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Decomposing the Drivers of Changes in Inequality During the Great Recession in Ireland using the Fields Approach

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Abstract: In this paper we take as a case study a developed country that both experienced one of the highest sustained growth periods in recent decades, but also had one of the largest economic declines during the recent crisis period; Ireland. In particular, given the availability of data and the period from the peak before the economic crisis and the lowest point in the crisis, we focus on the period around the boom 2007-2012. We find that inequality in terms of disposable income decreased over the period, with an increase in the redistributive effect of the tax-benefit system offsetting a rise in market income inequality. We utilise the Fields regression decomposition to understand the impact of demographic, labour market and other drivers. We find that the explanatory power of the Fields regressions fell over time, reflecting the asymmetric shock induced by the economic crisis. Labour market drivers had the largest impact on the level of income inequality over the period, accounting for 64 per cent of variability in 2007, but rising to 75 per cent in 2012. Educational attainment is positively associated with inequality. However, the effect greatly diminished between 2007 and 2012. Changes in the demographic structure and changes in the level and distribution of market incomes increased inequality. We also decomposed the change in inequality into price and quantity effects that result from a change in the return and composition respectively.

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I INTRODUCTION

Ireland experienced a severe macroeconomic decline from 2007 to 2012 in terms of a fall in output and loss in employment with significant sectoral specific impacts. During this period, Ireland along with Spain and Greece experienced the largest declines in the employment rate among OECD countries (OECD, 2015) with a decline from a peak of 61.7 per cent, with 2.1 million in work in Q3 2007, to a low point of about 51 per cent in Q1 2012 (Figure 1.b). The severe macro-economic decline from late 2007 manifested itself in a fall of real GDP (GNP) per capita of 20.1 per cent (15.6 per cent) from its peak in Q4 2007 (Q4 2006) to Q4 2009 (Q1 2012) (Figure 1.a). Thus in terms of national income per capita and employment, the decline occurred between a peak in 2007 and the lowest point in 2012. Many of these changes will have had direct and indirect impacts on inequality. In this paper, we consider the economic and demographic drivers of pre- and post-policy inequality to understand the macro-economic drivers of inequality and redistribution within the economic crisis. Our paper is therefore one of the first studies to examine the medium-term inequality impact of the crisis.

Prior to the crisis, Ireland experienced a very high growth period from the mid-1990s until the mid-2000s, growing from 115 per cent of EU GDP per capita in 1997 to a high point of 148 per cent in 2007. Whelan (2014) explains, however, that the Irish economy developed dangerous imbalances during this boom period. House prices in Ireland quadrupled between 1996 and 2007. In 2007, Ireland's tax revenue was heavily dependent on the health of the property sector and property related tax revenue quickly collapsed. This required changes to the tax-benefit system so that public finances could be placed on a sustainable path. The scale of these adjustments was amplified by flaws in the design of the Euro currency (O'Rourke and Taylor, 2013). By 2007, Ireland's cost competitiveness had also become eroded and net exports declined as a share of GDP. This was reversed in subsequent years as Ireland's main trading partners exited the crisis. Whelan (2014) attributes some of the improvement in cost competitiveness to the relative decline in labour costs but explains that little of this improvement can be attributed directly to structural reforms.

Ó'Riain (2014) explored the role of economic liberalism in influencing investment and policy decisions in the period leading up to the crisis. Ó'Riain (2014) argues that poor investment decisions were associated with shortcomings in active labour market policy, risk capital, employee training and support for the development of Irish owned companies. Ó'Riain (2013) explored the financialisation of the Irish economy during the boom period and its contribution to the crisis. Ó'Riain (2013) identifies the reduction in the capital gains tax rate from 40 to 20 per cent in 1998 as a catalyst for the rapid growth in property investment and points to the rise in the share of total credit going to construction

and real estate between 2000 and 2007. Whelan (2010) explains that the demise of the Irish banks could be attributed largely to loans to property developers, particularly in the latter stages of the construction boom.

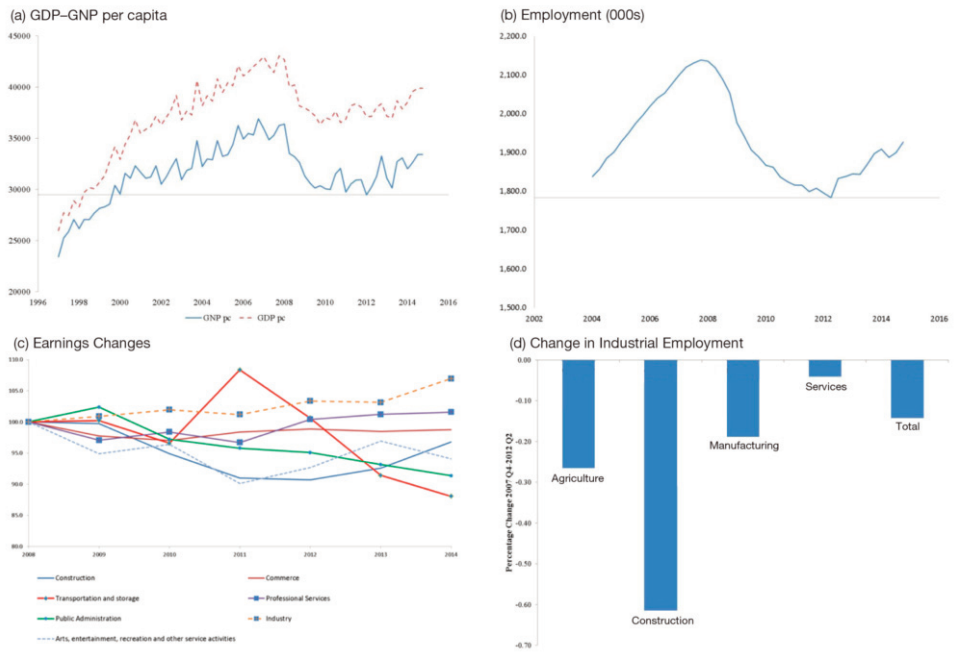
In addition to these financial, policy, industrial and macroeconomic forces, the crisis period also saw large demographic changes, with a return to high net emigration, together with some of the largest birth cohorts in recent history. Given these rapid economic changes, it is not surprising that income growth from different sectors varied (Figure 1.c). While all sectors saw a decline in employment, construction saw a decline of 40 per cent between 2007 and 2012. In terms of price inflation, the CPI (Consumer Price Index) grew by 2.8 per cent in this period. Within the CPI, there was significant heterogeneity in differential price growth across different good types, resulting in differential changes in purchasing power between different family types (Loughrey and O'Donoghue, 2012).

