DISCUSSION PAPER SERIES

IZA DP No. 7242

Using the EU-SILC to Model the Impact of the Economic Crisis on Inequality

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February 2013

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IZA Discussion Paper No. 7242
February 2013

ABSTRACT

Using the EU-SILC to Model the Impact of the Economic Crisis on Inequality[1]

In this paper we attempted to chart the impact of the early part of Ireland's economic crisis from 2008-2010 on the distribution of income. In order to decompose the impact of components of income, we utilised a microsimulation methodology the EU-SILC User Database. In order to do this we had to develop a simulation based methodology to disaggregate the main 6 benefit variables in the EU-SILC into 17 used in our tax-benefit model. Validating, our results were positive, giving us confidence in our methodology. We utilised the framework to model changes to the level of income inequality from the period just before the crisis in 2004 to after the crisis in 2010. In terms of the impact of the economic crisis, we found that the income inequality fell in the early part of the crisis, but rose steadily and then rapidly. Much of this change was due to rising inequality of market incomes, (even when discounting unemployment). This was due to the differential effect of the downturn on different sectors where some sectors such as the construction and public sectors were significantly hit, while the international traded sectors have been relatively immune from the downturn and have seen continued growth. The impact of the tax-benefit system has been to mitigate this upward pressure, with a gradual rise in the redistributive effect of the tax-benefit system driven by an increase in demand on the benefits side and increased progressivity on the tax side.

JEL Classification: I38, C53

Keywords: inequality, microsimulation, macro-economic change

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[1] The authors are grateful for helpful comments provided at the IZA-OECD conference in Paris and from two anonymous referees.

Using the EU-SILC to Model the Impact of the Economic Crisis on Inequality

1. Introduction

Ireland's economic crisis is well documented. After a very high growth period from the mid-1990's until the mid 2000's, growing grow 115% of EU GDP per capita, just below the EU15 average in 1997 to a high point of 148% in 2007, 32% above the EU15 average,[2] Ireland faced an unprecedented economic decline from late 2007. The period to quarter 4 2009 (the lowest quarter) saw a fall in GDP (in constant prices), a measure of national output, of 11.5% from its peak in quarter 4 2007 (the peak) and a fall in GNP, a measure of national income, of 15.6%. from its peak in quarter 4 2007 to its floor in quarter 1, 2011. At this point real GDP was equivalent to the value in quarter 4 2005 and GNP.

Whelan (2010) discusses some of the reasons and implications of the economic crisis. Firstly as a small open economy, it was inevitable that Ireland would be significantly affected by the global economic and financial crisis. The construction related boom that characterised the last years of the boom period saw the share of the workforce working in construction reach an unsustainable 13.7% of the work force in 2007, fully 5 percentage points higher than most other EU countries. In addition demographic changes were no longer contributing to economic growth as the size of the labour force peaked. Productivity growth had also slowed. In parallel lending by financial institutions tripled or quadrupled to property developers over the period 2004-2007 as the banks concentrated on the property sector.

The period of economic growth had also seen the composition of fiscal policy change from income taxes to property capital gains taxes and VAT, which were largely related to the property boom. The ending of the property bubble saw construction employment decline from 270,000 in early 2007 to 126,000 at the end of 2009 and government tax revenues see a sharp decline of nearly 18% as a result of this unemployment and also losing the tax revenues associated with construction, while public expenditure on transfers increasing from €18.7 billion in 2007 to €23.5 billion in 2009. The collapse of the property bubble left most of the Irish banks in precarious positions as a result of collateral collapsing as a result of the fall in property values in the region of 40%, resulting in the state stepping into guarantee the banks.

The economic crisis manifested itself in changes both to the labour market, wages, prices including housing costs and public policy changes to tax, transfer and public sector pay costs. Each of these changes have quite heterogeneous impacts on the population and it is difficult to understand a priori who is impacted most by these changes. It is quite important therefore from a public perspective to understand the distributional impacts of these changes.

The impact of this decline can be felt in the household sector in a number of dimensions. Public sector wages have been reduced via a number of policy changes which Callan and Nolan (2010) found to be progressive. Callan and Nolan (2010) examined the tax increases and welfare rate reductions between 2009 and 2010, again finding these policy changes to be progressive. As the crisis progressed, combined

[2] See EUROSTAT, GDP per capita in Purchasing Power Standards (PPS) 1997-2008.

with increases in mortgage interest rates, households with high mortgages have faced pressures in meeting payments. McCarthy and McQuinn (2010) have considered the distributional characteristics of the ratio of mortgage interest to income ratio, finding quite significant heterogeneity. Counterbalancing falls in income 2009 and 2010 saw falls in the CPI with differential changes across commodity groups. Loughrey and O'Donoghue (2011) examined the distributional impact of these price changes.

Nolan et al, (2011) have utilised the EU-SILC to understand changes in inequality over time around the crisis. However comparing the income distribution of one year with another using micro-data we may have a confounding effect of labour market and population change on the one hand and policy change in the other. To decompose this effect, we would like to compare the counter factual effect of differences due to tax-benefit changes alone. Microsimulation analysis is particularly useful methodology for counter-factual simulation, which can help to explain the functioning of the tax-benefit system relative to alternatives.

Microsimulation modelling is a simulation based method using micro-data that is typically used to assess the impact of policy changes. In Ireland, the SWITCH model (Callan et al., 1994) has been used for 20 years to assess the impact of policy change on inequality (Callan et al., 2001). Callan et al. utilise a special version of the EU-SILC dataset available for Ireland for 2008. Callan et al. (2012, 2011) have been used to assess the impact of budgetary policy relative to a base population in 2008 adjusted for population and labour market change using reweighting and updating.

In this paper we would like to understand changes in the distribution of income over the period of the EU-SILC 2004-2010, tracking the period before and after the crisis until the crisis levelled out. In particular we would like to assess the distributional impact of individual policy changes. Given a number of challenges associated with the EU-SILC (Figari et al., 2007), we have developed a microsimulation model of the Irish tax-benefit system for each year to understand the impact of individual taxes and benefits to help decompose this impact. In particular the paper proposes a method to overcome some of the challenges in using the harmonised EU-SILC for microsimulation modelling.

Section 2 describes the tax-benefit microsimulation methodology used in this paper. Section 3 describes recent trends in the macro-economic situation, while section 4 describes the data requirements of utilising the EU-SILC for microsimulation modelling. In section 5, we consider the impact of labour market changes over the period 2005-2009, while section 6 describes the welfare impact of labour market and tax-benefit changes. Section 7 concludes.

2. Methodology – Tax Benefit Microsimulation

Methodologically, the focus in this paper is in understanding the way in which the Irish tax-benefit system has changed over time. In this section, we describe the data requirements for modelling the system.

Changes in income inequality depend not only upon changes in market income, but also changes in tax-benefit policy. The Irish tax-benefit system falls within the Anglo-

liberal category of welfare states, social transfers have primarily a poverty reduction focus based around flat rate insurance benefits, or means tested benefits.[3]

There are no earnings related components of the benefit system. The income taxation has a schedule with two rates and has an optional joint filing system with partial transfer of bands and credits. The 2000's have seen a move away from allowances to credits payable at the standard rate. Social insurance contributions are flat rate with a floor and a ceiling on payments. Increases in the value of credits has seen a gradual erosion of the tax-payer base over time, with 650000 of 1.9 million tax-payers exempt in 2005 and 40% in 2007.

Disposable income, defined as income after direct taxation and social benefits is calculated through the use of a static tax-benefit microsimulation model, programmed in Stata. The model simulates the main direct tax and transfer instruments

- Income Taxation
- Social Insurance Contributions (Employee, Self-Employed and Employer)
- Income and Pension Levies
- Family Benefits
- Social Assistance Benefits
- Social Insurance Benefits

Using the tax-benefit model only the level of payment of social insurance benefits are modelled, with eligibility being assumed to depend upon receipt in the data, within this paper. The tax-benefit system is stylised, focusing on the main instruments, but ignoring some tax-credits and housing related benefits.

