmark economy. All values are heavily below their true counterparts. However, as we are more interested in the variation than the absolute level of these coefficients, we can continue with the model.

6.3 Results

In this section, the outcomes for the OLG model are shown. Can it correctly predict cross-country differences in aggregate statistics, solely through country-specific fiscal policy variables? Figures 6.1 and 6.1 present the results for respectively employment and the disposable income Gini. Table 6.2 comprises the correlations for employment, earnings, wealth, market income and disposable income for all models. For convenience, correlations of models from the previous sections are also shown.

Considering labor market performance, the explanatory power drops compared to the RA and HA models: the R-squared decreases from 0.42 to 0.16. The countries that were overestimated in the previous models, which are the Netherlands, Denmark, Norway and Spain, find themselves

Figure 6.1: Aggregate labor market performance in individual countries, OLG model estimations

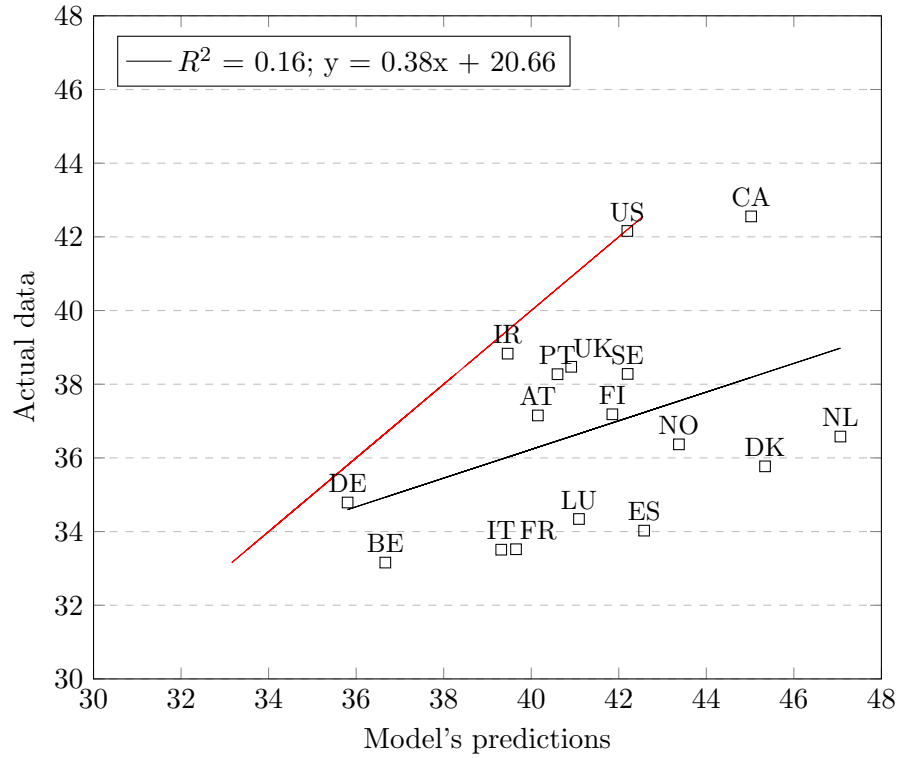


Figure 6.2: Income inequality in individual countries, OLG model estimations

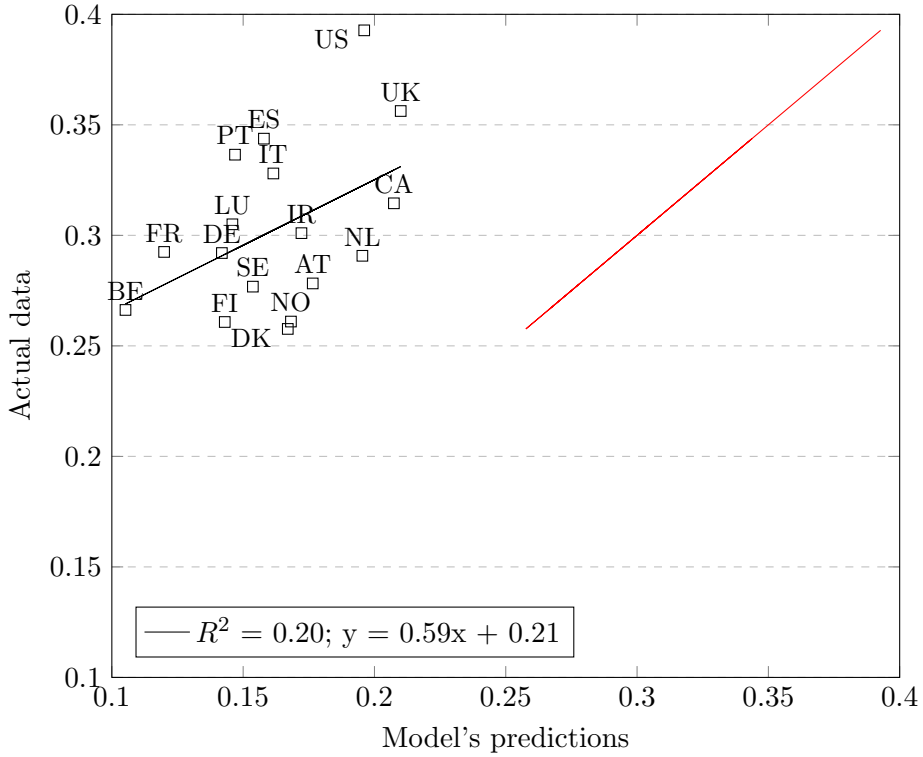


Table 6.2: Correlations of employment (EMP), labor earnings (LE), wealth (WTH), market income (MI), disposable income (DI) and redistribustion (RDIST) [1]

	EMP	LE	WTH	MI	DI	RDIST
RA	0.65					
RA + Pref[2]	0.73					
HA	0.65	0.28	-0.44	0.15	0	0.61
HA + WI[3]	0.55	0.84	-0.36	0.67	0.73	0.49
OLG	0.40	0.33	0.46	0.58	0.45	0.69
OLG + HA(2)[h]	0.25	0.50	0.50	0.25	0.17	0.70

[1] The measure for income variables is the Gini coefficient.
[2] 'Pref' stands for the fact that there are country group-specific taste for leisure parameters γ.
[3] 'WI' means that country group-specific productivity processes are applied.
[4] 'HA(2)' is the extention of the OLG model to two heterogeneous agents who know their productivity with certainty.

even further from their true data-points. Without them, the R-squared returns to 0.62, which is only a little lower than the 0.70 for the RA model without these countries.

Comparing Figure 6.2 to Figure 5.2, we find improvements for inequality. Even though there are no initial differences in the productivity processes, the model generates (too) much variation in inequality variables. Table 6.2 shows that, compared to the basic HA model, the correlation for labor earnings inequality is better and that the correlation for wealth finally shows the right sign. The fiscal policy in the model can explain 20% of the variation in the disposable income Ginis and around 50% of the diversity in redistribution.

