Working Family Tax Credit and the Poverty Rate of Single Mothers in the UK: *An Empirical Study*

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Abstract

In this thesis I investigate the effect the UK Working Family Tax Credit (WFTC) had on the poverty rate of single mothers. Evidence from the literature on the American EITC (Hoynes & Patel, 2018) suggests that in-work credits do reduce the poverty rates of recipients. Using British Household Panel Survey (BHPS) data from the period 1995-2003, I employ a difference-in-difference model with single mothers as the treatment group and single childless women as control. I find that, after allowing for different linear trends for the two groups, the WFTC did not prompt a significant one-off reduction in the poverty rate of single mothers, but instead inverted the time trend decreasing the poverty rate of single mothers by around 2.7 percentage points per year. The difficulties in the estimation lie in the threat of a composition effect and the fact that the WFTC reform was implemented at the same time as other consequential reforms such as the Income Support reforms of 1998-1999 which to a small degree affected single mothers and single childless women in a different way. To the best of my knowledge I am the first to apply this methodology to study the impact of the WFTC on poverty rates.

1. Introduction

Over the past 50 years the British Government tried several times to create an efficient tax credit scheme. A succession of Labour and Tory government starting from the 1960s all tried their best to integrate welfare benefits and taxation to devise the best way to appropriately give funds to those who needed them the most [1]. In 1998, the new Labour government with Gordon Brown as Chancellor of the Exchequer proposed what they defined as the "New Deal" for lone parents (HM Treasury, 1998). The aim of the new deal was to encourage subsets of the population that were historically at the margins of the labor force, such as lone parents, to work at least part time, with the broader objective of reducing poverty and social exclusion and creating a fairer United Kingdom.

The expansion of the Working Family Tax Credit (WFTC, from now on) placed itself as the main

[1] https://www.theguardian.com/politics/1999/sep/08/labour.labour1997to99

contribution towards this objective, mainly by increasing the generosity of the previous Family Credit for families with young kids, reducing the *taper rate* (the rate at which the benefit is reduced for each additional £ earned) and for introducing a childcare credit component specifically aimed at tackling child poverty.

It is for this reason that the goal of this thesis is to study the effects of the WFTC on the poverty rates of single mothers. I will in fact try to investigate to what extent did recipiency of the WFTC reduces the poverty rate of single mothers in the UK.

This investigation has both scientific and social relevance. The scientific relevance stems from the fact that, to the best of the knowledge of the author, no scientific publication has yet analysed the impact of the WFTC on the poverty rate of single mothers. Previous studies have in fact focused on the impact of the credit on employment (Blundell, Brewer, & Shephard, 2005), fertility (Ohinata, 2011) and childcare expenditure (Francesconi & Van der Klaauw, 2007), given the incentives (*Section 2*) this policy creates towards employment for single parents and the generosity of the credit increasing with the number of dependent children. However, since the WFTC was part of a plan outlined in 1998 to create a fairer United Kingdom, it is necessary to evaluate it also on its performance with respect to poverty. To do so, I employed the *difference-in-difference* (DD, from now on) strategy used in Hoynes and Patel (2018), which evaluated the effect of the American EITC on the absolute poverty rate of US single mothers.

Moreover, this thesis is socially relevant as it provides an ex-post evaluation of the WFTC on one of its stated policy objectives, which will help UK policy makers in making informed decisions when reforming the tax system. More broadly seen, it helps in evaluating the WFTC as a tax credit that performs the income support function typical of welfare transfers, while, at the same time, still aiming at boosting employment.

To perform my analysis, I used the British Household Panel Survey's (BHPS) (University of Essex, Institute for Social and Economic Research, 2018) waves 5 to 13 spanning from 1995 to 2003. From the BHPS, I created a dataset comprising all the single women interviewed in the 9 waves considered, and divided them into single women with and without children. I included the basic socioeconomic characteristics (ethnicity, education level, employment status) and household net income, necessary to compute poverty rates.

Employing the basic DD comparison between single mothers (*Treatment)* and single childless women (*Control*), I find that the reform had a significant and sizable effect, reducing the poverty rate of single mothers by around 7.7 percentage points. However, after allowing for different linear time trends for treatment and control group and controlling for the simultaneous economic reforms, such as the introduction of the National Minimum Wage (NMW) and the Income Support reforms (IS) the one-off effect of the credit becomes statistically not significant. To best accomodate the data, in my preferred model I allow for a more gradual effect, consistent with the reasoning of Chetty, Friedman, and Saez (2013), assuming that the WFTC reform affected not the level with a one-off reduction, but the post-reform trend of the poverty rate of single mothers. With this approach I find that the WFTC prompted an average yearly reduction of the poverty rate of single mothers of around 2.7 percentage point, significant at the 10% level. In the robustness checks section I address

the threat of a composition effect of the treatment and control group.