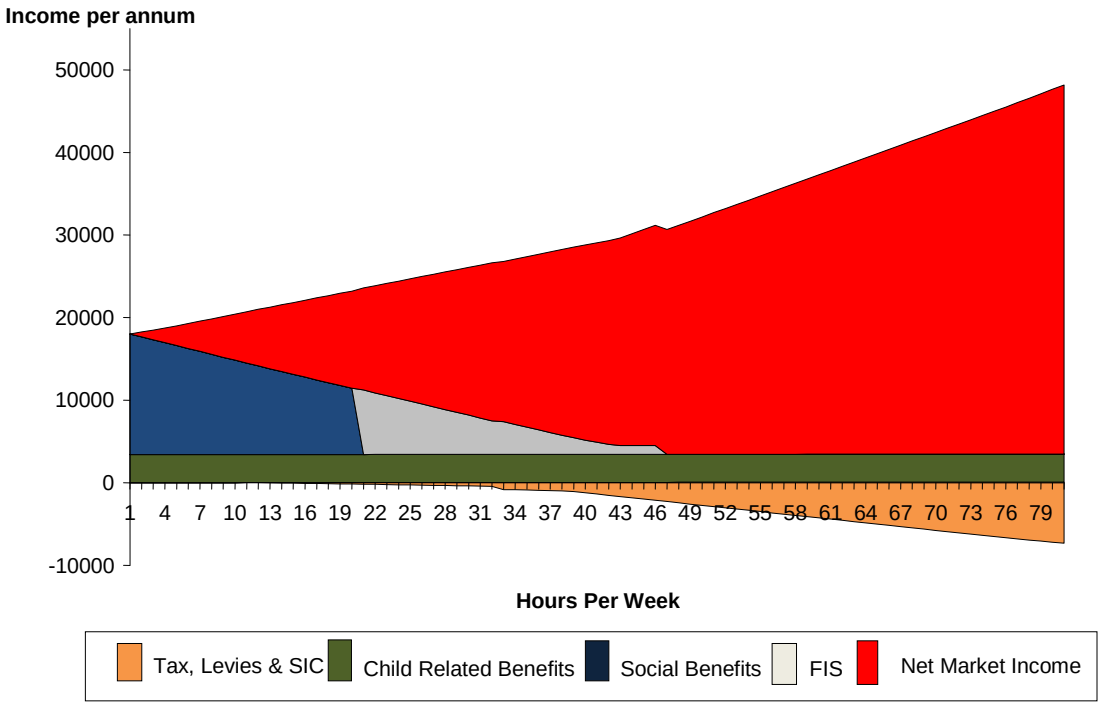
In figure 2, we describe the functioning of the tax-benefit system, simulating this system in 2005 for a hypothetical family with single earner married couple with two children simulated using the tax-benefit microsimulation model used in this paper. The main earner has a wage rate of two thirds of the average wage rate per hour, with hours varying from 0 hours (and seeking work) through to 80 hours per week.

In the figure we describe the different components of disposable income, which is equivalent to the top of the graphic. Disposable income is comprised of net market income, equal to gross market income minus income taxation, social insurance contributions and income levies. Unemployment assistance is paid at zero hours and gradually tapered away with a 60% withdrawal rate up until 20 hours per week is worked. Once this 20 hour limit is reached a family income supplement (FIS), an in-work cash benefit for low income families, is paid. Child related benefits, including child benefits and from 2006 a child care subsidy for young children are also included.

In figure 2, we report trends in the overall budget constraint over the period of respectively 2003-2007, the period up to the crash and for 2007 to 2012, the period after the crash. These budget constraints reflect the disposable income associated with different hours worked at the averages, deflating by the CPI to account for changes to purchasing power. Wages are assumed to grow at the average rate for industrial employees.

[3] For a broad description of the structure of the Irish tax-benefit system, see O'Donoghue (2004).

Figure 1. Budget constraint diagram for 2005 tax-benefit system (with detailed decomposition of disposable income)



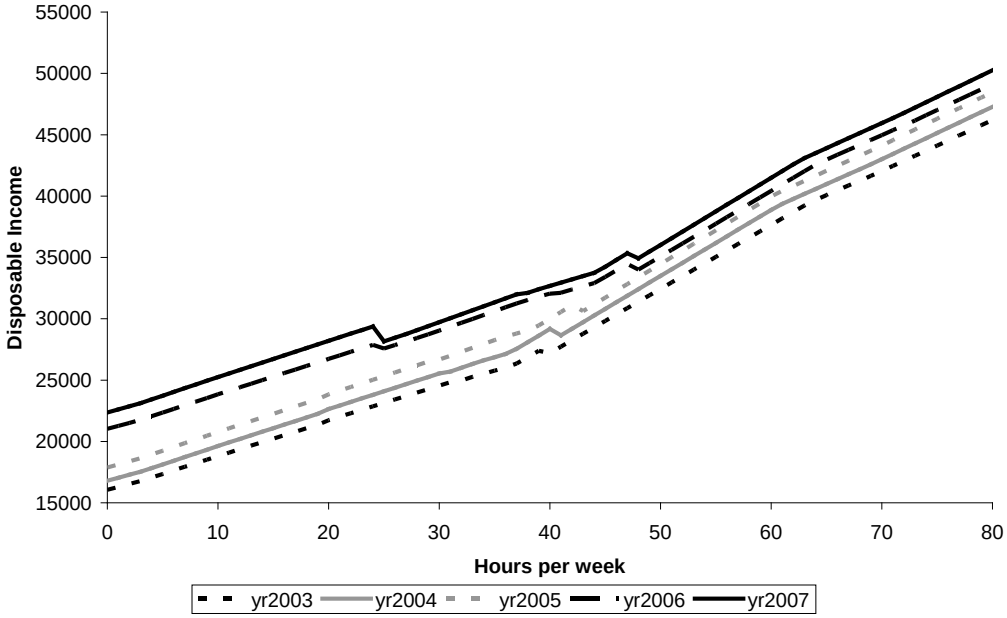
Note: We assume here a single earner married couple with 2 children, aged X and Y, with no direct housing costs for simplification. The main earner has a wage rate of two thirds the average wage.

The main changes to the structure of the tax-benefit system have been outlined in Appendix 1. Most changes have been parametric, with some structural changes to "income levies" or additional taxes, social insurance contributions the introduction and abolition of a childcare supplement. Some of the changes applied to part years. In order to incorporate this, looking at annual incomes, we apply a proportion of each set of policy parameters to the appropriate number of months.

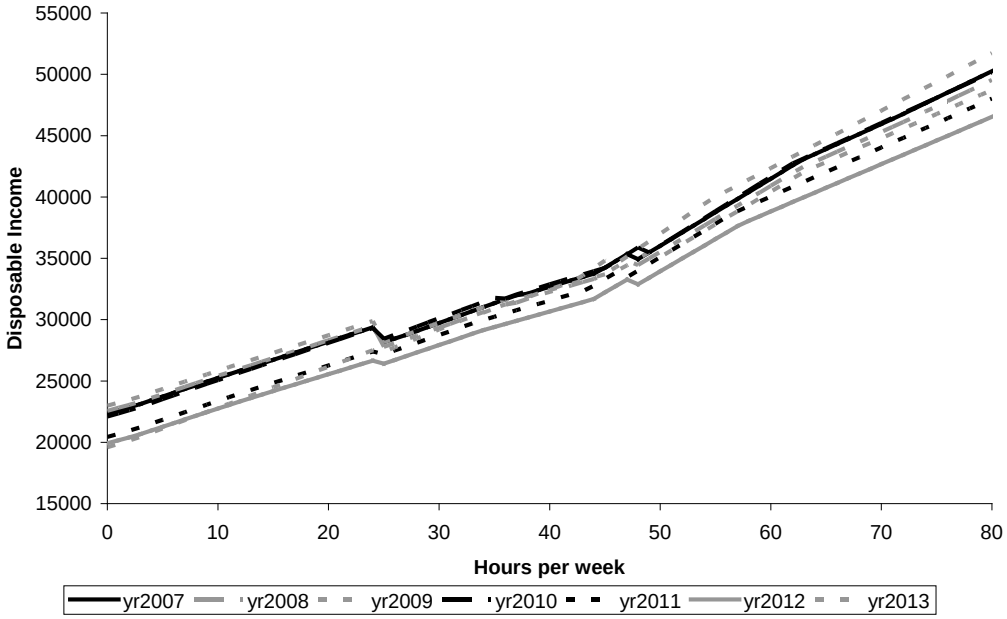
In the period to 2007, we notice that the overall budget constraint flattens, with ratio of disposable income for 40 hours to 0 hours decreasing from 1.70 in 2003 to 1.45 in 2007. It also continues to fall 2009 at 1.39, before rising again. The period to 2007 sees a steady rise in the level of the budget constraint as the purchasing power for all parts of the budget constraint rose as wage and benefit growth outstripped inflation. In 2008, the budget declined slightly at the top. In 2009, the purchasing power of the bottom of the distribution rose slightly, but fell at the top, with the reverse occurring in 2010. In 2011, purchasing power fell for most groups, with the bottom falling slightly more. Purchasing power continued to fall across all income levels in 2012. However in 2013 the system becomes more regressive, with purchasing power rising at the top as we make the assumption that earnings will grow at the same rate as the previous year, the same assumption that is made for CPI.

Table 1. Budget Constraint Diagram for tax-benefit systems

(a) 2003-2007



(b) 2007-2013



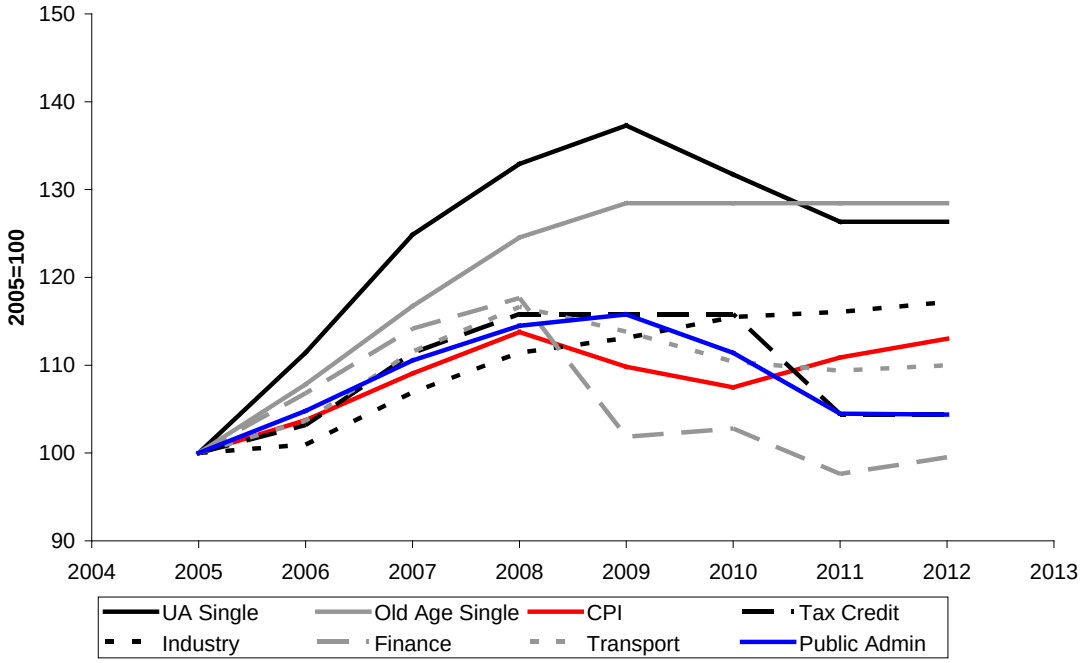
Note:

1. We assume here a single earner married couple with 2 children, aged X and Y, with no direct housing costs for simplification. The main earner has a wage rate of two thirds the average wage.
2. The budget constraints have deflated by CPI to reflect purchasing power. Wages have been assumed to grow in line with average wage growth

In figure 2, we consider some of the components that drive these changes, reporting changes in the values of sectoral wage rates, CPI, tax credits and benefit levels. It is be necessity only a snap shot of a number of the changing parameters. To consider the impact of changes against purchasing power, we focus first on CPI, which rose to 2008, but then Ireland experienced deflation to 2010, before prices rose again to 2012. Working age unemployment benefits have risen the most relative to CPI, even with a

nominal cut in 2009 and 2010.[4] As old age benefits incurred no nominal cut, by the end of the period, even with no nominal rise since 2009 purchasing power increased for this group. Tax credits initially rose at a rate close to CPI, but then nominal cuts relative to rising CPI saw the index dip below CPI and thus leading to fiscal drag. Of the 4 sectors considered, the financial sector, given the banking collapse has seen the largest fall relative to CPI, with industrial, largely export based sector having wage growth exceeding CPI.

Figure 2. Growth Rate of Components of the Tax-Benefit System relative to Prices and Incomes



Note: UA – Unemployment Benefit rate

Data Requirements

In order to simulate taxes or benefits, we require data with the following characteristics

- A dataset representative of the household population with appropriate weights, with sufficient sample size for sub-groups to undertake disaggregated analysis
- Data that has incomes before the application of incomes (gross incomes)
- The period of analysis may vary from instrument to instrument too, with income taxes typically assessed over a year (which may or may not align with the calendar year), while some benefits may have a period of analysis of a month. Sometimes the period of analysis for payment of a benefit (current month), may differ from the period of analysis of the means for assessment (e.g. previous year). However very few datasets allow for such heterogeneity

[4] There were much more significant cuts for young people.

3. Data

Understanding the impact of changes in labour market, incomes and policy measures required data with sufficient detail. SILC is a dataset that has been collected in Ireland since 2003 and is the successor to the earlier European Community Household Panel Survey. The SILC dataset collects information on incomes, labour market characteristics, demographics and living conditions and is used to undertake analyses on poverty, inequality and deprivation.

The EU-SILC is collected at the national level, with harmonised version supplied to Eurostat, which is then processed and provided to researchers as a harmonised User Database (UDB). We utilise the Irish component of the EU-SILC (UDB) in which to model the income distribution. Data are provided gross of taxes and contributions.The Irish component uses partially survey and partially register data. 80% of respondents allowed their national social security number to be used to access administrative data in relation to their benefit entitlement (Callan et al., 2010).

A national weighting methodology is utilised incorporating constraints based upon (sex, age-group, region, household composition) based upon a combination of population projections based on the Census and from the Quarterly National Household Survey (Callan et al., 2010). It should be noted however that although the weights are representative of the population structure, they are not fully representative of either the social transfer recipients not of the taxable income distribution. Callan et al., (2010) proposed a reweighting methodology based upon external data to improve the representativity in this dimensions. As the purpose of this paper is to understand the difference using the EU-SILC definition of income and associated weights, we do not make this adjustment here.

There are however a number of challenges to utilising the EU-SILC for microsimulation modelling.

Given the availability of parental and partner ID variables, it is possible to generate most (within household) units of analysis required by a tax-benefit system. However the data is not sufficient, where instruments require knowledge about inter-household units of analysis, say for higher education grants.

A challenge in the use of the EU-SILC rests in the difference between the period of analysis for the income variables, which typically are the previous year and the personal characteristics which typically relate to the time of interview. Thus one may observe people made unemployed in the interview year but with employment income in the data. Thus there may be inconsistencies between both. Ireland has a slightly different definition as the reference period spans two tax years as the "income reference period" is "12 month prior the date of interview", the end of income reference period is the date of the interview. Approximately 25% of the sample is collected in each quarter.

As both tax-benefit models and the EU-SILC, aim to measure household disposable, income, by and large, the EU-SILC has the appropriate variables required for tax-benefit modelling. However there are a number of issues. Firstly there are some missing variables such as capital gains and wealth or property values. However this is typical of most income surveys and so most tax-benefit microsimulation models make look at a definition of disposable income that does not incorporate taxes based upon

these measures. It would be reasonable therefore for an EU-SILC based model to make a similar assumption.

A particular challenge to microsimulation modelling is that some of the variables are not easily attributable to the appropriate unit of analysis. For example some of the income variables that are received by individual such as capital income, rental income, private transfers, young person's income, are only recorded at the household level. Thus in practice these variables will be assigned to the head of household, which in a progressive tax system, may over-estimate the amount of taxation if some of these incomes were incident on others in the household. This is also the case with family benefits which may be incident at the nuclear family level but are only recorded at the household level. Where these instruments are taxable, this too may bias the results.

One of the most serious challenges to using the EU-SILC for microsimulation modelling is the aggregation of benefits. Within the EU-SILC, social benefits are aggregated into 6 benefits recorded at the individual level (unemployment, old-age, survivor, sickness, disability and education) plus 3 recorded at the household level (family, social exclusion, housing benefits). If it were possible, utilising other data to model all benefits, then this aggregation would not be an issue, as we could replace the data recorded benefits with the simulated benefits. However, while in practice we model most benefits in Ireland as there are no earnings related benefits, we model the value for most benefits. The Irish social science data archive makes available a variant of the SILC for Ireland with disaggregated benefits. However this dataset is not suitable for tax-benefit microsimulation modelling as incomes are aggregated to the household level and some variables such as age have been banded.

As we do not know the contributory conditions used for social insurance benefits, we would like to utilise benefit receipt to model the level of these benefits. For most social assistance and family benefits, we have sufficient information to model the benefit. Callan et al., (2010) have access to a special research version of the 2008 EU-SILC which does not suffer from these aggregation issues.

It should be noted however that even where we can fully model an instrument, because of benefit take-up issues, we would still like to know the value and presence of the benefit so that take-up can be modelled; although many models assume 100% take-up.

A similar issue to benefit take-up is the use of survey data to make inferences about mis-calculation of taxes and social insurance contributions. Ideally therefore taxes and social contributions would be available separately at the most appropriate unit of analysis. However within the EU-SILC, they are reported at an aggregated level in terms of the instruments being reported in a single variable and at an aggregate level in terms of being reported at the household level. However this is not a major issue as many income datasets do not have separate income tax and social insurance contribution data.

In general the EU-SILC has a relatively good availability of appropriate expenditures used in the tax and benefit system, particularly containing mortgage interest, private pension contributions and other housing costs. However in common with other income surveys, there is missing information on other deductible expenditures including medical insurance etc. The survey also does not contain the value of the

residential property, which from 2013 is required in Ireland to model a local property tax.

4. Statistical Model: Benefit Disaggregation and Property Value Estimation

As identified in the last section, there are a number of barriers to utilising the EU-SILC for microsimulation purposes. A challenge in this paper is to impute disaggregated benefit entitlement. Figari et al. (2007) describe a methodology developed by Levy and Mercader (2003) for disaggregating benefits in the Spanish EU-SILC. They required splitting:

- Unemployment benefits into 2 disaggregated benefits
- Old Age Benefits into 3 disaggregated benefits
- Survivor's Benefits into 2 disaggregated benefits

Unemployment benefits in Spain can be split relatively easily as insurance benefits cannot fall below 75% of the minimum wage and assistance benefits are equal to 75% of the minimum wage (although income tested, they are not means tested). Old age benefits, except for an old age supplement that is income contingent, are relatively straightforward to disentangle as they do not overlap in terms of value. Survivor's Benefits are imputed in a similar way. Child Benefits can more or less be modelled on the basis of information in the data.

However the Irish case is (as is likely the case in many northern European countries) more complicated. This is due to the fact that there are more instruments (See table 8 in the appendix) with more complicated rules and with overlapping values between instruments.

Methodology

In order to impute the value of these benefits at a disaggregated level, we need to understand the characteristics associated with the receipt of each benefit and then to simulate, given the receipt of an aggregated benefit group, the value of a benefit at each level.