The system that causes disparities is similar to the previous models: countries with high transfer levels display lower work efforts. The reduction in hours is proportionally more important during the periods in which age-specific productivity is low, causing a negative correlation between employment and earnings. However, without uncertainty, there is no precautionary savings motive. Instead, agents save to finance consumption during retirement. If employment is low, everybody works, earns and saves less. With interest income accumulating over time, this generates less dispersed wealth inequality. Market inequality increases with earnings and wealth inequality, but as these two have opposing trends relating to employment, market inequality is generally unrelated to latter. Finally, as in the HA model, low employment means high transfers and thus high redistribution. In result, countries with low (high) employment display low (high) disposable income inequality.

How do the new policies contribute in explaining cross-country differences? Surprisingly, when adding the policies one by one to the model, we find that pensions and bequests cause the worsening for employment and improvement for inequality. Progressive taxation on the other hand, does not deteriorate nor enhance the models' explanatory power. In agreement with the consequences of the addition of country group-specific wage processes in the HA model, policies

that improve the inequality correlation, decrease the one for employment.
Finally, we also attempted to add heterogeneity in skill to the model by introducing two agents that know their fixed productivity level (one low and one high) with certainty[15]. The results are very poor, as correlation coefficients for employment and income inequality decrease substantially. The figures for employment and inequality are shown in appendix B.

7 Conclusion and Outlook

OECD countries exhibit broad differences in aggregate labor market performance and inequality. This paper investigated how much cross-country variation in these statistics can be explained through country-specific fiscal policy. Three models were used during this study. The first model was a Neoclassical representative agent model with endogenous labor and government intervention through capital, labor and consumption taxation and lump-sum transfers. The second model extended the framework to a heterogeneous agent framework: households now faced uninsurable idiosyncratic productivity shocks and a non-negative borrowing constraint. The final version expanded the representative agent model with a life-cycle dimension, which allowed the inclusion of new fiscal programs such as pensions, inheritance taxation and progressive labor taxes. Each of these models were calibrated on the US, using data from the period 2013-2018. Once parameter values were assigned, these three benchmark models could generate estimations for aggregate employment and inequality statistics. Country-specific fiscal policy parameters were plugged in to estimate these variables for the 17 countries covered in our analyses: Austria, Belgium, France, Germany, Luxembourg, the Netherlands, Denmark, Finland, Norway, Sweden, Italy, Portugal, Spain, Canada, Ireland, the United Kingdom and the United States.