The rest of the paper is organised as follows: In section 2 I will discuss in detail the features of the WFTC, whereas in section 3 I'll review the relevant related literature. In sections 4 and 5 I'll explain the data cleaning process and my methodology. I'll then outline my empirical results in sections 6. Finally in section 7 I discuss the implications of the results and conclude with some recommendations for future research.

2. Institutional Background: The WFTC in the UK

The 5^{th} of October 1999, as part of the Labour's government agenda of *"Making Work Pay"*, the WFTC replaced the Family Credit as the main in-work tax credit centered on families. It remained a central tax-credit up until April 2003, when it was re-organised in two separate credits the Child Tax Credit and the Working Tax Credit[2]. The focus of this subsection will be to give an overview of the eligibility rules of the FC/WFTC, which remained unchanged by the reform. In the following subsection, I will discuss the changes from the Family Credit to the WFTC that substantially increased the generosity of the credit and justify the study of its impact on the poverty rate of single mothers. Moreover, I will discuss the role of the other reforms implemented concurrently with the WFTC, such as the NMW and changes in Income Support programs. In the final subsection by referring to the work of Hoynes and Patel (2018) I will discuss how, theoretically, the increased generosity of the WFTC has an impact on the poverty rate of single mothers.
In order to be eligible for the WFTC a family needs to meet a set of requirements, as outlined in Francesconi and Van der Klaauw (2007) and Dilnot and McCrae (2000):
The first requirement is that at least one of the two parents (or the lone parent) is in paid work for at least 16 hours per week with no minimum earnings requirement. The second important eligibility rule, that lies at the basis of the methodology employed in this thesis (Section 5), is that the "family" (or benefit unit, using BHPS terminology), must have at least one dependent child [3]. Additionally, family assets above 3000£ reduce the benefit and assets above 8000£ completely prevent eligibility (Brewer, Duncan, Shephard, & Suárez, 2005). Moreover having a weekly income higher than 90£ triggers the so-called *taper rate*, which, after the 1999 reform, reduces the benefit by 55p for every additional £ earned.

2.1. The 1999 Reform

A first interesting difference between the WFTC and the FC lies in the way it was administered: instead of being credited to families via the UK Benefits Agency, as traditional welfare transfers, it was included in the wage packet as compiled by the recipient's employer. This shows an effort to present it as a tax credit and remove part of the social stigma associated with claiming welfare

[2]The 2003 reform did not substantially alter the generosity of the credit, however it changed how the benefit was administered, in particular it assigned the child credit part to mothers, irrespective of their main earner status within the family; to see how this shift may impact household spending see Fisher (2015)

[3]Cohabiting and aged maximum 16 or 19 if in FT education.

checks (Taylor, 1998).

Moreover, It is in four ways that the WFTC can be considered as a more generous credit than the Family Credit it replaced. First it increased the generosity of the credit for families with children aged 0-10 by a nominal amount of around 6£ p.w. (from 19.85 to 25.85 £ p.w.). Moreover, the reform increased the income threshold, before the *taper*, from 80.65£ p.w. to 90£ p.w. The third important aspect that changed was the reduction of the previously mentioned *taper* rate (or Benefit Reduction Rate) from 70% to 55%. The fourth aspect concerns the childcare component of the credit: Under the FC it was only possible to disregard childcare costs up to 60 £ p.w from the calculation of family net income. With the advent of the WFTC, the disregard was replaced by a credit worth 70% of incurred childcare costs up to a maximum of 100£ p.w. for families with 1 child and 150£ p.w. for families with two or more children [4].

On the other hand, it is a challenge to specifically single-out the effect of the WFTC on poverty rates and to disentangle it from other reforms that happened at same time in the UK, such as the introduction of the National Minimum Wage (April 1999) or the Income Support reform. Specifically, The NMW was sanctioned in 1998 by the National Minimum Wage act which made it effective at the national level starting from April 1999. The NMW was initially set at the level of 3.60 £ per hour and according to Dickens and Manning (2004) mechanically increased labor earnings of 7% of the UK workforce. Given this mechanical increase, it is clear that by increasing earnings, the NMW increases families' net income and thus impacts poverty. However, it is also evident that a NMW does not affect single childless women and single mothers in a different way. I will outline in section 5 how did I properly account for this reform in my model. On the other hand, the Income Support reforms that took place in 1998-1999 (HM Treasury, 1998) pose a different problem. Income Support is a program specifically aimed at helping those that are at the margins of the labor force (working less than 16h p.w.) for a specific reason (caring for a child aged 0-5 or severe disability, for example) and can't find a stable full time job. In 1998-1999, as part of the Labour "New Deal" for lone parents, the government increased the so-called "family premium" of income support by 2.5 £ p.w. for families with kids aged 0-11. This increase constitutes another potential reform that affected single mother differentially *vis-a-vis* single childless women. This reform influences the validity of my methodology and calls for caution in interpreting the results of my analysis especially when dealing with the primary poverty rate. However, it needs to be noted that: 1) working families (the target of the WFTC) do not receive Income Support, as they work more than 16 h p.w. 2) the "family premium" increase is substantially lower than the increase in generosity of the WFTC.