The first objective therefore is to estimate a series of statistical models relating entitlement to a disaggregated benefit as a function of the aggregate benefit. To disaggregate these variables into their benefit components, we utilise the fact that an earlier survey, the Living in Ireland Survey (LII) 1994-2001 contains disaggregated benefits. We estimate equations of benefit entitlement in the LII and use these estimates to simulate entitlement to disaggregated benefits in the SILC data. It is in effect a parametric statistical matching method. We based this relationship on demographic characteristics, existence of other incomes, labour market characteristics of the recipient and spouse.

Depending upon whether the dependent variable is binary as in the case of survivor's benefits or old age benefits or have more than 2 categories as in the case of unemployment or disability benefits, we utilise respectively a multinomial logit model.

Table 2. Benefit Disaggregation Equations (Unemployment Benefits) – Multinomial Logit

Dependent Variable Category	Unemployment Means-tested Assistance Receipt	Back-to Work Allowance Receipt	Pre-Retirement Allowance Receipt
Male	0.898***	0.088	-0.904
Aged 55+	-0.447	-0.875	3.816
Lose Job in Last Year	-0.177	-0.339	0.336
Value of Social Welfare Benefits	0.835***	2.355***	0.89
Employment Earnings	-2.432***	-0.918	-22.142**
Employee	0.37	5.851***	-36.643
Farmer	1.717**	0.988	0.398
Self-Employed	2.586*	8.598***	-42.89
Unemployed	0.355	-36.824	-1.375
Spouse in-work	0.23	-1.263*	0.497
Inactive	0.135	-36.009	0.888
Retired	-44.891	-40.393	7.074***
Age	0.042	0.088	-0.213
Age squared	-0.001	-0.001	0.003
Married	-0.274	-0.25	0.842
Widowed	37.636	38.453	-1.628
Separated or Divorced	-0.455	1.105	1.524
Number of Children aged 0-11	0.074	0.646**	-2.045
Number of Children aged 12-15	0.238	1.017**	0.992
Constant	-1.146*	-8.792***	-0.751
Pseudo R squared	0.5023		

Note: The base case here is not in receipt of benefits.

We choose as explanatory variables, characteristics that may be associated with the type of dependent variable. So for example for unemployment benefits, we would expect those over 55 to be more likely to claim the pre-retirement allowance. Those with higher household current market income will more likely to be in receipt of social insurance benefits. For similar reasons, those with in-work employment status will be more likely to be in receipt of social insurance. The self-employed are typically not eligible for social insurance benefits. As benefits give additional payments for dependents, and thus the taper for a means tested benefit will extend longer for a larger family, making larger families more likely to be in receipt of a means tested benefit. By its nature, those in receipt of a back to work allowance are more likely to be in-work than for the other benefits. Table 2 confirms these results for unemployment benefits. The pseudo R2 indicates a reasonably good fit.

For survivor's benefits, the distinction is between means-tested and insurance benefits. In table 3, we see as in the case of unemployment benefits that those in receipt of other incomes are less likely to be in receipt of means tested benefits. However older people are more likely to be in receipt. The fit of the model is not very good and this gets progressively worse over time, as by 2010, only about 2% of recipients receive means tested survivor's benefits. There is s a similar relationship for old age benefits. As only the Old Age (Transitory) Pension, modelled as part of the insurance pension here, requires one to retire from the labour market, we notice that receipt of the insurance pension is highly significantly related to being retired. As in

the case of survivor's benefits, share in receipt of means tested benefits has fallen over time.

Table 3. Benefit Disaggregation Equations (Survivor's Benefits)

Dependent Variable:	Survivors Assistance Pension Receipt
Male	-0.42
Value of Other Benefits	0.143 **
Value of Social Welfare Benefits	-4.073 **
Other Household Income	-0.957 **
Employment Earnings	-3.719 **
Employee	1.114 **
Retired	-0.056
Age	0.054 **
Age squared	-0.001 **
Number of Children aged 0-11	-0.007
Number of Children aged 12-15	0.246
Constant	1.742 **
Pseudo R squared	0.108

Table 4. Benefit Disaggregation Equations (Old Age Benefits)

Dependent Variable:	Old Age Insurance Pension Receipt
Male	-0.496***
Value of Other Benefits	0.21***
Value of Social Welfare Benefits	-0.971***
Household Income	-0.422***
Employee	-1.145
Retired	-1.157***
Age	0.476*
Age squared	-0.003*
Married	-0.313
Widowed	-0.525**
Separated or Divorced	0.042
Number of Children aged 0-11	0.097
Number of Children aged 12-15	0.287
Constant	-18.745**
Pseudo R squared	0.1678

Again for disability benefits we observe the same pattern in relation to means tested benefits with higher other income sources reducing the likelihood of receipt. Unsurprisingly, chronic illness is relatively more important. Carer's meanwhile are more likely to be younger and have more children.

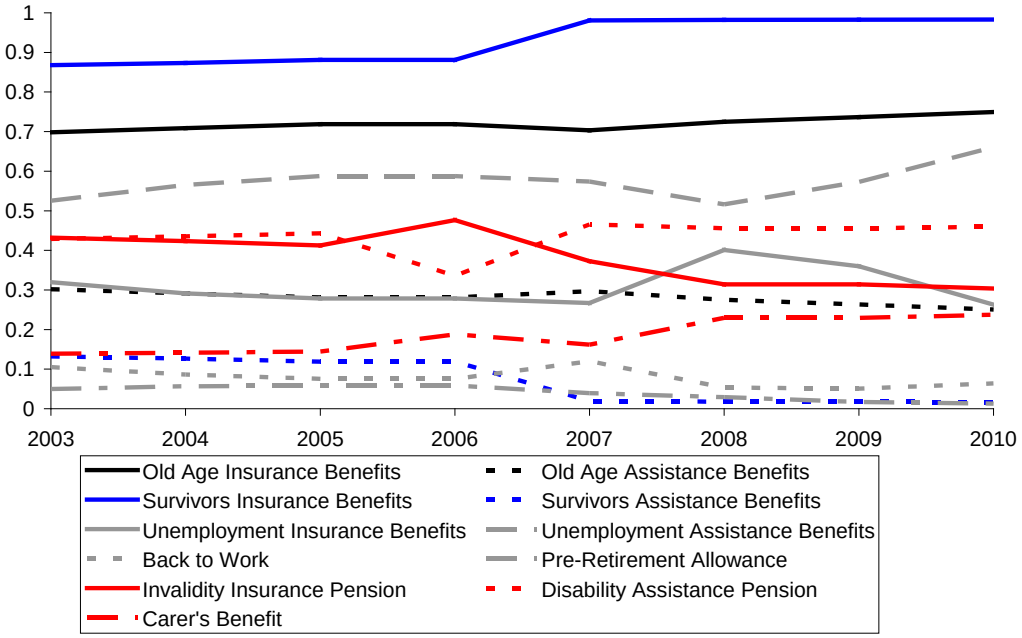
Table 5. Benefit Disaggregation Equations (Disability Benefits) – Multinomial Logit

Dependent Variables	Long-Term Disability Assistance Benefit Receipt	Carers Allowance/Benefit Receipt
Male	-0.524	-0.688
Lose Job in Last Year	-0.055	0.192*
Value of Social Welfare Benefits	-0.953**	-1.21**
Household Income	0.255	0.389
Employment Earnings	-2.986*	0.422
Employee	-0.055	-0.437
Chronic Illness	1.307***	-37.911
Retired	-2.016*	-35.843

Age	0.019	-0.139**
Age squared	0	0.002*
Married	-2.331***	0.041
Widowed	36.067	-1.251
Separated or Divorced	-2.906**	0.937
Number of Children aged 0-11	0.022	0.926***
Number of Children aged 12-15	0.077	-0.23
Constant	1.373	1.624
Pseudo R squared	0.3661	

Note: The base case is not in receipt of benefits.

Table 6. Calibration Totals for Benefit Disaggregation



Source: Department of Social Protection Statistics

Conditional on receipt of an aggregate benefit in the data, we utilise these equations to simulate the disaggregated benefits. These regressions are then utilised to simulate benefits in the SILC, using proportions with aggregated category consistent with Social Welfare Statistics. We note that as the Irish social insurance system matures and as economic change occurs, the balance between different benefits changes, for example the share of survivor's insurance benefits approach 100%. As the economic crisis arose in 2008, the share of those in receipt of short term unemployment benefits rose, before falling as the share of longer termed unemployed rose. The economic crisis has also seen a rise in the share of means tested disability benefits. We utilise the equations to predict the disaggregation of highest probability and then rank this variable to select the most likely disaggregated benefits.

This imputation was evaluated against the actual data and was found not to be completely precise as a small number of individuals were predicted by these equations to receive means tested benefits, but had means too high to be eligible.

In order to evaluate this we had to run the tax-benefit system. However as noted above the Irish component of the EU-SILC has incomes that span two tax years. In

order to get a more accurate measure we run the tax-benefit system for the data interview year and for the preceding year, taking a weighted average depending upon the quarter of interview.

In order to correct these problems; individuals who were simulated to receive assistance benefits but not eligible under the precise rules were given eligibility for contributory benefits and a corresponding number of those with insurance benefits were given eligibility for assistance benefits. A second iteration of the tax-benefit system was then used to calculate the value.

Adjustments were also made for some measurement error. For example some individuals of pension age were classified as being in receipt of working age benefits. In this case we assume a classification error and transform them to old age benefits. Where working age people are in receipt of state pensions, we transfer these to occupational pensions.