The main findings of the study are as follows.
Simple representative agent models can explain about 40% of cross-country variation in employment, solely through country-specific fiscal policy. Excluding four outliers[16], this rises to 70%. The country-specific size of transfers, largely determined by the height of the labor tax rate and government consumption, play a major role in accounting for this result. However, the model overestimates the influence of fiscal programs, causing too high variability in the model estimations compared to reality. Again, removing outliers can mitigate this result. Finally, country-group differences in the preference for leisure, can account for another 10% of variation

[15]Skill levels are chosen to match a disposable income Gini of 0.39 for the US. They are 0.5 and 2. Moreover, bequests are modelled as a luxury good.
[16]These are the Netherlands, Denmark, Finland and Spain.

in employment. Allowing country-specific differences, could improve this figure even more.
The incomplete market model, that has similar explanatory power for employment, inflates the effects of fiscal policy even more. In heterogeneous agent models, households are more reactive in their adjustment of labor supply because government programs can moderate productivity shocks and serve as an extra smoothing mechanism for consumption over time. The previous findings confirm the existing literature on cross-country differences in employment.
The incomplete markets model can also explain about 40% of the variation in redistribution between market income and disposable income. However, it fails to explain any of the cross-country differences in the disposable income Gini coefficient. Performance on this front can be ameliorated by the addition of country group-specific wage processes, which raises the R-squared of the disposable income gini to 0.53. The main reason is that it improves correlation for market income inequality. However, this also weakens the explanatory power of fiscal policy for employment.
The same trade-off arises when pensions and inheritance taxation are added: the model performs better for inequality (it can explain 20% of the diversity in disposable income inequality and 50% of redistribution), but performs worse for employment (accounting for only 15% of variation). Surprisingly, even though many countries exhibit progressive personal income taxes in reality, a linear labor tax serves as a sufficient approximation to capture the effects of labor taxation on employment and inequality: the addition of a progressive labor tax function does not improve nor worsen the correlation between model and reality for these two statistics.
Summarizing, fiscal policy can account for some of the cross-country variations in employment and inequality, but often leaves over half of the differences unexplained. A final issue, is the fact that when we decompose correlations within country-groups, the model always performs well for the Anglo-Saxon countries and Western Europe, but not for Northern and Southern Europe. This indicates that the model might be missing a factor or mechanism that is important in these two country groups.
The most important conclusion to be drawn from these findings, is that caution and some healthy skepticism is always necessary when interpreting policy recommendations based on the current frameworks in modern macroeconomics. These models remain a simplification of reality and do not capture all the behaviors that households exhibit in their decisions concerning labor supply and saving. They fail one of the few quasi-natural experiments that can be undertaken, i.e. explaining cross-country differences in macro-economic variables through country-specific parameters.

We end this section with several extensions of the dissertation that could be implemented to

augment the quality of this work. The focus lies on two aspects: the specification of the models, and the expansion of the research question and research methods.

Regarding the first aspect, the most obvious failure in this dissertation is the fact that we do not show the results of a incomplete markets, overlapping generations model. Both frameworks show different ways to improve the correlations for inequality outcomes. A combination of the two could generate even better results.

Secondly, we only touch upon country-specific wage-profiles very shortly. As available data is often outdated and incomplete, it would be interesting to estimate the productivity process ourselves, in a coherent way for each of the 17 countries studied. Getting wage inequality right should improve the estimations for labor earnings, market income and disposable income inequality. However, this would also pose a new question: why do countries have different wage processes? Which institutions cause this? Does culture or fiscal policy matter? Endogenizing the labor productivity process in the model, for example by formalizing human capital accumulation, could be a good start to answer these questions.

Finally, we could broaden the fiscal policy in the model even more. Some very important policies are still omitted. Most importantly, there is no unemployment and thus also no unemployment benefit system. Extending the framework with search and matching frictions can allow for this aspect to also be included. Moreover, including other government expenditures, for example on health, education and infrastructure, would also better approximate the real workings of governments. Finally, some of the policies that are included, are modelled too primitively to capture all country-specific aspects. An obvious example is the retirement system and pensions. It could be worthwhile to concentrate on less countries, but allow a more diverse and exact specification of the fiscal programs.

Turning to research methods, one weakness in this work, is that we base our self on simple linear regression and correlation statistics. More interesting would be to actually test the significance and contribution of the different policies in explaining cross-country differences in employment and inequality. This could be performed through a Shapley-decomposition for example.