2.2. The WFTC and Net Household Income

In describing the effect of the WFTC reform on Household Income I will employ the framework used by Hoynes and Patel (2018), which make a distinction between direct (or *mechanical*) and indirect (or *behavioural*) effects on income.

[4] This implies a maximum of 70£ p.w. for families with 1 child and of around 105£ p.w. for families with 2 or more children.

The first mechanical effect is that by virtue of just receiving a more generous tax credit household net income increases. On the other hand, the discussion of the behavioural effects is slightly more complex.
The first indirect effect is that receipt of WFTC payments may induce women to change their earnings by changing their employment status. To discuss the sign of this change in earnings it is necessary to briefly refer to labour supply theory:
For unemployed single parents, the WFTC unambiguosly increases returns to work, given that the worker now earns its wage plus WFTC payments as soon as he reaches the 16h threshold. On the other hand, turning to the intensive margin of labor supply, for employed single parents in the flat income region (below 90£ p.w. but working more than 16h) the income effect that derives from the increased generosity of the credit may decrease total hours worked. This predicted income effect may partly offset the mechanical effect the WFTC has on net income and thus mitigate the probability that a relatively poor working woman crosses the poverty line.
Additionally for single parents, with incomes above the 90£ p.w. threshold the taper rate creates a negative substitution and income effect prompting a negative effect on hours worked and, as a consequence, income. To sum up, the WFTC creates a strong incentive for single parents to enter employment, which will have a positive effect on net income and has an ambiguous and possibly negative effect for those already in employment due to a negative income effect.
The third indirect effect comes from the reduction in welfare income that may come from the mechanical and behavioural increase in earnings. An example would be for example a single mother that by entering employment loses the right to claim Income Support.
To give a full picture, the group whose earnings (and position with respect to the poverty line) stands to improve the most are single mothers entering the work-force which will enjoy a positive mechanical effect, a positive "labour supply" effect and a negative "welfare income" effect. Single mothers already in the workforce face a positive mechanical effect, a negative "welfare income" effect and a more ambiguous "labor supply effect".
In the next section I will discuss how the literature studied the impact of credits like the WFTC and the EITC.

3. Literature Review

3.1. Literature on the WFTC

In this section I will briefly review the most relevant parts of the literature that evaluated the impact of the WFTC with respect to employment, childcare expenditure and fertility, using panel data or repeated cross-sections. To the best of my knowledge there is no paper yet that evaluated the WFTC and its impact on the poverty rate of single mothers using BHPS data. Consequently, I will then bridge the WFTC literature with the EITC literature and discuss how researchers evaluated the impact of the EITC on poverty rates.

Right after the implementation of the reform in October 1999, Blundell, Duncan, McCrae, and

Meghir (2000b) *simulated*, before any ex-post data became available, the potential employment effects of the credit on single mothers and women in couples. Pooling together data from the Family Resource Survey, a repeated cross-sectional random survey covering around 30000 UK households, from 1994-1996, they compute household net income using the micro-simulation model TAXBEN, by the Institute of Fiscal Studies. In order to simulate the employment effects of the reform Blundell and co-authors use the behavioural labor supply model developed in Blundell, Duncan, McCrae, and Meghir (2000a), and find that the WFTC will lead to an increase in employment of 2.2 percentage points (p.p.) for single mothers, a decrease in employment of 0.57 p.p. for women with employed partners due to the potential reduction in the benefit consequential to the woman starting to work as well, and an overall increase in labor force participation of about 30000 people.

In the following years, several researchers evaluated the impact of the WFTC after reliable survey data was published by the UK Data Service. Blundell et al. (2005) estimate a probit model with a DD specification, using single mothers as the treatment group and single women without children as the control group. They find that the WFTC led to an increase in employment of around 3.6 p.p. for single mothers, based on Labour Force Survey data from 1996-2002, and a 3.7 p.p. increase using Family Resource Survey data, another smaller representative UK survey. Their findings imply an increases of labor force participation of around 60000 people, however the authors caution the reader to interpret their results as an upper bound only as they did not properly control for the contemporary reforms taking place in the UK.