As the crisis progressed, the problem of household indebtedness became an urgent research and policy issue with distributional consequences. Russell *et al.* (2011) identified high variability among the social strata in the degree of risk attached to over-indebtedness as the crisis emerged. From a sample of mortgage borrowers, McCarthy (2014) identified relationships between mortgage arrears and the household income distribution with mortgage arrears tending to be associated with lower incomes and a large recent income drop. Mühlau (2014) found however, that despite the high indebtedness of the middle classes, financial hardship increased most for the working classes and the class of own account workers and self-employed employees.

The impact of the decline in earnings and employment reached the household sector in a number of dimensions. Public sector wages were reduced via a number of policy changes which Callan *et al*. (2010) and Callan *et al*. (2011) found to be progressive. Callan *et al*. (2013) examined the tax increases and welfare rate reductions between the government budgets for 2009 and 2014 including the changes to indirect taxation. This research found these policy changes to be proportional rather than progressive or regressive with the greatest losses being at the top of the income distribution, and the next greatest losses at the bottom.

This paper extends the existing literature on the impact of the economic crisis in Ireland by decomposing the impact of labour market and demographic changes in addition to tax-benefit changes. This research encompasses a five-year period from the initial stages of the financial crisis to arguably the lowest point of the recessionary period. The paper attempts to provide further understanding about the main drivers of the change in inequality in the medium term in the context of the Great Recession in Ireland. Our paper consists of a literature review in Section II, a methodological justification in Section III, a description of the data and summary statistics in Section IV, with results discussed in Section V. Section VI concludes.

Figure 1: National Accounts, Earnings and Employment



Source: CSO National Accounts, the CSO Earnings, Hours and Employment Costs Survey and the Quarterly National Household Survey.

II LITERATURE REVIEW

Bargain *et al*. (2017) decomposed the change in income inequality from 2008 to 2010 into policy effects and other effects and found that while policy effects reduced income inequality during this early part of the crisis, this was largely cancelled out by the other effects, which include demographics, labour market and the pre-tax earnings distribution. Bargain *et al*. found however that policy changes between 2010 and 2013 increased income inequality slightly and contributed to a 'substantial increase in poverty rates'. O'Donoghue *et al*. (2013) found that income inequality fell in the early part of the crisis from 2008 to 2009, as the tax-benefit system more than offset the rise in market income inequality. The gradual rise in the redistributive effect of the tax-benefit system was the product of an increase in demand primarily on the benefits side and increased progressivity.

In terms of international comparisons, the levels of income inequality varied significantly across European countries as the global economy entered into recession in 2007/2008. Jenkins *et al*. (2013) showed that the Nordic countries such as Norway and Sweden entered the recession with much lower inequality than the Southern European countries, a story consistent with the typologies proposed by

Esping-Andersen (1990). In 2007, income inequality in Ireland was similar to the Southern European countries of Spain and Italy but somewhat lower than Greece, Portugal and the United Kingdom. Jenkins *et al*. (2013) found that the level of income inequality in both Ireland and the United Kingdom declined marginally between 2008 and 2009. Callan *et al*. (2014) found however, that the Irish decline was short-lived and that income inequality quickly returned to the pre-crisis level in 2010 and 2011.

From the existing literature, it therefore appears that the inequality of disposable income has changed relatively little as a result of the crisis in Ireland. The relative stability of income inequality in Ireland during the boom (Nolan *et al*., 2012; Voitchovsky *et al*., 2012) and subsequent crisis implies that Ireland continues to have one of the more unequal income distributions in Western Europe. Atkinson (2015) has outlined twelve policy proposals that could bring about a reduction in income inequality in countries with a similar income inequality profile to Ireland. While the appropriateness of these proposals for income inequality in Ireland are discussed, there remains further scope to improve public understanding on the recent history of income inequality and how different forces i.e. economic, demographic and tax-benefit policy have contributed to the overall pattern.

Microsimulation analysis can help to explain the functioning of the tax-benefit system relative to alternatives and to compare the counterfactual effect of differences due to tax-benefit changes alone. In Ireland, the SWITCH model (Callan, 1991) has been used for 20 years to assess the impact of policy change on inequality. Callan *et al*. (2011; 2012) 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. Bargain and Callan (2010) decompose changes in inequality into policy and other changes utilising tax-benefit microsimulation models to simulate counterfactual incomes.

There are a number of potential methodologies to understand the driving forces of inequality change. Shorrocks' (1982; 1984) seminal work allows for a non-parametric decomposition of inequality indices into income factors and population sub-groups respectively. However, decomposition by population groups is subject to a number of problems (Morduch and Sicular, 2002). Because of these methodological problems, a regression-based method has been developed by Fields (2003) to investigate the contribution made by such factors as unemployment, labour force participation, family status, age distribution, education distribution etc., to inequality. In this study we utilise this approach to understand drivers of inequality, changes in inequality and redistribution in Ireland over the economic crisis at the household level.[2] This paper thus builds upon an existing literature by

[2] In later work, we extend this analysis to further disaggregate the drivers at the within household level using decomposition (Bourguignon *et al.*, 2001) where a set of equations or income generation model is used to decompose changes in the distribution of market income over time into participation, occupational and income inequality components.

developing a recent methodology to understand the nature of the changes in the distribution of household disposable income in one of the EU countries most affected by the economic downturn.

2.1 Market Income Inequality

The recent research in relation to income inequality suggests that while the inequality of disposable incomes changed little during the crisis, it appears that market income inequalities increased somewhat. A number of academic studies have addressed this specific market income inequality. For example, O'Donoghue *et al*. (2013) found that some of the rise in market income inequality could be attributed to the differential effect of the downturn on different sectors so that rising unemployment was not the only contributory factor. The observed stability in the inequality of disposable income was due in large part to the tax-benefit system offsetting significant increases in unemployment induced and market-driven inequality (Callan *et al*., 2014).

Gornick *et al*. (2017) find that Ireland has the second highest market income inequality among 24 OECD countries with Hungary having the highest market income inequality and Iceland the lowest. The relatively high level of market income inequality is also highlighted in O'Connor and Staunton (2015). Ó Riain (2014) noted that the construction boom helped deliver full employment and stemmed market income inequalities temporarily but this was based on a fragile short-term economic strategy. In addition, recession induced job loss can have significantly negative long term impacts on market income inequality given the negative effects on long-run earnings (Davis and Von Wachter, 2011; Eliason, 2011).

The International Monetary Fund reports that the market income share of the bottom 20 per cent of households is the lowest in the OECD (IMF, 2017). The IMF identifies the relatively low labour market participation rate of women as a contributory factor along with a large increase in the extent of long-term unemployment. The IMF identifies low intergenerational income mobility and a relatively high proportion of young people without employment, education or training as further contributory factors towards the relatively high market income inequality.