There are some period effect issues also where multiple income replacement benefit receipt occurs during a single year. As the data does not contain information on the number of months of receipt of different benefits, only the total, we make the assumption that the dominant benefit (i.e. the one with the higher value) is received for 12 months. The latter assumption is likely to bias upwards benefit receipt as it will overstate the benefits of those in receipt for less than 12 months.

A further adjustment is also made as the SILC data contains some private sector social protection instruments such as redundancy payments and some private pensions. Amounts over and above state social protection instruments, calculated using the tax-benefit model, are transferred into market income variables.

Validation

Before going further, we undertake a validation of simulation of taxes and benefits. We firstly in table 7 consider the non take-up rate at the aggregate level. Combining all benefits the non-take up rate is about 5-6 percent, rising slightly over time. The non-take-up rate is highest amongst those in receipt of survivor's benefits and lowest amongst the elderly. To some extent non-take-up is underestimated in the data as much of the entitlement is generated by construction.

Table 7. Non take-up rates by instrument

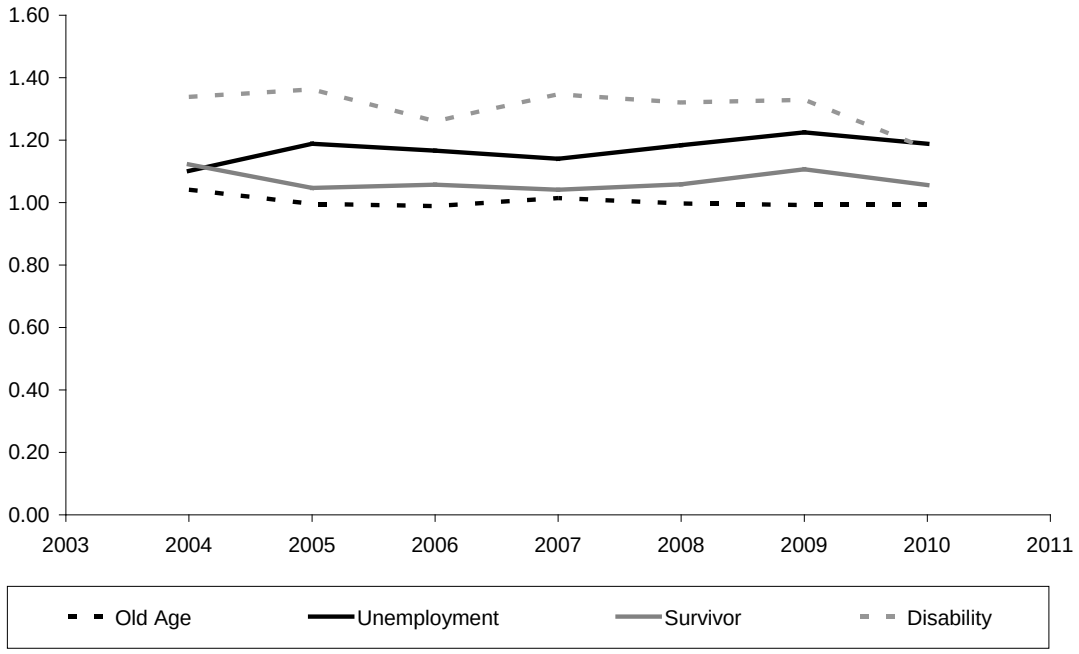
Take-Up	2004	2005	2006	2007	2008	2009	2010
Old Age	2.8	2.1	1.7	1.9	2.8	2.7	2.8
Unemployment	8.0	9.8	9.5	8.6	7.8	9.1	8.7
Survivor	19.0	18.8	19.0	21.4	11.2	9.6	14.8
Disability	6.1	6.7	9.1	8.9	7.1	9.5	8.7
All	5.2	5.1	5.3	5.3	5.1	6.1	6.2

Note: Non take up is modelled at the aggregate benefit level, at the individual unit of analysis

The next point of concern arises from the annual period of analysis. Without any data on the number of months of benefit receipt, we make the assumption of 12 months of receipt. Thus our methodology will tend to over-estimate insurance benefits for those with alternative income sources. In order to assess the effect of this, we utilised the equations predict the likely receipt of disaggregated benefits, then simulated the value of each benefit and then re-aggregated them again to be able to compare with the equivalent characteristics in the data. One source of variation from 12 months is the

presence of other sources of income, particularly for income replacement benefits. In order to avoid this confounding issue, we compare in figure 3 simulated with actual data for benefits only for those without another labour income source. We note that for old age and survivor benefits, which are long-term and largely continuous, the average ratio of simulated to actual is close to one. For more transient instruments related to spells in unemployment or illness, the ratio is much higher indicating the existence of spells.

Figure 3. Ratio of Average Benefit of Simulated to Actual Benefit



Note: For the purpose of this figure, we assume full-take up in the simulation and consider households with no alternative income sources.

5. Results: Distributional Impact of Downturn

In this section we report the results of our analysis based upon our model. We firstly track mean incomes via components market income, gross income (market plus benefits) and disposable income (gross minus taxes and contributions). We have deflated by CPI to report the change in purchasing power. Each measure exhibits the same trend, rising to 2007 and then falling to 2010. We note that average market income is lower in real terms in 2010 than in 2004. However both mean gross income and disposable income are at levels equivalent to 2005. We note for each measure the high of actual data to simulated data. Gross income is slightly lower reflecting issues associated with take-up and issues associated with the length of benefit receipt in a year. The ratio remains relatively constant over time.

Table 8. Mean Equivalised Household Incomes (Actual and Simulated)

Market Income	2004	2005	2006	2007	2008	2009	2010
Simulated	20972.05	21781.42	22991.5	24883.61	23496.18	21961.61	19628.753
Data	20861.8	21670.4	22891.8	24739.5	23360.4	21803.7	19496.66

	5	1	1	7	1	7	5
Ratio	0.99	0.99	1.00	0.99	0.99	0.99	0.99
Gross Income	2004	2005	2006	2007	2008	2009	2010
Simulated	25738	26933	28659	31177	30402	29115	27127
Data	24720	25916	27595	29975	28995	27613	25500
Ratio	0.96	0.96	0.96	0.96	0.95	0.95	0.94
Disposable Income	2004	2005	2006	2007	2008	2009	*2010*
Simulated	21059	21927	23235	25170	24666	23182	*21518*
Data	21007	21601	22970	25091	24401	22994	*21434*
Ratio	*0.99*	*0.99*	*0.99*	*1.00*	*0.99*	*0.99*	*1.00*

Notes:

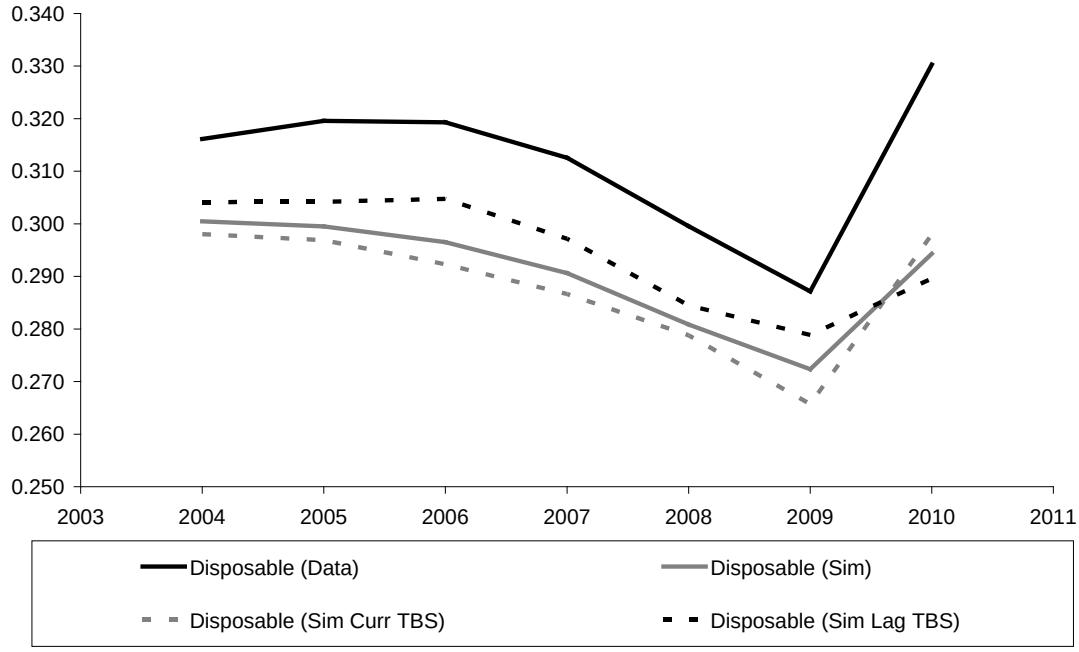
1. Equivalence scale used is the modified OECD scale.
2. For validation purposes, we have not used weights in this table

Inequality

In figure 4, we report the trend in the inequality of equivalised household disposable income over time. We note that inequality fell from 2004 to 2009 and then rose significantly in 2010. Thus the initial impact of the crisis in 2008 and 2009 was inequality reducing, while inequality increased rapidly in 2010.