Of the papers using a DD methodology, noteworthy is Gregg, Harkness, and Smith (2003) that instead of conditioning the DD estimator on a set of control variables, uses Propensity Score Matching (PSM) to increase balance between single mothers and childless single women, and allows for differential time trends between treatment and control group. They find that the employment rate of lone parents increased by around 5 p.p. after the introduction of the WFTC. Another seminal paper is Francesconi and Van der Klaauw (2007). An important first difference from the previously mentioned literature is the use of the BHPS, which is a panel survey, different from repeated cross sections such as the Family Resource Survey or Labor Force Survey. Francesconi and Van der Klaauw (2007) use a DD specification which allows for differential time trends and controls for the reforms that were contemporaneous to the WFTC, such as the introduction of the NMW and the Income Support reforms, by interacting the post-reform period indicator with a post-reform time trend, which allows for a common jump in the slope of the function estimating the employment effects. The model however confirms the positive employment effects of the WFTC alone and finds a 5.8 p.p. increase in the labor force participation of single mothers.

Additionally, the focus of the literature turns to other important outcomes such as fertility, and marriage entry. Ohinata (2011) using BHPS data from 1995 to 2003, estimates the effect of the WFTC on fertility using a probit DD model. The peculiarity of Ohinata (2011) is that it attempts to prevent reverse causality by using the pre-reform household income data to proxy for the changes in household income that happen after the reform. Ohinata finds that the WFTC reduced the probability of having an additional birth for single mothers by 4 p.p., explaining that this reduction may be at least partly induced by the increased labor force attachment of this group, as documented in

the literature. Francesconi and Van der Klaauw (2007) use instead a linear probability model with the aforementioned DD specification, and find, using BHPS data from the period 1991-2001, that the WFTC led to a reduction in fertility of around 7 p.p. This effect is however not statistically significant in any of the model specifications they employ. Finally, Francesconi and Van der Klaauw (2007) are the only ones that analyse the effect the reform had on the probability of forming a partnership (be it simple cohabitation or marriage) and find a reduction of 28% in said probability. They imply that this effect may be a consequence of the more generous benefits lone mothers receive under the WFTC, which are inevitably reduced when forming a partnership.
In short, the literature points to a positive impact of the WFTC on the employment rate of single mothers, on the other hand there's no broad consensus on its side effect on outcomes such as fertility and partnership formation.

3.2. Literature on the EITC

The EITC is the American natural term of comparison of the WFTC, since both of the policies are in-work tax credits mainly aimed at boosting labor earnings of lower income families. The main difference between the two is that the EITC has a *phase-in* range (a range of labour earnings for which the credit gradually increases) whereas the WFTC doesn't. It is for this similarity that in order to find suitable reference papers to study the impact of in-work credits on the poverty rate of single mothers it was necessary to turn the attention on the EITC literature. In this section I will review the most relevant EITC papers and those that relate the most to my research question.

Eissa and Liebman (1996) are the first to study the impact of the 1987 EITC expansion, after the Tax Reform Act of 1986, on the labor supply decisions of single mothers both at the intensive and extensive margin. Eissa & Liebman employ a DD specification with single mothers as the treatment group and single women without children as control. In explaining their choice they mention (as stated before in this thesis with respect to the WFTC) that single mothers are the group that unambiguously benefited from the credit, because when deciding on whether to work or not they don't have to consider the labor supply decision of the partner, which may have a negative effect on the amount of credit received and thus discourage participation of the second-earner. It is then predictable using static labour supply models that the employment of single mothers on the extensive margin will increase as a result of the increased generosity of the credit. The overall effect on the intensive margin is less clear because women with incomes in the *phase-out* region face negative income and substitution effects caused by the taper rate. Moreover, to specifically single out credit recipients, the authors choose two different treatment groups: single women with children and low levels of education and single women with children and predictably low income, based on socio-economic characteristics. To find suitable groups of unaffected taxpayers they pick two different control groups: single women without children and low education and single women with no children and high levels of education. They estimate that the EITC expansion increased employment of single mothers by around 2.8 percentage points and find that there was no reduction in hours worked for taxpayers already in employment.