Callan *et al*. (2014) have decomposed income inequality by income source using the approach of (Shorrocks 1982; 1984) and found that employment income acted to increase inequality between 2008 and 2011 while changes in self-employment income partially offset this development. In addition, Callan *et al*. (2014) found that the combined impact of tax, benefits and public sector pay changes reduced income inequality although the changes in market incomes carried more influence on the overall distributional outcomes.

III METHODOLOGY: EMPIRICAL STRATEGY FOR DECOMPOSING DISTRIBUTIONAL CHANGES

Following Cowell and Fiorio (2011), the methods for decomposing distributional differences are classified in two main types. The first type includes the 'a priori approaches', namely the classical decompositions by population sub-groups or characteristics (Shorrocks, 1984) and by factor components (e.g. Paul, 2004; Shorrocks 1982, 1983; Theil, 1979). These are descriptive methods that help identify the contribution of population sub-groups (defined by various categorical characteristics such as education, region, gender, etc.), and the contribution of income sources to overall inequality.

The decomposition by population sub-groups, however, is subject to a number of problems (Morduch and Sicular, 2002). As it depends on the sample size, the use of many sub-categories is often not feasible given data constraints. It can also be difficult to examine the influence of variables such as age, which can be regarded as continuous variables. Using many categories also makes the calculations quite cumbersome. In addition, both sub-group and factor source decomposition methods are sometimes criticised as being purely descriptive rather than analytical, as being irreconcilable one with another and as failing to identify the contribution of individual determinants to inequality (Cowell and Fiorio, 2011).

The second type includes regression-based decomposition methods. Proposed initially by Blinder (1973) and Oaxaca (1973), this approach (hereafter refereed as Oaxaca-Blinder) seeks to decompose the differences in mean incomes between groups (e.g., men versus women) into the effect of differences in characteristics – 'composition effect', and the effects of the difference in returns to these characteristics – 'returns or price effect'. Essentially, this approach estimates wage regressions separately by population sub-groups defined by categorical characteristics (e.g. gender).

$$W_a = \beta_a X_a + \varepsilon_a \tag{1}$$

$$W_b = \beta_b X_b + \varepsilon_b \tag{2}$$

Subtracting the two estimated equations, the difference in mean wages can be decomposed into a 'composition effect' (assuming the same returns, the effect driven by differences in characteristics) and a 'returns or price effect' (assuming the same composition, the effect driven by differences in returns).

$$\overline{W}_a - \overline{W}_b = (\overline{X}_a - \overline{X}_b)\hat{\beta}_b + (\hat{\beta}_a - \hat{\beta}_b)\overline{X}_a \tag{3}$$

The highest level of complexity of the regression-based approach was achieved by Bourguinon *et al.* (2001; 2007) (hereafter referred as the BFL approach). The BFL

approach extends the decomposition of the differences beyond the mean, to the entire distribution. Bourguinon *et al.* built a parametric model for generating the distribution of household income. They model each income source as functions of personal and labour market characteristics. Each of the labour market characteristics and selected personal characteristics are modelled in turn as functions of demographic characteristics. The effect of demographic characteristics is captured using semi-parametric reweighting techniques in the tradition of Fortin and Lemieux (1996), who used a semi-parametric method based upon kernel density estimators to examine the changing wage distribution in the United States, focusing on institutional and labour market returns.

The decomposition of the differences in inequality relies on estimating a sequence of counterfactual distributions by 'importing' either the composition of certain characteristics or the returns to these characteristics. By applying this exercise in different sequences, the approach could decompose the differences in inequality into the effect of each component modelled in the parametric specification of the income-generation process. The decomposition follows the same logic of the Oaxaca-Blinder decomposition described in Equations (1) to (3), but extended to the entire distribution. The main criticism of the extended approach is that it is data-hungry and computationally cumbersome due to its complexity. It requires a separate modelling for many of the driving characteristics of inequality (e.g. employment structure, industry structure, contract type, etc.) and most of the income sub-components (e.g. wages, self-employment income, capital income, tax-benefit systems, etc.).

An intermediary approach, which is less data-hungry and less computationally cumbersome, while allowing the decomposition of indices that cover the entire distribution of income was used by Fields and Yoo (2000), Kattuman and Redmond (2001), Morduch and Sicular (2002) and Fields (2003). This approach (hereafter referred as the Fields approach) was used to investigate the contribution made by factors such as unemployment, labour force participation, family status, age distribution, education distribution to inequality. Potential influences on inequality that might require separate modelling as decomposition by groups or by income components can usually be easily and uniformly incorporated within an econometric model by an appropriate specification of the explanatory variables. The method estimates an income-generating function and uses the estimated coefficients to derive the inequality weight of each explanatory factor. It allows one to not only estimate the relative contribution of different characteristics to inequality, but also the relative contribution of each factor to the difference in inequality between distributions, be it time periods, population sub-groups or countries.

The main advantage of the Fields approach over the structural modelling approach is that the driving factors of inequality can be incorporated within a single econometric model by a careful specification of the independent factors, which is

much less data-hungry (Cowell and Fiorio, 2011). Its advantage over the Oaxaca-Blinder decomposition is that it enables the decomposition of inequality into its driving factors, whereas the Oaxaca-Blinder is limited to decomposing the differences in means.

The attractiveness of the Fields approach is evident in its increased popularity in the decomposition literature, e.g. Wan (2004), Wan and Zhou (2005) and Wan *et al.* (2007) for the case of China. Manna and Regoli (2012) have applied this approach for Italy; Israeli (2007) have applied the fields approach for Israel; while Guanatilaka and Chotikapanich (2009) have applied this approach for Sri Lanka. We use the Fields approach to decompose the drivers of changes in inequality during the Great Recession in the medium term in Ireland. We formalise the approach as follows.

Disposable income (Y_D) depends upon market income (Y_M), benefits (B) and taxation (T). Market income is in turn dependent upon personal skills, individual and family characteristics (X). The taxation (T) and benefit (B) components are a function of the tax-benefit parameters (θ) (e.g. tax brackets, benefit levels) and the X characteristics (e.g. marital status, number of children, etc):[3]

$$Y_D = Y_M(X) - T(X, \theta) + B(X, \theta) \tag{4}$$

Market income Y_M is a function of the receipt of market income source i, $I_{M,i}$, and the amount $Y_{M,i}$. Each are a function of the observable personal characteristics X that covariate with income, unobservable characteristics ε, and the decomposition unit – time period t.

$$Y_M = \sum_i Y_{M,i}(X, \varepsilon_t) \times I_{M,i}(X, \varepsilon_t) \tag{5}$$