We validate the microsimulation model by comparing actual and simulated Gini's. The data year's in the Irish EU-SILC, span 2 years as incomes apply to the 12 months before the interview date, with interviews conducted more or less equally across the year. As a result we model the simulated year as the weighted average of the current and lagged year as a function of the quarter of data collection. We also report the simulation of tax-benefit systems in the current and lagged year. We note firstly due to reasons such as benefit non-take up and specification issues in the simulation of taxation such as the inability to model specific allowances, as well as tax evasion and avoidance, that there is a gap between the level of the Gini for simulated and actual equivalised disposable income. This is not surprising and consistent with other microsimulation analyses. For the period to 2009, there is not much difference in the trend between the different assumptions, with a correlation of about 0.98. However the trend shifts in 2010, with the current system matching much more closely the trend, resulting in a correlation over the whole period of 0.95. Meanwhile the lagged system has a different trends (rising, but at a lower rate), with a correlation of 0.68, resulting in the weighted average also growing at a relatively lower rate between the two measures, with a correlation of 0.88. We would therefore conclude that the current tax-benefit system is a better predictor of trend than the lagged or weighted average.

Figure 4. Distribution of Disposable Income, Simulated and Actual



Note: Equivalence scale used is the modified OECD scale.

We now try to understand the differences in the levels between the actual and simulated data as a result of the assumptions made. We focus first on the assumptions made in relation to the benefits system. We consider three alternatives, modelling

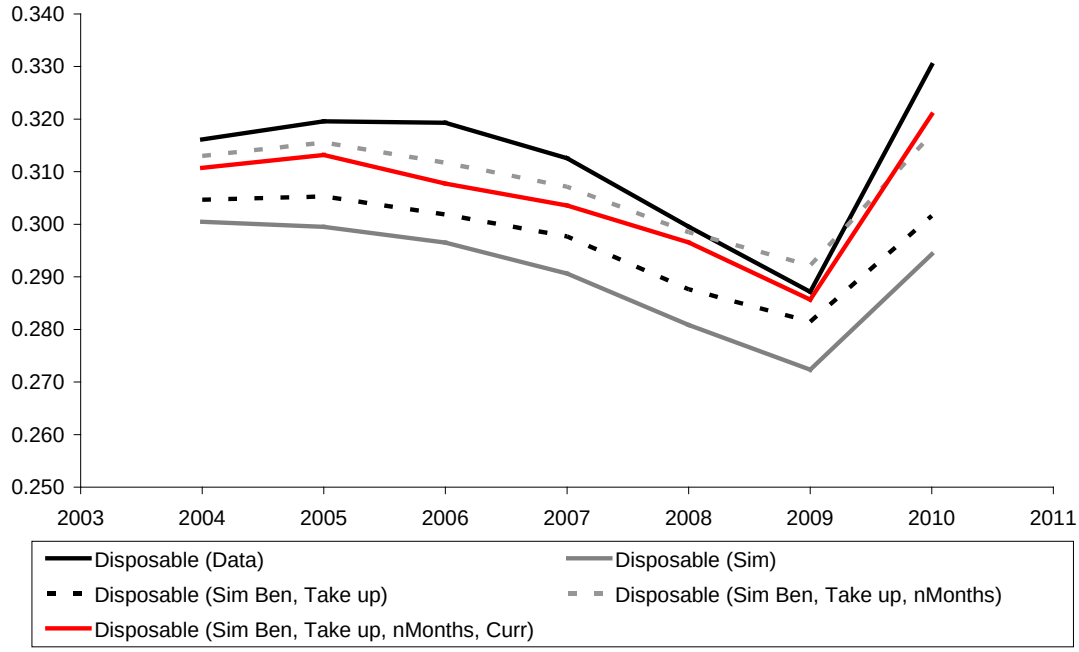
- Non take-up with the weighted average of current and lagged systems
- Non take-up and an estimate of months of benefit receipt with the weighted average of current and lagged systems
- Non take-up and an estimate of months of benefit receipt with the current system

We model take-up at the level of the benefit unit level. Take-up regressions are reported in appendix 3. The coefficients follow the usual signs, with the higher the potential benefit receipt, the higher the take-up. Higher other sources of household income results in lower take-up. Similarly, being in employment increases take-up, while farmers have a lower take-up than other groups. Separated or divorced are less likely to take-up benefits than other groups. Interestingly, prior to the boom, those with higher education had a lower propensity to take-up social benefits, while after the crash, this effect become non-significant.

Modelling benefit non-take-up at the family level, we see that the inequality trend over time remains the same, with curve shifting about a quarter to a half of the gap closed. As noted above, part of the reason for the over-simulation of benefits, is that it is not possible to identify in the EU-SILC data, receipt of benefits of less than a year. Imputing the number of months received on the basis of the difference between actual and simulated benefits, we see that much of the remaining gap is closed in figure 5. In 2009, this over-compensates pushing inequality over 100%. However this is as a result of utilising the weighted average of the two years. Utilising only the rules of the current year, we see that inequality tracks but is always lower than the actual data.

This is consistent with the fact that we have not modelled misspecification in modelling taxes and contributions.

Figure 5. Distribution of Disposable Income, Simulated and Actual with different Benefit Assumptions

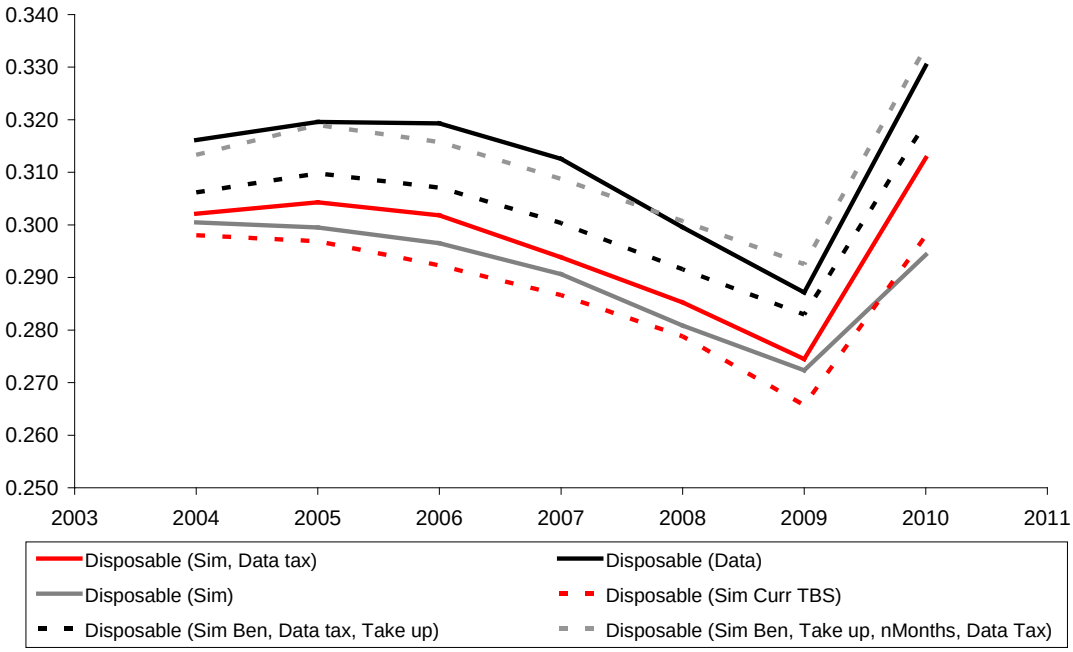


Note: Equivalence scale used is the modified OECD scale

We now consider the impact of misspecification in the modelling of taxes and contributions. We do this by replacing the simulated value for taxes and contributions with the variable supplied in the data. We note in figure 6 that prior to 2009, that replacing simulated taxes and contributions (based upon a weighted average of two years) with the actual value had quite a varied effect, reducing the gap by between 10% and 50%.This effect is much more consistent however at 30-40% when one looks at the change in the gap between actual and simulated based upon the current tax-benefit year. We note however that gap is reduced by a greater degree by improvements in the benefit assumptions.

We now try to understand the trend in different components. We firstly focus on the distribution of market income as measured by the Gini coefficient. We note in particular that the trend in the distribution of market income (excluding zero's) was increasing to 2006, before falling slightly relatively flat in the period before the crisis. After 2007 market inequality widened firstly quite steadily to the 2009 and then very significantly between 2009 and 2010, as the wage rate of some sectors such as industry rose, while declining sectors experienced oftentimes falls in nominal wages. This is consistent with the story in figure 2 above.