Finally, another related path of study could be pursued. This dissertation only takes a cross-country perspective. We could also analyze time-series: how much of changes in employment and inequality over time can be accounted for by changes in fiscal policy? Which factors have gained and which ones have lost importance? Has the Financial crisis deterministically changed the workings of our economies? Many of these questions remain unanswered.

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A Data, Construction and Sources

In this appendix, we provide more detail on the construction of the performance data and the policy variables in 17 OECD countries. We use similar calculation methods as used in Dujardin and Heylen (2018).

A.1 Performance variables

ℓ: Total labor supply, (2013-2017)

Definition: employment rate in persons x actual hours worked per person / potential hours worked per person.

With potential hours = 2920 (= 365 days per year x 8 hours per day)

Data source: OECD Stat; Labour Force Statistics; Average annual hours actually worked per worker and Employment rate, aged 15-64, all persons.

Labor earnings Gini, (2011)

Definition: Inequality measure for annual labor earnings from both paid work and self-employment.

Data source: Divided we stand. Why Inequality keeps rising (OECD, 2011). Figure 4.6: Inequality of earnings (Gini coefficient) among the entire working-age population.

Wealth Gini, (2018)

Definition: Inequality measure for wealth.

Data source: Credit Suisse Group AG, Global Wealth Databook.

Market income Gini, (2013-2017)

Definition: Inequality measure for income, pre taxes and transfers.

Data source: OECD Stat; Social Protection and Well-Being; Income Distribution and Poverty.

Disposable income Gini, (2013-2017)

Definition: Inequality measure for income, post taxes and transfers.

Data source: OECD Stat; Social Protection and Well-Being; Income Distribution and Poverty.

Percentage share of wealth by population quintile, (2018)

Definition: Percentage share of wealth is the share that accrues to subgroups of population indicated by quintiles.

Data source: Credit Suisse Group AG, Global Wealth Databook.

Percentage share of market and disposable income by population quintile, (2013-2016)

Definition: Percentage share of income is the share that accrues to subgroups of population indicated by quintiles..

Data source: World Inequality Database and the Worldbank.

A.2 Policy variables

τ_c: Tax rate on consumption (2013-2018)

Definition: taxes less subsidies on products divided by domestic demand corrected for taxes less subsidies on products. We assume the same tax rate on investment goods as on consumption goods.

Data source: OECD stat; National Accounts; Annual National Accounts; Main Aggregates; Gross Domestic Product (GDP); 1. Gross Domestic Product (GDP); 'D21-D31: Taxes less subsidies on products' and 'P3-P5: Domestic demand'.

τ_k: Tax rate on capital returns (2013-2018)

Definition: Statutory corporate income tax rate

Data Source: OECD Stat; Public Sector, Taxation and Market regulation; Taxation; Table II.1: Statutory corporate income tax rate.

τ_ℓ: Tax rate on labor (2013-2018)

Definition: average tax wedge (as a percentage of total labor costs)

Data source: OECD Stat, Public sector, Taxation and Market Regulation; Taxation; Taxing wages, Comparative tables.

λ_0, λ_1, λ_2 and λ_3: the labor tax function (2013-2018)

Definition: We obtain data for the tax wedge (as a percentage of total labor costs) at 50%, 75%, 100%, 125%, 150%, 175%, 200%, 225% and 250% of the average wage. We then fit the smooth function $\tau_\ell(\hat{y}/AY) = \lambda_0 + \lambda_1(\hat{y}/AY) + \lambda_2(\hat{y}/AY)^{\lambda_3}$ to these data points such that the RSS are minimized. All tax functions appear increasing and concave. Moreover, the R-squared is never below 0.9. For more information, see Guvenen (2009)

Data source: OECD Stat, Public sector, Taxation and Market Regulation; Taxation; Taxing wages, Comparative tables.

τ_h: Tax rate on bequests (2013-2018)

Definition: The tax rate is calibrated such that the correct number is attained for government tax revenue from estate, inheritance and gift taxes as a percentage of GDP (h) (cf. De Nardi (2014)).

Data source: OECD Stat, Public sector, Taxation and Market Regulation; Taxation; Government Revenue Statistics, '4300 Estate, inheritance and gift taxes'.

p: Gross pension replacement rate (2014-2016)

Definition: The gross replacement rate is defined as gross pension entitlement divided by gross pre-retirement earnings.

Data source: OECD Stat, Social Protection and Well-Being, Social Protection, Pensions at a Glance. The OECD provides net replacement rates for males and females at three earnings levels. We assume the ratio for a singe male previously earning the average wage.

g: government spending on goods and services (2013-2018)

Definition: Sum of government final consumption expenditure and government fixed capital formation, as a percentage of GDP.