Since all components of income depend on the set of observable characteristics, we can approximate the income-generation process by a regression equation, which has on the left-hand side the log of income (market and/or disposable) and on the right-hand side the observed characteristics (X). Formally,

$$Y = X\beta + \varepsilon, \tag{6}$$

where X is an $n \times K$ vector of attributes and an $n \times 1$ vector of residuals. The method involves splitting, for each unit, i, total income into the component Y_i^k, accounted for by each independent variable (e.g. industrial variables, personal variables, etc) as defined:

[3] The potential role of the tax-benefit system in altering work incentives and consequently market income is not captured by this model.

$$Y_i = \sum_{k=1}^{K} Y_i^k + \varepsilon_i, \text{ where } Y_i^k = X_i^k \beta^k \tag{7}$$

The Fields method (Fields, 2003) implies estimating the income generating-function:

$$\ln (Y_i) = \sum_{k=1}^{K} X_i^k \beta^k + \varepsilon_i \tag{8}$$

Taking the variance of expression (8) allows us to estimate the contribution of explanatory factor k to the level of inequality measured by the log-variance of income:

$$s_k = \frac{cov[\beta^k X^k, \ln Y]}{\sigma^2(\ln Y)} = \beta^k \frac{[\sigma(X^k) \cdot cor[X^k, \ln Y]}{\sigma(\ln Y)} \tag{9}$$

A positive s_k indicates an inequality-increasing factor k, whereas the reverse holds for a negative value.[4] The contributions of the observed explanatory factors add to the regression R^2:$\Sigma_{k=1}^{K} s_k = R^2$. The contribution of the residual is $s_\varepsilon = 1 - R^2$.

Relating to the literature on decomposing inequality by income sub-components (m), under certain assumptions discussed in Shorrocks (1982), the contribution to inequality attributable to each component m equals

$$s_m = \frac{cov(Y^m, Y)}{\sigma^2(Y)} = \frac{\beta^m \cdot \sigma(X^m) \cdot cor[X^m, Y]}{\sigma(Y)} \tag{10}$$

such that $\Sigma_{m=1}^{M} s_m + s_\varepsilon + R^2 + s_\varepsilon = 1$. The fraction of inequality explained by the m component, $p_m(Y)$, is:

$$p_m(Y) = \frac{s_m(Y)}{R^2(Y)} \tag{11}$$

Following the parallelism between expression (9) and (10), it becomes clear that instead of using a decomposition method for income sub-components (or population groups), we can use a decomposition method for the characteristics determining income. Inequality can be broken into the absolute factor contribution, where factor contributions relate to characteristic related components rather than

[4] The sign of the correlation coefficient between the explanatory factor k and income $cor[X^k, \ln Y]$ is important in determining whether or not the share s_k is positive or negative in value. As noted by Bigotta *et al.* (2015), the share s_k can be negative if the coefficient of the factor β^k and the correlation $cor[X^k, \ln Y]$ have different signs i.e. the partial correlation has the opposite sign to the simple correlation. The size of the share s_k is also influenced by the value of the standard deviation of the explanatory factor m i.e. $\sigma(X^k)$. High variability in the explanatory factor m leads to a share further from zero while low variability leads to a share closer to zero.

income sources. Similar to (11), we can assess the relative contribution of factor k by:

$$p_k(Y) = \frac{s_k}{R^2(Y)} \tag{12}$$

Fields (2003) extended this result to any inequality index $I(Y)$ which is continuous, symmetric and for which $I(\mu, \ldots, \mu) = 0$. This holds for any standard inequality index, meaning that when we estimate how much income inequality is accounted for by each explanatory variable and how much remains unexplained (accounted for by the residual), the relative contributions of each factor are the same for any index that fulfils these properties (Fields, 2003). Whereas this holds when looking at levels; when exploring inequality differences (between periods, groups, countries), namely how much of the difference in income inequality is accounted for by the explanatory factors, the relative contributions vary depending on the inequality index (Fields and Yoo, 2000, Fields, 2003).

We make use of the Fields approach to decompose the changes in inequality in Ireland during the crisis, between 2007 and 2012, into the contribution of income determinants.

Following Fields (2003), the change in inequality between the two periods is decomposed as:

$$I_2 - I_1 = \sum_{k}^{K+1} [s_{k,2} I_2 - s_{k,1} I_1] \tag{13}$$

Residuals are included among the k factors. The contribution of factor k to the change in inequality is

$$C^k = \frac{s_{k,2} I_2 - s_{k,1} I_1}{I_2 - I_1}, \tag{14}$$

where $\Sigma_k^{K+1} C_k = 100$ per cent.

We opt to use the log-variance as a measure of inequality in order to identify the price and quantity effects. This approach was put forward by Juhn *et al*. 1993), and discussed by Fields (2003) in the context of the Fields approach to decomposing inequality differences. The decomposition identifies the contribution due to differences in returns to characteristics ('price' effect) and the contribution due to differences in the composition of characteristics ('quantity' effect). This implies estimating a counterfactual inequality for period 2 that uses the returns ('prices') of period 1, while retaining the residuals of period 2. Assuming the income generation process in (8), the difference in inequality, measured by log-variance of income, can be decomposed as follows:

$$I_2(\Sigma X_2^k\beta_2^k + \varepsilon_2) - I_1(\Sigma X_1^k\beta_1^k + \varepsilon_1) = [I_2(\Sigma X_2^k\beta_2^k) - I_2^C(\Sigma X_2^k\beta_1^k)]_{price} + [I_2^C(\Sigma X_2^k\beta_1^k) - I_1(\Sigma X_1^k\beta_1^k)]_{quantity} + residual \quad (15)$$

The first term captures the difference between inequality in period 2 and the counterfactual level of inequality in period 2 (I_2^C) assuming the returns from period 1. This identifies the price effect of each characteristic *k*. The second term captures the quantity effect of each characteristic *k*, including the residuals. Following the mathematical derivations in Fields (2003), these effects become:

$$\begin{aligned}&\sigma^2(\ln Y_2) - \sigma^1(\ln Y_1) = \\ &= \Sigma_k[\beta_2^k\sigma(X_2^k)cor(X_2^k, \ln Y_2)\sigma(\ln Y_2) - \beta_1^k\sigma(X_2^k)cor(X_2^k, \ln Y_2^c)\sigma(\ln Y_2^C)] + \\ &+ \Sigma_k[\beta_1^k\sigma(X_2^k)cor(X_2^k, \ln Y_2^c)\sigma(\ln Y_2^C) - \beta_1^k\sigma(X_1^k)cor(X_1^k, \ln Y_1)\sigma(\ln Y_1)]\end{aligned} \quad (16)$$

IV DATA AND SUMMARY STATISTICS: HOUSEHOLD INCOME DISTRIBUTION IN IRELAND

Understanding the impact of changes in labour market, incomes and policy measures requires 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 per cent 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 (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 nor of the taxable income distribution. Callan *et al*., (2010) proposed a reweighting methodology based upon external data to improve the representativity in these 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. The data are not sufficient, however, when instruments require knowledge about inter-household units of analysis, say for higher education grants.