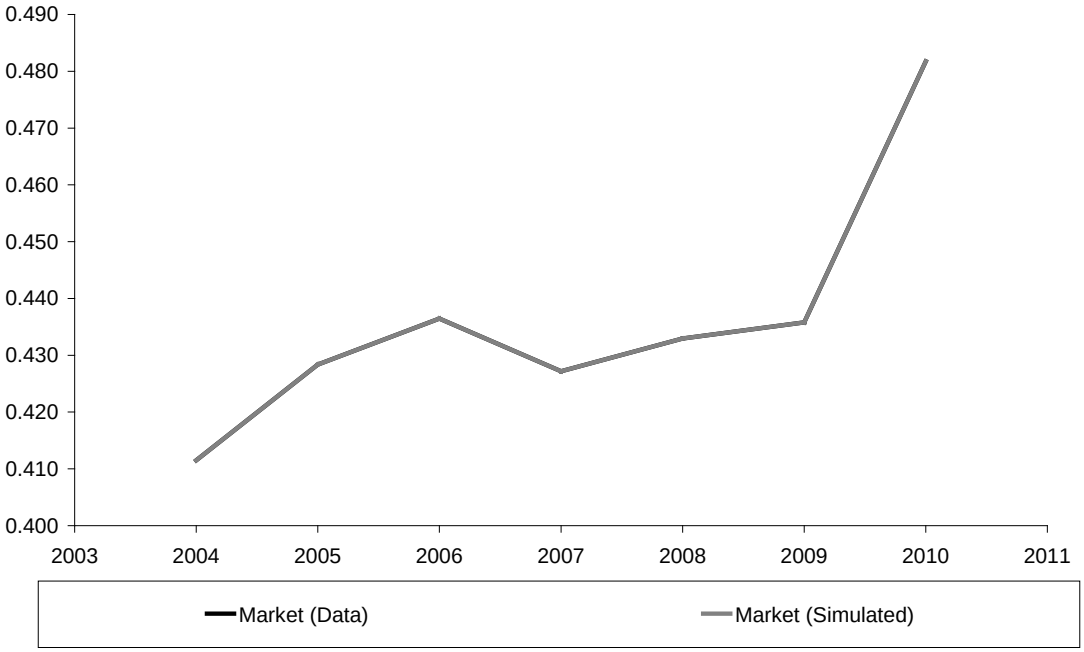
Figure 6. Distribution of Disposable Income, Simulated and Actual with different Tax Assumptions



Note: Equivalence scale used is the modified OECD scale.

Market Impact

Figure 7. Distribution of Market Income, Simulated and Actual



Note: Equivalence scale used is the modified OECD scale.

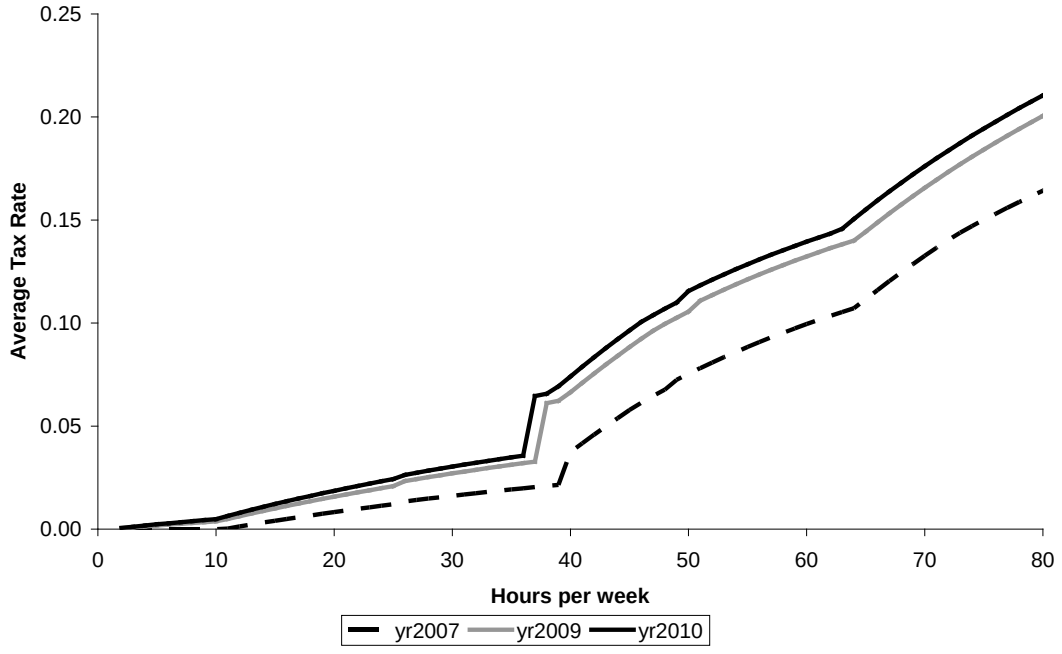
Redistributive Impact

We turn now to the impact on changes to the distribution of income that results from changes to policy. We measure redistribution relatively simply, comparing the change in the Gini coefficient between market, gross and disposable incomes. We note that this ignores re-ranking and put off a more detailed examination as to the drivers of redistribution to further work.

Considering first the impact of benefits, we see in figure 9.a, the steady rise in the redistributive impact of the benefit system in the period to 2007, driven by the relative growth in benefits relative to CPI and wage growth during the period. After the onset of the crisis, the redistributive impact of the benefit system ratcheted up, due to increased demand. We will consider in further work, the impact of changes to the level of targeting in the instruments, due to for example changes in the means testing of benefits. As is clear from analyses of the distribution of disposable income above, assuming full take-up and receipt for 12 months increases the redistributive effect of the benefit system relative to the data. We note that there is relatively difference between the simulated values based upon a weighted average of two years and those based upon the current system.

The redistributive impact of the tax-system revealed in figure 9.b reveals a similar story of rising redistribution, very steadily at first and then rising rapidly post 2008 as some of the tax reforms took hold. We notice a relatively large difference between the weighted average and the current system. This is due to the changing progressivity of the systems. In general the redistributive effect of the current system matches that of the data quite well. We notice a difference that is hard to explain however in 2010, as the data exhibits a fall in the redistributive effect, while the model exhibits a rise. This is consistent with the increase in progressivity of the tax and contribution system observed in figure 8.

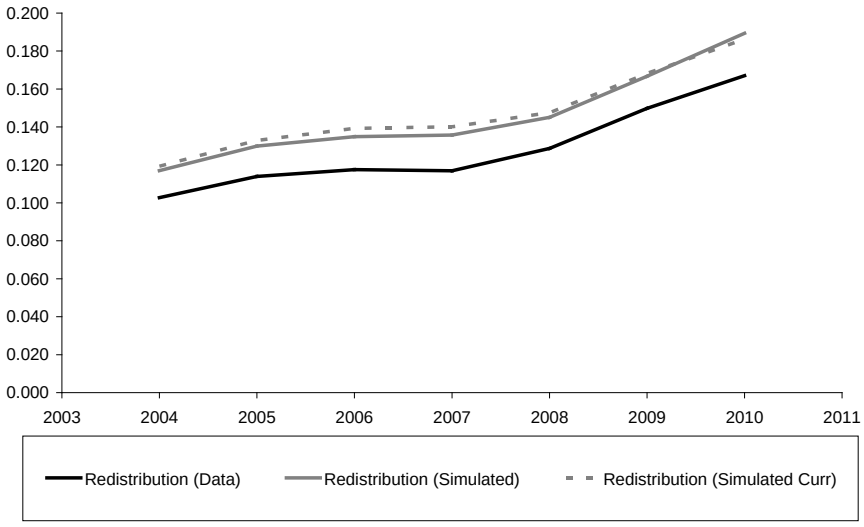
Figure 8. Average Tax and Contribution Rate, 2007, 2009, 2010 (Stylised Family)



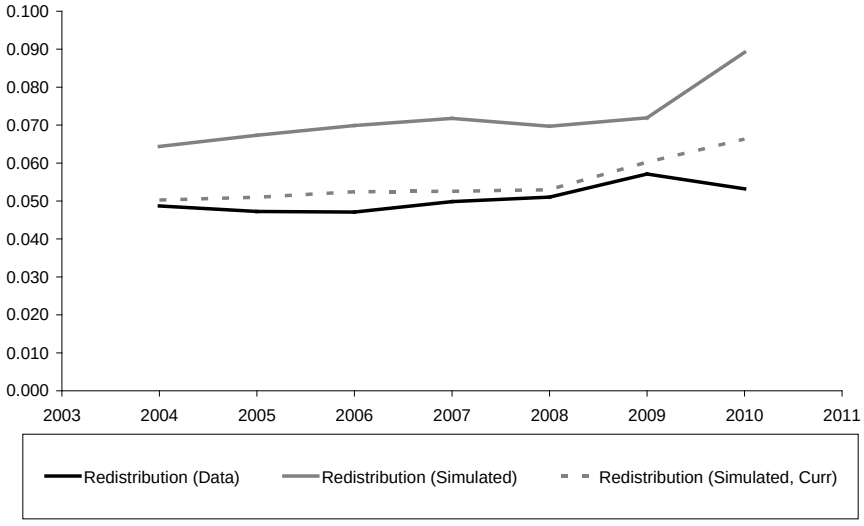
Note: Stylised Family – Single Earner Couple with 1 child at average wage

Table 9. Redistributive Impact

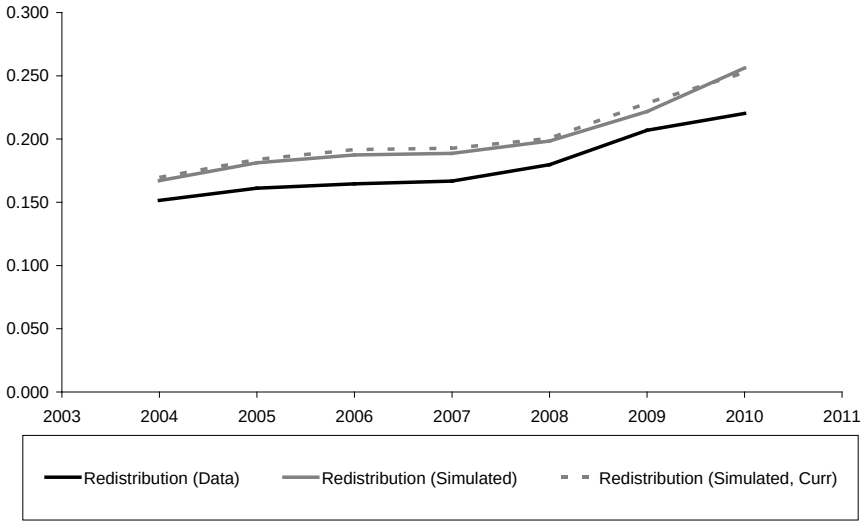
(a) Benefits



(b) Taxes



(c) Tax-Benefit System



Note: Equivalence scale used is the modified OECD scale

6. Conclusions

In this paper we attempted to chart the impact of the early part of Ireland's economic crisis from 2008-2010 on the distribution of income. In order to decompose the impact of components of income, we utilised a microsimulation methodology. However the EU-SILC User Database, the main potential data source is difficult to use for microsimulation purposes due to benefit aggregation, missing information in relation to the length of benefit receipt and a lack of documentation as to the choices made when producing the data. For relatively uncomplicated tax-benefit systems in Southern and Eastern Europe, Figari et al. (2007) adapted the EU-SILC for use in the EUROMOD tax-benefit framework. However Ireland poses greater challenges. The Irish case is (as is likely the case in many northern European countries) more complicated. This is due to the fact that there are more instruments with more complicated rules and with overlapping values between instruments.