Data source: OECD Stat; Economic Outlook N°103; Government Accounts and Expenditure and GDP.

Table A.1: Policy variables: tax and transfer rates [1]

	τ_c	τ_k	τ_ℓ	λ_0	λ_1	λ_2	λ_3	g	h	p
Austria	12.59	25.00	47.63	0.50	0.00	-0.03	-2.15	22.63	0.00	78.25
Belgium	12.06	33.26	52.67	0.65	0.00	-0.11	-1.51	26.03	0.73	46.65
France	11.77	36.21	47.63	0.57	0.00	-0.07	-2.02	27.34	0.54	57.95
Germany	11.95	29.79	49.50	0.51	0.00	-0.01	-2.83	21.54	0.19	37.85
Luxembourg	17.30	28.33	38.17	0.53	-0.01	-0.14	-1.02	20.73	0.16	76.75
Netherlands	12.78	25.00	37.67	0.54	0.00	-0.17	-0.78	28.36	0.25	93.70
WE average	13.08	29.60	45.54	0.55	0.00	-0.09	-1.72	24.44	0.31	65.19
Denmark	16.55	23.17	35.66	4.25	-0.01	-3.87	-0.03	28.83	0.21	77.10
Finland	15.92	20.75	42.30	0.79	-0.01	-0.35	-0.41	27.95	0.30	56.20
Norway	13.27	25.67	35.81	0.64	-0.01	-0.26	-0.41	28.10	0.03	47.45
Sweden	13.67	22.00	43.06	2.46	-0.02	-1.98	-0.07	30.62	0.00	55.90
NE average	14.85	22.90	39.21	2.03	-0.01	-1.62	-0.23	28.88	0.14	59.16
Italy	11.70	30.13	47.88	0.63	-0.01	-0.13	-1.01	21.23	0.04	76.30
Portugal	14.94	30.50	40.71	0.62	0.00	-0.21	-0.64	20.00	0.00	73.90
Spain	10.46	27.17	39.38	0.44	0.00	-0.04	-2.03	21.17	0.25	77.20
SE average	12.37	29.27	42.66	0.56	0.00	-0.13	-1.23	20.80	0.10	75.80
Canada	6.84	26.55	30.71	3.41	0.00	-3.13	-0.03	24.44	0.01	38.85
Ireland	11.27	12.50	32.70	0.73	-0.01	-0.39	-0.47	15.20	0.16	34.40
UK	11.92	20.33	30.90	0.62	-0.01	-0.30	-0.45	21.53	0.23	21.85
US	3.09	36.80	29.58	2.95	0.00	-2.64	-0.03	17.73	0.14	36.75
SA average	8.28	24.05	30.97	1.93	0.00	-1.61	-0.24	19.72	0.14	32.96
Total average	12.24	26.66	40.12	1.22	0.00	-0.81	-0.93	23.73	0.19	58.06

[1] All data are expressed in percentages, except λ. For the calculation of the variables, we refer to the text.

B Results of the overlapping generations model with heterogeneous agents

Figure B.1: Aggregate labor market performance in individual countries, OLG with heterogeneous agents model estimations

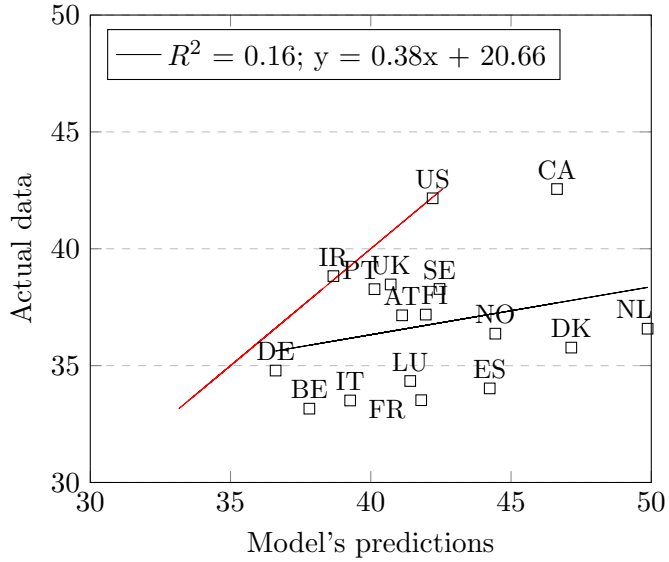

Figure B.2: Income inequality in individual countries, OLG with heterogeneous agents model estimations