Another seminal contribution on the impact of the EITC on the employment of single women was given by Meyer and Rosenbaum (2001). In their paper the authors quantify how much of the increase in the employment rate of single mothers is due to the EITC expansions from 1987 to 1996. Using Current Population Survey data from the 1984-1996 period, they build on and improve Eissa and Liebman (1996)'s model, by developing a multi-period DD probit that controls for business cycle variables, such as the local unemployment rate, alongside the traditional socio-economic status controls (ethnicity, education, housing tenure). Meyer & Rosenbaum find that between 1984 and 1996 the employment rate of single mothers rose by 7.1 p.p. with respect to the employment rate of single women without children. Moreover, basing themselves on the findings of the structural labour supply model they develop, they find that the EITC alone accounts for around 60% of the overall increase in employment of single mothers.

While all of the previously mentioned papers suggest a strong positive effect of the EITC on employment of single mothers Kleven (2019), in his "reappraisal" of the employment effects of the EITC has a different view. Kleven starts by observing that over the past 40 years in the US, single mothers have almost completely bridged the employment gap with single women without children. He argues however, and later proves empirically using event studies specifications that this trend was not caused by the several EITC expansions from the 70s to the late 00s but mostly by changes in welfare recipiency rules and the booming macroeconomy of the 90s. His take can be summarised by the example of a single mothers who, because of the introduction of, say, time limits, is pushed off welfare: she will easily find a job only if there are many vacancies available and not necessarily because of the generosity of the EITC.

Finally, an interesting approach to evaluate the impact of the EITC, this time on earnings, comes from Chetty et al. (2013). Their intuition is that in order to maximally benefit from the EITC and its expansion one needs to have knowledge about the EITC schedule. Using US IRS administrative data, they proxy knowledge about the EITC schedule across different zip-codes by the amount of self-employed taxpayers that report their income exactly in the region where the credit is maximised. Using event studies, Raj Chetty and co-authors find that right around the time of child birth, women are more likely to continue working in high-knowledge zip-codes, where the amount of credit claimed is maximised. They conclude that the EITC boosted labor earnings of lower income families to a larger degree in areas with higher knowledge about the EITC schedule.

To summarise, the literature that focused on the labour supply effects of the EITC (including Kleven (2019)), concludes that, at least, the generous EITC expansions of the 90s have had positive a positive effect on the employment rate of single mothers.

3.3. The EITC and Poverty

This last sub-section will be now dedicated to the contributions that specifically focused on the impact of the EITC on poverty rates and the income distribution.

The first important study I'm going to analyse is the contribution of Hoynes and Patel (2018). Their paper is important as it is the first to quantify the "direct" and "indirect" effects of the EITC on the After Tax and Transfers Income (ATT) of single mothers. By *direct effect* the authors mean

the immediate increase in income that follows a tax payment; *indirect effects*, instead, comprise the increase in earnings and the reductions in other forms of transfer income that might follow from receiving EITC payments. The indirect effects are a consequence of the behavioural effects of the credit on labor supply decisions of single mothers. Hoynes & Patel first employ the now familiar DD specification with single mothers and single women without children, and using 1985-2014 CPS data compute poverty rates as the share of women with ATT below the federal poverty line. They find the EITC decreased by around 7 p.p. the poverty rate of single mothers. Moreover, Hoynes & Patel improve their DD model, to counter the threat of reverse causality that follows from the relationship between EITC payments and income, by substituting the traditional $Treat \times Post$ indicator with $\overline{SIMEITC}$, which is the simulated EITC payment a family would receive, based on pre-reform characteristics, without any behavioural response, in a given year. Using $\overline{SIMEITC}$ they design a "parametric" DD, where they find that the credit led to a decrease of 8.4 p.p. of single mother's poverty rate for every 1000$ increase in EITC payments. In my thesis I only inspire myself to the DD specification, not the tax simulation. Hoynes & Patel findings seem to confirm the anti poverty effects that credits like the EITC and, by extension, the WFTC may have.

Another important contribution to the literature is given by Gundersen and Ziliak (2004). First, they do not use the poverty rate itself but instead a poverty index, computed as the squared poverty gap[5], which allows them to analyse not only the poverty headcount but also the depth of individual's poverty. Gundersen and Ziliak (2004) specify a dynamic fixed effects model of the effects of various US social policies and general macroeconomic performance on the poverty index, and find that the EITC expansions of the 90s reduced the overall before-tax poverty index by 9% more than the expansions of the 80s, just by stimulating labor force participation and increasing earned labor income, and reduced the after-tax index by an additional 5% . Hence, the authors conclude that EITC is a good anti-poverty program that effectively redistributes income to the poorer subsets of the population.