A challenge in the use of 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 per cent 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.

Table 1 describes the change in equivalised disposable incomes over the income distribution in Ireland between 2007 and 2012. Disposable incomes fell on average by 10 per cent with those in the top quintile falling by 14 per cent and those at the bottom falling by 6 per cent, reflecting a narrowing of the income distribution during the crash, captured in a fall in the Gini coefficient by just over 1 point. As we will be modelling the change in the income distribution, these are simulated disposable incomes, using simulated market income, taxes and benefits. However, the trend is consistent with those in the raw data, albeit with particular assumptions such as full take-up of benefits. The mean disposable income for 2007 is slightly higher in value relative to the value reported by Keane *et al*. (2012, p. 111) in the EUROMOD country report for Ireland 2006-2011. The mean disposable income for 2012 is similar in value to that reported by O'Donoghue (2016, p. 104) in the EUROMOD country report for Ireland 2009-2014. The one point decline in the Gini coefficient between 2007 and 2012 is also evident from a comparison of these Euromod reports.

In Table 2 and Table 3 we report how households with different characteristics (as measured by the share within household of particular individual level characteristics) moved over the income distribution in respectively 2007 and 2012. We notice in particular a shift in the composition of the bottom quintile with a

Table 1: Changes in the Distribution of Equivalised Disposable Income 2007-2012

	2007	*2012*
1	10,805	10,162
2	16,177	14,364
3	22,416	20,159
4	30,512	27,032
5	50,129	43,298
Mean	25,169	22,581
Gini (Simulated)	0.304	0.292
Gini (Raw)	0.312	0.299

Source: Authors' Calculations using EU-Survey of Income and Living Conditions data.

reduction of those of pension age in the bottom quintile and a substantial increase of those of working age at the bottom of the distribution. This is accompanied by a large increase in those with children in the bottom quintile. For those with the

Table 2: Population Structure 2007 by Disposable Income Quintile

	Population Share					
	Working Age	*Children Aged <= 5*	*Children 6-12*	*Children Children 13-17*	*Pension Age*	*In-Work*
1st Q	0.43	0.03	0.06	0.08	0.39	0.26
2nd Q	0.54	0.06	0.07	0.10	0.22	0.56
3rd Q	0.64	0.05	0.08	0.06	0.15	0.70
4th Q	0.72	0.05	0.06	0.06	0.10	0.85
5th Q	0.81	0.05	0.05	0.04	0.04	0.92
Total	0.62	0.05	0.06	0.07	0.20	0.64
	Spatial			*Education*		
	Urban	*Peri Urban*	*Rural*	*University Educated*	*Upper Secondary Educated*	*Lower Education*
1st Q	0.28	0.29	0.43	0.09	0.27	0.64
2nd Q	0.27	0.31	0.43	0.21	0.41	0.38
3rd Q	0.29	0.32	0.39	0.35	0.40	0.24
4th Q	0.38	0.29	0.33	0.49	0.34	0.17
5th Q	0.48	0.25	0.27	0.78	0.17	0.05
Total	0.34	0.29	0.37	0.37	0.31	0.32

Source: Authors' Calculations using EU-Survey of Income and Living Conditions data.

youngest children, there is an increase also at the top 60 per cent, thus a hollowing out of the youngest children in the middle of the distribution. For those in work, the share decreased across all quintiles, particularly in the bottom two quintiles, consistent with the working age story.

Not much happened from a spatial perspective at the bottom of the distribution, with much of the changes occurring in quintile 2 and quintile 3, with a shift upwards by those living in peri-urban and rural areas from quintile 2 to quintile 3 and higher, and a shift down from quintile 3 to quintile 2 in cities. Overall, education levels rose, with the share rising in particular at the bottom of the distribution with younger higher educated workers losing employment.

Table 3: Population Structure 2012 by Disposable Income Quintile

	Population Share					
	Working Age	*Children Aged <= 5*	*Children 6-12*	*Children 13-17*	*Pension Age*	*In-Work*
1st Q	0.64	0.05	0.10	0.09	0.11	0.16
2nd Q	0.38	0.03	0.08	0.05	0.45	0.31
3rd Q	0.60	0.05	0.07	0.06	0.20	0.54
4th Q	0.70	0.07	0.06	0.05	0.12	0.73
5th Q	0.80	0.06	0.04	0.03	0.07	0.85
Total	0.62	0.05	0.07	0.06	0.20	0.51
	Spatial			*Education*		
	Urban	*Peri Urban*	*Rural*	*University Educated*	*Upper Secondary Educated*	*Lower Education*
1st Q	0.29	0.28	0.43	0.22	0.35	0.43
2nd Q	0.27	0.30	0.42	0.19	0.31	0.50
3rd Q	0.30	0.25	0.45	0.40	0.33	0.27
4th Q	0.32	0.27	0.40	0.55	0.31	0.14
5th Q	0.46	0.28	0.26	0.77	0.18	0.05
Total	0.33	0.28	0.39	0.42	0.30	0.29

Source: Authors' Calculations using EU-Survey of Income and Living Conditions data.

For clarification, the variables used in this analysis are household shares. For example, the University Educated is the share of household members with university level education. The same logic applies to labour market and industrial variables. This facilitates the regression analysis where each household is represented by a household head but the independent variables reflect the characteristics of the household as a whole. By applying household shares, we

overcome many of the issues relating to the use of categorical variables and in particular the choice of omitted category, as outlined in Gardeazabal and Ugidos (2004).

Table 4: Industry Share, 2007-2012[5]

	Industry Share							
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*
2007	0.06	0.10	0.12	0.17	0.05	0.28	0.15	0.05
2012	0.04	0.07	0.12	0.21	0.05	0.28	0.16	0.07

Source: Authors' Calculations using EU-Survey of Income and Living Conditions data.
Note: Industry: A – Agriculture; B – Construction; C – Manufacturing; D – Commerce; E – Transport; F – Public Administration; G – Professional Services; H – Other.

Table 4 describes what happened to the employment structure in terms of industry. The industries with the largest fall in employment shares were agriculture and construction, with commerce and the other sectors having the largest increase in share.

In Table 5, we report the mean and some distributional-related ratio statistics for the sources of market income. The largest source of market income is income from employment, which fell over the period reflecting the fall in employment. Self-employment and capital income also fell, with other income rising, due to an increase in recorded occupational pension income in the data. We utilise the ratio of average quintile 5 to quintile 3 as a measure of the distributional effect. We utilise quintile 3 as there is relatively little market income at the bottom of the distribution. In the case of employment income, capital and other income, these income sources become more concentrated at the top, while self-employment becomes less concentrated.