As the microsimulation model can simulate the taxes and contributions contained in the EU-SILC, the main objective required to make the EU-SILC suitable for microsimulation was to disaggregated the incidence of benefits from 6 variables in the EU-SILC to 17 disaggregated variables. To do this we estimated a series of equations from an earlier dataset based upon the European Community Household Panel dataset, together with official statistics in relation to the number of recipients to simulate the incidence of the different types of benefits. We also adjusted the number of months of receipt on the basis of differences between the data and simulated values. Our method also highlighted a number of data quality issues in relation to the inclusion of some payments such as redundancy lump sums within social transfer variables. This methodology is potentially applicable to other countries too and thus could be utilised to develop the EU-SILC for microsimulation purposes.

We undertook a detailed validation of the methodology, finding that the methodology was reasonably effective, subject to the usual consequences of assumptions using microsimulation such as 100% benefit take-up and under-estimating the impact of non-modelable allowances, full year of receipt for benefits and tax avoidance/evasion in tax system. Overall we found that the simulated and data based approaches generated a similar trend, albeit with lower levels of inequality for these reasons. Modelling benefit take-up, and partial year receipt, we were able to bridge much of the gap between the two approaches, giving us confidence in our methodology.

We utilised the framework to model changes to the level of income inequality from the period just before the crisis in 2004 to after the crisis in 2010. In terms of the impact of the economic crisis, we found that the income inequality fell in the early part of the crisis, but rose steadily and then rapidly. Much of this change was due to rising inequality of market incomes, (even when discounting unemployment). This was due to the differential effect of the downturn on different sectors where some sectors such as the construction and public sectors were significantly hit, while the international traded sectors have been relatively immune from the downturn and have seen continued growth. The impact of the tax-benefit system has been to mitigate this upward pressure, with a gradual rise in the redistributive effect of the tax-benefit system driven by an increase in demand on the benefits side and increased progressivity on the tax side.

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Appendix 1: Structure of Tax-Benefit Reforms

Table 10. Structure of Reforms 2008-2013

Year	Main Structural Changes
2008	Increase in social welfare payments above CPI Increases in limits for mortgage interest
2009	Introduction of a Pension Levy for Public Servants Social Welfare rates increased (ahead of CPI) Halving of Child Care Supplement Introduction of an income levy Increase in the standard rate bands Minor Adjustments to mortgage interest relief
2009 Suppl.	Reduction in Social Welfare rates for the young unemployed Reduction in the duration of mortgage interest to 7 years Doubling rates of income levy and adjust bands Doubling rates of health levy and adjust bands Raise PRSI ceiling
2010	Cessation of the Child Care Supplement Reduction in Child Benefits Reduction of Public Servant Pay Reduction in working age social welfare benefits
2011	Second homes tax Reduction in Child Benefits Reduction in working age social welfare benefits Reduction in pay of new entrants to the public service Reduction in public service pensions Replacement of income and health levy with the Universal Social Charge, which has a broader base Reduction of bands and credits by 10% Removal of ceiling for PRSI for contributions Restriction of relief for PRSI for pension contributions
2011 Jobs Initiative	Reduced Employer's PRSI
2012	Change to Mortgage Interest Relief deduction rate Change to the exemption level for the Universal Social Charge Introduction of a Household Charge (Flat rate property tax) Changes to rates of child benefit Ending of lone parent half payment for period of entry to labour market
2013	Reduction in Child Benefits Household Property Tax Some Changes to Benefits

Appendix 2: Mapping of Benefit Variables

Table 11. Mapping of Benefit Variables

Social Protection Benefit	No. of Recipients (2010) – 1000's	Modelled Benefit	EU-SILC Benefit
State Pension (Contributory)	280.4	State Pension (Contributory & Transitory)	Old Age Benefits
State Pension (Transitory)	10.2		
State Pension (Non-Contributory)	97.2	State Pension (Non-Contributory)	
Widow(er)'s Contributory Pension	114.6	Widow(er)'s Contributory Pension	Survivor's Benefits
Widow(er)'s Non-Contributiory Pension	2.0	Widow(er)'s Non-Contributiory Pension	
Deserted Wife's Benefit	8.4	Deserted Wife's Benefit/Allowance	Family Benefits
Deserted Wife's Allowance	0.5		
One Parent Family Allowance	92.3	One Parent Family Allowance	
Maternity Benefit	23.5	Maternity Benefit	
Child Benefit	591.4	Child Benefit	
Other Child Related Benefits	1.5	n/a	
Family Income Supplement	28.2	Family Income Supplement	
Illness Benefit	81.3	Illness Benefit	Sickness Benefits
Invalidity Pension	50.8	Invalidity Pension	Disability Benefits
Blind Pension	1.5		
Injury Benefit	0.8		
Disablement Pension	13.7		
Disability Allowance	101.1	Disability Allowance	
Carer's Benefit	1.6	Carer's Benefit/Allowance	
Carer's Allowance	50.6		
Other Illness Benefits	0.9	n/a	
Jobseeker's Benefit	123.5	Jobseeker's Benefit	Unemployment Benefits
Jobseekers's Allowance	261.9	Jobseeker's Allowance	
Farm Assist	10.7		
Supplementary Welfare Allowance	37.4		
Pre-Retirement Allowance	6.0	Pre-Retirement Allowance	
Back to Work Allowances	9.0	Back to Work/Education Allowances	
Back to Education Allowance	21.1		

Source: Department of Social Protection Social Welfare Statistics 2010

Appendix 3. Logit Models of Benefit Take-up

	2004	2005	2006	2007	2008	2009	2010
Age	0.015*	0.002	0.0082	0.0162**	0.0148**	0.0167**	-0.0029
Non Benefit Household Income	-0.3785***	-0.3632***	-0.4472***	-0.4395***	-0.324***	-0.2037**	-0.2144**
Simulated Receipt of Unemployment Benefits	0.1179	-0.626**	-0.8447***	-0.6446**	0.5667**	0.1518	-0.4918*
Simulated Receipt of Survivor Benefits	-1.4418***	-2.3788***	-1.9545***	-2.0104***	-0.3928	-0.7043*	-1.3968***
Simulated Receipt of Disability Benefits	0.2387	-0.324	-1.0189***	-1.0238***	0.2256	-0.0124	-0.4207
Total Simulated Benefit Receipt	0	0.00004	0.0001***	0.00009***	0.0001***	0.00002	0.00003
In Employment	0.5753**	0.6855***	0.8319***	0.4305*	0.4588**	0.4428*	0.4748*
Is a Farmer	-0.5086	-0.6533	-0.4308	-0.3645	-0.8272**	-1.2007***	0.9581
Retired	0.8546***	0.4189	0.1007	0.1221	0.5052*	0.6225**	0.3097
Married	0.1346	0.6812***	1.1447***	0.5571*	0.4651*	0.1549	0.5827**
Widowed	-0.2407	0.6187*	-0.3704	-0.6617*	-0.0464	-0.0883	-0.0996
Separated or Divorced	-1.0764***	-0.4815	-0.9053***	-1.0323***	-1.069***	-0.7219**	-0.1311
Number of Children aged 0-11	-0.398	-0.466**	-0.106	-0.2375	0.5033	-0.0403	-0.2144
Number of Children aged 12-15	0.2507	-0.2266	0.0605	0.0653	-0.3472*	-0.2155	-0.1604
Suburban	0.0772	-0.2786	-0.4095*	-0.3254	-0.1127	0.1652	-0.1587
Rural	-0.347*	-0.3389*	-0.3571*	-0.3427	-0.3345*	-0.0658	-0.3918*
University Educated	-0.561**	-0.4588*	-0.5654**	0.1587	-0.5162**	0.0084	0.2392
Upper Secondary Educated	-0.5145**	-0.3738*	-0.5526***	-0.5288***	0.1078	-0.0244	0.0312
Constant	2.5637***	3.3866***	3.18***	2.8931***	1.6974***	1.8536***	3.3055***
N	3446	3938	3773	3768	3834	3746	3330
Pseudo R2	0.0967	0.1201	0.1542	0.1625	0.0789	0.0585	0.044

Source: Sologon and O'Donoghue (2013)