Grogger (2003) in his paper dedicated to the effects of welfare time limits on welfare use, earnings and employment, dedicates a section to the impact of the EITC on income and earnings. Employing a fixed effects model exploiting welfare policy variation at the state level applied to Current Population Survey data, Grogger finds that the 1993-1996 expansions of the EITC, through the earnings boost it gave to poorer people and the incentives to enter employment, reduced welfare use by 15.8%. What is interesting for the purpose of this thesis and links to the direct and indirect effects of the EITC on ATT income discussed in Hoynes and Patel (2018), is that according to Grogger the EITC is associated with an increase in earnings, which may stem from its employment effects and with a decrease in welfare income. Grogger's analysis suggests that the EITC can be considered a success in reducing welfare usage, which was one of the aims of the US welfare reforms of the late 80s and 90s.

The final article I will include in this review is Bollinger, Gonzalez, and Ziliak (2009), an extension to Grogger (2003) that studies the effect of the EITC on earnings and income, considering a

[5]The poverty gap is computed as $GAP = \sum \frac{(z_t - y_t^q)^\alpha}{z_t}$ where z_t is the family specific poverty threshold, and y_t is the family's income. Depending on the exponent α the researcher gives increasing weight to the poorest households, thus quantifying the depth of poverty.

longer time frame. Bollinger and co-author's paper uses CPS data up until the 2004 wave. The authors compute family net income starting from the CPS and derive tax liabilities and credits using TAXSIM, the tax simulator of the NBER. They then develop a model of income and earnings using as explanatory variables the individual's socioeconomic characteristics alongside state-level welfare policy and business cycle indicators and education level controls based on the evidence that people in different percentiles of the income distribution were affected differently by the EITC and welfare reforms. In fact, Bollinger et al. (2009) find that individuals in the 10th percentile of the distribution, even after the EITC expansions, still rely heavily on welfare income. Nonetheless, the EITC can be considered responsible for a sizable increase in real income experienced by people in the 25th percentile between 1993 and 2004.

The findings of the literature on the positive effect of the EITC on poverty, earnings and income, would suggest that a similar effect is foreseeable for single mothers after the WFTC expansion of 1999.

4. The Data

In order to perform my analysis I used the *waves* 5 to 13 of the British Household Panel Survey (University of Essex, Institute for Social and Economic Research, 2018), covering the time period 1995-2003. The choice of the time frame depends on the fact that I aim to observe the pre-reform trends of the poverty rate of single women, and it is only meaningful to evaluate the WFTC up until 2003 when it was reorganised into the Working Tax Credit and Child Tax Credit. To create a suitable dataset of all of the single women that were likely affected by the WFTC I first excluded from the analysis respondents from the European Community Household Panel subsample and those from the Scotland, Wales and Northern Ireland booster samples, as Francesconi and Van der Klaauw (2007) did, since they only started being interviewed in later waves, and are not part of the original BHPS sample[6]. Moreover, given that the WFTC is only administered to working individuals I excluded from the analysis full time students, the long-term disabled and individuals who are retired at the time of the interview. Moreover, in order to select single women I excluded married and cohabiting women, which left me with only benefit units (families) comprising single women without children and single mothers. As a final step, using the variable *"wEEAGE"*, I selected working-age (16-59) women.

Using this procedure, each of the 9 waves analysed carries around 800 women-wave pairs, yielding a final dataset of 7151 women-wave pairs (observations), 4950 of which are single childless women, and 2201 are single mothers. Each of the individuals is observed on average for 3.7 waves, which implies that the analysis will be carried out on an unbalanced panel. This is a consequence of the fact that changes in marital or cohabitation status imply exit from the analysed sample. In the robustness checks section I'll also study whether movements from the control to the treatment group pose a concern to the validity of the results.

[6]Original sample members (OSM) are identified by the value 10 of the variable *wMEMORIG*.

4.1. The Poverty Rate

In this section I will report the computation of the poverty rate used in my thesis. I started from the work of Levy, Bardasi, Jenkins, Zantomio, and Sutherland (2012) which computed net weekly household income for each of the respondents to the BHPS. To allow for greater comparability across years all income values are converted into January 2010 Prices. The resulting definition of household net income is the following:

$$HouseholdNetIncome^{t}_{2010RPI} = NetLabourEarnings + InvestmentIncome + BenefitIncome(incl.WFTC) + WelfareIncome - LocalTaxes$$