In Figure 2, we report trends in the overall budget constraint over the period of 2004 to 2012. In addition to the period after the crash, we include 2004 to highlight the change in purchasing power and redistribution in the period prior to the crash. These budget constraints reflect the disposable income associated with different hours worked at the average industrial wage rates, deflating by the CPI to account for changes to purchasing power. Wages are assumed to grow at the average rate for industrial employees. 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.

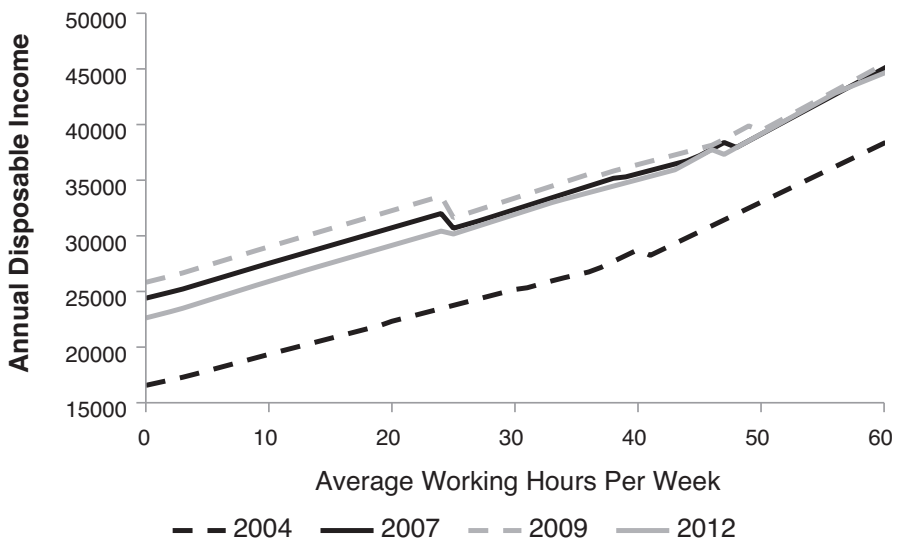
[5] We have excluded the occupation variable in the analysis. The exclusion of the occupation variable is due to the change in the ISCO classification definitions in the EU-SILC data from 2011 onwards, see here http://www.ilo.org/public/english/bureau/stat/isco/isco08/index.htm.

Table 5: Summary Statistics of Market Income

	2007	*2012*	*2007*	*2012*
	Mean Income		*Ratio Q5:Q3*	
Employment Income	12,060	11,032	3.7	4.7
Self-Employment Income	1,891	1,058	5.1	3.4
Capital Income	954	266	4.8	5.2
Other Income	1965	2417	3.1	6.3
Market Income	16,871	14,774	3.5	3.8
	2007	*2012*	*2007*	*2012*
	Mean		*Ratio Q5:Q1*	
Inwork	0.48	0.38	4.1	5.7
University	0.19	0.26	7.4	4.9
Upper Secondary Educated	0.26	0.24	1.3	1.0
Age	35.0	35.8	0.9	0.8
Urban	0.34	0.35	1.5	1.4
Children Aged <= 3	0.22	0.27	1.5	2.1

Source: Authors' Calculations using EU-Survey of Income and Living Conditions data.

Figure 2: Change in the Budget Constraint 2004-2012



Source: Authors' Calculations.
Note: We assume here a single earner married couple with two children, aged one and six, with no direct housing costs for simplification. The main earner has a wage rate of two-thirds the average wage.

In the period to 2007, we notice that the overall budget constraint flattens, with the ratio of disposable income for 40 hours to 0 hours decreasing from 1.74 in 2004 to 1.46 in 2007. It also continues to fall to 1.40 in 2009, before rising again to 1.55 in 2012. The period to 2007 saw 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 2009, the purchasing power of the bottom of the distribution rose slightly, but fell at the top. In 2012, purchasing power fell for most groups, with the bottom falling slightly more. In 2007 and 2009, a significant kink appears at approximately 25 hours. This reflects a situation whereby the replacement of unemployment assistance by family income supplement is accompanied by a decline in household income. Family income supplement may not sufficiently compensate for the withdrawal of unemployment assistance at the assumed wage rate.

V RESULTS

5.1 Tax-Benefit Drivers of Inequality

Public policy has one of the largest impacts on inequality. We do not attempt to distinguish between the effects of automatic stabilisation and discretionary policy interventions. This is dealt with elsewhere by Savage *et al*. (2018) who conclude that:

> *over three-quarters of the effective buffering against inequality increases by the Irish tax and transfer systems was due to automatic stabilisation effects, and just under a quarter was due to changes in discretionary policy.*

In Table 6, we report the change in different components of inequality between 2007 and 2012. Gross income is defined as market income plus social transfers, while disposable income is defined as gross income minus taxes and transfers. While average market income fell, this has been compensated by a rise in social transfers. Taxes and contributions have seen a net fall in mean equivalised disposable income.

We note that market income inequality rose over the period, but that gross income inequality was relatively flat reflecting the increasing redistributive effect of social transfers. Disposable income inequality declined reflecting the increasing progressivity of taxes and contributions.

5.2 Regression Drivers

We now attempt to understand the drivers of the change in income inequality using the single equation regression based method due to Fields and Yoo (2000) and Morduch and Sicular (2002).

Table 6: Tax-Benefit Drivers of Inequality 2007 and 2012

Inequality	*2007*	*2012*	*2007*	*2012*
	Gini		*Mean*	
Market	0.478	0.516	32,754	31,451
Gross	0.355	0.355	36,582	36,456
Disposable	0.304	0.292	27,865	24,087
Redistribution	*Change in Gini*		*Prop. Change in Mean*	
Benefits	0.122	0.161	0.117	0.159
Taxes	0.052	0.063	–0.266	–0.393
Tax–Benefit System	0.174	0.224	–0.149	–0.234

Source: Authors' Calculations using EU-Survey of Income and Living Conditions data.

Table 7 describes regressions of equivalised household disposable income for 2007 and 2012 used by the single equation regression based decomposition approach. The explanatory power of the model is relatively high in 2007 at about 50 per cent. However, the R-squared term declined about 5-10 per cent between 2007 and 2012, with observable characteristics having a lower association with equivalised disposable income over the period, reflecting the asymmetric impact of the economic downturn.

The demographic structure coefficients, except for pension age which increases, are not statistically different between periods, with higher shares of working and pension age being associated with higher incomes and with higher shares of children, particularly teenage children associated with lower incomes. Unsurprisingly the share of people in work has a positive relationship, increasing significantly between the two periods, reflecting the impact of the crisis on employment.