Where Labour Earnings comprise employment earnings minus National Insurance contributions, pension contributions and Income Taxes. Investment Income includes weekly dividend or interest income obtained. Welfare Income includes weekly cash welfare transfers. Local Taxes include the Uk Council Tax. Household Net Income resembles the ATT measure included in Hoynes and Patel (2018), and includes WFTC payments. Because this is a self-reported measure of income its validity is hampered by the threat of measurement error. Nonetheless, the BHPS is deemed to be a very high-quality survey which specifically asks about each of the aforementioned components of net income, signifying that there's no imputation of tax liability involved in the computation of household net income.
Consequently, I collected the values of weekly equivalised median income from the Household Below Average Income (HBAI) survey (Department for Work and Pensions, 2020), reported in 2019 prices. I use equivalised median income as it allows for a meaningful comparison across different household sizes, I then normalised prices by converting the median income reported in January 2019 prices into January 2010 prices using the RPI [7] series by the UK Office of National Statistics (ONS), which is the same used by Levy et al. (2012):

$$MedianIncome_t(Jan.2010Prices) = MedianIncome_t(Jan.2019Prices) \times \frac{RPIJan.2010}{RPIJan.2019}$$

Finally, as my baseline specification, I computed the poverty rate as the fraction of individuals in the sample with Household Income below 60% of median equivalised household income. I use the official measure of *relative* poverty set by the HBAI survey. It is a measure of relative poverty because it compares Household Income in year t with the median equivalised income in the same year, and median income varies every year according to national statistics[8]. My approach measures the so-called poverty *head-count* that is the number of people with income below a given threshold. Its main shortfall is that it does not capture the depth of poverty but only whether someone is above or below 60% of median income. For this reason, this measure of poverty may bias policy towards only helping the "least" poor, those just below the threshold, thus leading to a potential overstatement of a policy's anty-poverty effect. An interesting solution to this limitation of the poverty rate I

[7] RPI is a consumer price inflation series that comprises all items excluding mortgage interest and council tax `https://www.ons.gov.uk/economy/inflationandpriceindices/timeseries/dqad`

[8] The absolute poverty line is set at 60% of the median household income in 2011.

adopted is the poverty Index proposed by Gundersen and Ziliak (2004), briefly outlined in Footnote 6. The index is also able to capture the depth of poverty by quantifying the distance between household income and the poverty threshold. I will propose the use of this measure as an extension to my work.
In section 6 I extend my analysis to different multiples of the median equivalised income.

4.2. Summary Statistics

In this subsection I will present summary statistics for the socioeconomic characteristics (*Table 1*) and labor market outcomes(*Table 2*) I collected for the purpose of my analysis. The third column in both tables displays the difference between the means of single mothers and single childless women with significance stars: $^{***}p < 0.01$, $^{**}\ p < 0.05$, $^{*}p < 0.1$

It can be seen from Table 1 that single mothers are on average older than single childless women (35 v 31 years old), and have lower levels of university degree attainment. This is understandable as pregnancy and consequent childbirth are likely to interrupt or put on hold the studies the prospective mother was potentially undertaking, especially if the pregnancy comes in the late teens or early twenties. Additionally, single mothers have double the rate of no educational qualifications (significant at the 1% level) which supports this line of reasoning.
While there is a good balance in terms of ethnicity, with the exception of women of black ethnicity where there's a 1.7 p.p. difference, single mothers show lower rates of house ownership (43.8% against 66.1% of single women) and live in significantly higher percentages in social housing. Furthermore, I report statistics on the number of children, obviously for single mother only, and it is interesting to notice that slightly less than half of our sample of single mother has more than one dependent child, and thus receives the maximum amount of the childcare credit component of the WFTC, which will predictably have a stronger effect on non equivalised net income.

In Table 2, on the other hand I report summary statistics of the poverty rates, weekly income, employment rate and other financial situation indicators of the sample of single women analysed.
The first aspect to notice is that single mothers display significantly higher poverty rates over the whole time span considered. In the first row of Table 2 it can be seen that over the 9 years considered, the average poverty rate of single mothers is 19.7%, while that of childless single women is 8.1%, implying a statistically significant gap of almost 12 p.p. Additionally, there exists a gap of respectively 31.8 and 39.9 p.p. in the fraction below 100% and 150 % of median income. For now I will leave the reader with this static representation of the poverty rate and I'll present its evolution over time when discussing the parallel trends assumptions in the next subsection.
This gap in the poverty rates is fundamentally explained by the fact that average weekly net income differs by around 265 £ from single childless women to single mothers. To further support the reasoning that there exists a gap in the economic statuses of single mothers and single childless women, employment (self-reported economic status in the BHPS) also differs significantly between the two groups, for single childless women it almost touches 90%, whereas it is only 56% for single mothers. The final three rows display self-reported financial situation and further prove the existence of said gap between the groups in terms of economic outcomes, which provides additional justification for

Table 1: The socio-economic characteristics of non-cohabiting single women and single mothers