The relationship between educational attainment and income is positive, but the impact reduces over the period, reflecting the reduction in employment of the more highly educated younger population. This finding corresponds to the results identified by Holton and O'Neill (2017), a study which focused solely on the wage earning population. Urban areas are more associated with higher income than rural or peri-urban areas, with the urban-rural gap decreasing slightly. The share of workers by industry makes a significant contribution, with a rise in the value of the coefficients for all industries relative to agriculture in the market income model. For the model of disposable incomes, the pattern is largely reversed as the coefficients for the non-agricultural industries decline thus indicating a significant interaction with the tax-benefit system.

Table 8 reports the decomposition of inequality using the Fields method. Combining the in-work share with industrial composition, labour market participation has the biggest effect on inequality, accounting for 64 per cent of variability in 2007, but rising to 75 per cent in 2012. Thus the impact of differential

Table 7: Regression Estimates used for Fields Decomposition

Dependent Variable:	*Market Income*				*Disposable Income*			
	2007		*2012*		*2007*		*2012*	
	B	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*
In-Work	0.671***	(0.03)	0.960***	(0.05)	0.305***	(0.01)	0.474***	(0.02)
Working Age	0.338*	(0.18)	1.577***	(0.22)	0.126*	(0.07)	0.187***	(0.06)
Children Aged <= 5	–0.181	(0.20)	1.121***	(0.24)	–0.0690	(0.07)	–0.0683	(0.07)
Children 6-12	–0.272	(0.20)	0.802***	(0.23)	–0.228***	(0.07)	–0.169***	(0.06)
Children 13-17	–0.659***	(0.19)	0.600**	(0.24)	–0.638***	(0.07)	–0.553***	(0.06)
Pension Age	0.391**	(0.18)	1.921***	(0.22)	0.214***	(0.07)	0.298***	(0.06)
Agriculture	1.120***	(0.06)	1.522***	(0.09)	0.178***	(0.02)	0.158***	(0.02)
Construction	1.496***	(0.06)	1.545***	(0.09)	0.394***	(0.02)	0.143***	(0.02)
Manufacturing	1.496***	(0.05)	1.910***	(0.07)	0.439***	(0.02)	0.351***	(0.02)
Commerce	1.193***	(0.05)	1.429***	(0.07)	0.298***	(0.02)	0.100***	(0.02)
Transport	1.480***	(0.07)	1.768***	(0.09)	0.394***	(0.02)	0.248***	(0.03)
Public Administration	1.424***	(0.05)	1.808***	(0.06)	0.443***	(0.02)	0.306***	(0.02)
Professional Services	1.571***	(0.05)	1.772***	(0.07)	0.575***	(0.02)	0.302***	(0.02)
Other Industry	1.040***	(0.07)	1.320***	(0.09)	0.215***	(0.03)	0.0604**	(0.02)
University Educated	1.082***	(0.03)	0.911***	(0.04)	0.424***	(0.01)	0.230***	(0.01)
Upper Secondary Educated	0.605***	(0.03)	0.379***	(0.05)	0.141***	(0.01)	0.0261**	(0.01)
Urban	–0.138***	(0.02)	–0.130***	(0.04)	–0.0745***	(0.01)	–0.0894***	(0.01)
Peri-urban	–0.175***	(0.02)	–0.258***	(0.03)	–0.116***	(0.01)	–0.105***	(0.01)
Rural	7.355***	(0.18)	5.663***	(0.22)	9.321***	(0.07)	9.303***	(0.06)
Constant	0.671***	(0.03)	0.960***	(0.05)	0.305***	(0.01)	0.474***	(0.02)
R2	0.491		0.397		0.510		0.453	

Source: Authors' Calculations using EU-Survey of Income and Living Conditions data.
Note: The dependent variable is logged equivalised disposable income, where the equivalence scale is the square root of the household size.

Table 8: Fields Inequality Decomposition (Summary) 2007-2012

	Market Income		*Disposable Income*	
	2007	*2012*	*2007*	*2012*
Demographic Characteristics	–3.2	–4.0	–0.3	5.1
In-Work	22.6	28.8	25.4	47.0
Industry	48.2	55.4	38.6	28.2
Labour Market	**70.8**	**84.2**	**64.0**	**75.1**
Education	31.2	18.6	33.3	17.5
Spatial	1.3	1.2	3.0	2.2

Source: Authors' Calculations using EU-Survey of Income and Living Conditions data.

labour market interactions accounts for most of the variability in income in 2012. For disposable incomes, being employed became more important, whereas industry decreased in importance.

Educational attainment is positively associated with inequality. The effect, however, greatly diminished between 2007 and 2012. We find that demographic characteristics are not particularly important, but an increase is witnessed between 2007 and 2012. Spatial location is positively associated with inequality, but only accounting for about 2-3 per cent of variability in the inequality of disposable incomes.

5.3 Price and Quantity Effects

The decomposition of the change in inequality (as measured by the variance in log income) between 2007 and 2012 is decomposed into price and quantity effects in Table 9. This allows us to separate the effect of changes in returns to characteristics (e.g. education, industry) from changes in the composition of these characteristics. The effects in Table 9 plus the residual add up to the change in the variance of log income. Market income inequality increased over time, whereas inequality in disposable income decreased over time. This is consistent with the evolution of the Gini index, as reported in Table 6. In this two-period model, the results with regard to the price-quantity effects are not sensitive to the choice of reference period.

Overall, the changes in the demographic characteristics had an inequality-decreasing effect particularly in relation to market income inequality. This effect becomes substantially smaller once taxes and benefits are included. The underlying determinants differ somewhat. For market income, the demographic effect is driven by an overall negative price and composition effect, whereas for disposable income by an overall negative price effect. The composition effect is close to null under the tax-benefit system. The overall negative composition and price effects show that market income inequality would have increased more if the composition of demographics and their returns had remained unchanged.

The effects however differ significantly across the demographic sub-components. The decrease in the returns to education for the university educated during the crisis (see Table 7) contributed to the decrease in inequality in disposable income. We also find an inequality-reducing effect for market income, which implies that the increase in market income inequality would have been more pronounced if returns had stayed the same. The increasing shares of university educated (see Table 2 and Table 3), however, had a very small effect on disposable income.

For the upper secondary educated, the price and quantity effects on disposable income inequality offset each other. For market income, the changes in the composition of upper-secondary graduates (increasing shares in the bottom quintile in Table 2 and Table 3) had an inequality-decreasing impact, which signals that inequality in market income would have increased more if the composition of upper-secondary graduates would have not changed. This effect was partially reduced by the inequality-increasing effect determined by the decrease in returns for the upper-secondary graduates (see Table 7).

The increase in the returns to being of working age contributed to the increase in inequality in market income, whereas the fall in the share of the working age population had a decreasing effect on market income inequality (see Table 2, Table 3 and Table 7). The price and composition effects for people of pension age run in opposite directions: the increase in returns for those of pension-age, has an inequality-reducing impact, whereas the increase in the share of people of pension age contributed to the increase in market income inequality (see Table 2, Table 3 and Table 7). This makes intuitive sense given that people of pension age tend to have relatively low market incomes and a rise in the proportion of the pension-aged population tends to increase market income inequality. The impact of the tax-benefit system, however, largely reduces these effects when we look at disposable income.

In terms of the labour market, the changes in returns to the labour market characteristics contributed positively to the increase in inequality in market incomes, partially reduced by the negative composition effect. The impact of the tax-benefit system, reduces the magnitude of these effects. This shows the importance of the tax-benefit reforms in reducing the income inequalities, which were generated by rising returns to the highest earning industrial groups.

The decompositions for the industrial shares show that the decrease in returns for most industries relative to agriculture (see Table 7, disposable income) contributed to the decrease in disposable income inequality. The quantity/ composition effects differ across industries. The only negative quantity effects are observed for construction and transport. Their decreasing shares over the crisis contributed to the decrease in inequality. The other industrial categories record a counteracting quantity effect, which is found to be small for both market and disposable income. The share of the population in-work is inequality- increasing in terms of returns for both income measures, in particular the market income. The

drop in the share of people in-work had an inequality-decreasing impact on market income inequality, turned null by the tax-benefit system.

Summing up all contributions for the industry and educational structures, we find that, overall, the impacts of changes in the industrial and educational structure are inequality-reducing on disposable income. Overall, the changes in the labour market characteristics contributed to the increase in market income inequality, and the interactions with the tax-benefit system led to a decrease in disposable income inequality. Thus the changes in labour market characteristics in interaction with the tax-benefit policy changes over the crisis increased the net redistributive effect of the Irish tax-benefit system.

Table 9: Fields Inequality Decomposition (Price and Quantity Effects) 2007-2012

	Market Income		*Disposable Income*	
	Price	*Quantity*	*Price*	*Quantity*
Demographic Share	**–0.062**	**–0.042**	**–0.027**	**0.003**
Highest Education Level in HH	**–0.028**	**–0.059**	**–0.029**	**–0.003**
University Educated	–0.034	–0.006	–0.035	0.002
Upper Secondary Educated	0.006	–0.053	0.006	–0.005
Population Share	**–0.035**	**0.017**	**0.002**	**0.006**
Working Age	0.168	–0.018	0.002	–0.002
Children Aged <= 5	0.028	–0.001	0.000	0.000
Children 6-12	–0.004	0.003	0.000	0.001
Children 13-17	–0.005	0.006	–0.001	0.002
Pension Age	–0.222	0.027	0.001	0.005
Region	**0.006**	**–0.004**	**–0.001**	**–0.001**
Urban	Excl.	Excl.	Excl.	Excl.
Peri-urban	0.000	0.002	0.001	0.001
Rural	0.006	–0.006	–0.001	–0.002
Labour Market Characteristics	**0.355**	**–0.016**	**–0.014**	**0.007**
In-Work	0.151	–0.017	0.019	0.001
Industrial Share	**0.204**	**0.001**	**–0.032**	**0.006**
Agriculture	0.011	0.001	0.001	0.001
Construction	–0.009	–0.014	–0.002	–0.001
Manufacturing	0.054	0.015	–0.001	0.003
Commerce	0.015	0.006	–0.004	0.002
Transport	0.006	–0.012	–0.001	–0.001
Public Administration	0.106	0.006	–0.009	0.003
Professional Services	0.017	–0.003	–0.015	0.000
Other Industry	0.005	0.002	–0.001	0.000
Residual	0.000	0.862	0.000	0.001
Change in the log Variance		1.100		–0.031

Source: Authors' Calculations using EU-Survey of Income and Living Conditions data.

VI CONCLUSIONS AND SUMMARY

This study explores the factors driving income inequality in Ireland during the course of the economic crisis from 2007 to 2012. This is one of the first papers to provide a medium-term analysis with respect to the drivers of income inequality during the crisis period in Ireland.

Our findings suggest that inequality in terms of disposable income decreased marginally during the crisis as market income inequality increased sharply. The increase in the redistributive effect of the tax-benefit system was therefore sufficient, in more than offsetting the rise in market income inequality. The findings with respect to the trend in market income inequality correspond to Callan *et al*. (2014). We identify a small decrease in the inequality of disposable income, a finding which is consistent with Madden (2014). Previous work by O'Donoghue *et al*. (2013) found that the increase in the redistributive effect of the tax-benefit system was largely due to compositional changes but also due to the increased progressivity of both the tax and benefit systems in the late 2000s.

This research adds to the existing literature by utilising the Fields regression-based decomposition in order to understand the impact of demographic, labour market and other drivers of income inequality in the medium term during the Great Recession. The Fields approach, with a relatively low complexity, allows for multiple driving factors of inequality to be incorporated within a single econometric model by a careful specification of the independent factors, which is much less data-hungry than a structural modelling approach (Cowell and Fiorio, 2011). Callan *et al*. (2014) employed the Shorrocks decomposition approach to find that changes in the variability of employee income acted to increase inequality while self-employment income reduced inequality during the crisis. In line with our findings, the work of Callan *et al*. (2014) found that changes to income tax, welfare and public sector pay policy reduced income inequality between 2008 and 2011.

Our regression-based decomposition analysis encompasses a wider range of factors than the existing research by accounting for demographics, education and industry. We find that the explanatory power of the Fields regressions fell over time, reflecting the asymmetric shock induced by the economic crisis. Labour market drivers in the form of work participation and industry had the largest impact on the level of disposable income inequality over the period, accounting for 64 per cent of variability in 2007, but rising to 75 per cent in 2012. Educational attainment is positively associated with inequality. The effect, however, greatly diminished between 2007 and 2012. Changes in the demographic structure and changes in the level and distribution of market incomes increased inequality.

We also decomposed the change in inequality into price and quantity effects that result from a change in the return and composition respectively. In total, the returns to demographic structure are inequality reducing in terms of market income, while the changing composition counter-balances this change. The employment

variable is inequality increasing for market income in terms of returns and decreasing slightly in terms of composition. The effects are lower but with similar signs for disposable income. The changes in educational returns between 2007 and 2012 are inequality reducing. Industry is an important driver in terms of market income returns, with minor compositional impacts, although the price component for industrial share is decreasing for disposable income.

As in the case of Madden (2014), a number of caveats apply to our findings including the importance of non-cash benefits such as Medical Card availability, cuts to home help hours and cuts in the availability of special needs teachers etc. These changes may well have affected the distribution of broader welfare without directly affecting the distribution of income. The literature with respect to financial hardship such as Mühlau (2014) and deprivation indices such as Whelan and Maître (2013) may be better equipped in dealing with these wider welfare indicators.

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