Variable	Single Childless	Single Mothers	Diff.
Age	30.529	34.843	4.314***
	(11.615)	(8.305)	(0.274)
Education			
University degree	0.212	0.066	-0.146***
	(0.408)	(0.248)	(0.009)
Higher Vocational Qualif.	0.229	0.275	0.046***
	(0.420)	(0.447)	(0.011)
A levels	0.158	0.098	-0.060***
	(0.365)	(0.298)	(0.009)
O levels	0.203	0.239	0.036***
	(0.402)	(0.426)	(0.010)
Lower than O levels	0.070	0.134	0.063***
	(0.256)	(0.340)	(0.007)
No Qualifications	0.075	0.149	0.075***
	(0.263)	(0.357)	(0.008)
Ethnicity			
White	0.926	0.924	-0.002
	(0.262)	(0.266)	(0.007)
Black	0.019	0.037	0.017***
	(0.138)	(0.188)	(0.004)
Indian	0.011	0.013	0.003
	(0.102)	(0.114)	(0.003)
Pakistani or Bangladeshi	0.002	0.001	-0.001
	(0.045)	(0.030)	(0.001)
Chinese or Other	0.013	0.011	-0.002
	(0.113)	(0.106)	(0.003)
N. of dep. Children			
1 dependent child		0.539	
		(0.500)	
2 dependent children		0.338	
		(0.466)	
3 dependent children		0.098	
		(0.290)	
More than 3 dependent children		0.025	
		(0.152)	
Housing Tenure			
House Ownership	0.661	0.438	-0.223***
	(0.473)	(0.496)	(0.012)
In Social Housing	0.155	0.426	0.271***
	(0.362)	(0.495)	(0.010)
Privately Rented Housing	0.163	0.116	-0.047***
	(0.369)	(0.321)	(0.009)
Observations	4,950	2,201	7151

Note: *Std. Deviations in Parenthesis. Statistics reported represent averages over the 1995-2003 period.*

Table 2: Summary of Outcome & Financial Situation Variables

Variable	Single Childless	Single Mothers	Diff.
Poverty Rates and Income			
% below 60% of median income	0.081	0.197	0.117***
	(0.272)	(0.398)	(0.008)
% below 100% of median income	0.223	0.540	0.318***
	(0.416)	(0.498)	(0.011)
% below 150% of median income	0.378	0.776	0.399***
	(0.485)	(0.417)	(0.012)
Weekly Net household Income (not eq.)	589.575	324.174	-265.401***
	(408.095)	(207.081)	(9.667)
Financial and Economic Situation Variables			
Emp. Rate (at least 1h p.w.)	0.882	0.561	-0.321***
	(0.323)	(0.496)	(0.010)
Signed at UB office	0.047	0.040	-0.006
	(0.211)	(0.197)	(0.005)
Has use of a car	0.568	0.547	-0.021
	(0.495)	(0.498)	(0.013)
Good Financial Situation	0.623	0.375	-0.248***
	(0.485)	(0.484)	(0.012)
Decent Financial Situation	0.307	0.527	0.219***
	(0.461)	(0.499)	(0.012)
Difficult Financial Situation	0.035	0.078	0.043***
	(0.183)	(0.268)	(0.005)
Observations	4,950	2,201	7151

Note: *Std. Deviations in Parenthesis. Statistics reported represent averages over the 1995-2003 period.*

the reform of the WFTC by the Blair Government.

4.3. The Parallel Trends Assumption

Figure 1 depicts the evolution over time of the poverty rates of single childless women (in blue) and single mothers (in dashed red) before and after the introduction of the WFTC in 1999.

As outlined by Angrist and Pischke (2008), the assumption that needs to hold for a *difference-in-difference* estimator to provide an unbiased estimate of the treatment effect is the so-called *parallel trends* assumption. The assumption holds if the trends of the outcome variable for the treatment and control group run parallel and would continue running parallel had it not been for the treatment. The parallel trends assumption cannot be formally tested as it would require measurements of the outcomes of the treated in the absence of treatment, which are unobserved. It is only possible to get an idea of the counterfactual trend by observing the pre and post reform trends of treatment and control group, and assuming that in the absence of treatment the treated would have followed the same pre-reform trend. It is not possible to be fully confident about this approach but certainly parallel pre-reform trends increase confidence in the validity of results.

In figure 1, it is evident that while single women without children are on a stable flat trend, the pre-reform trend of single mothers presents more variation. Specifically, the mean poverty rate of single mothers drops already significantly from 1998 to 1999, signifying that families possibly anticipated the reform, and changed their behaviour to, as an example, start working, in order to become eligible for the more generous tax credit. This is possible as the WFTC was *announced* in the 1998 budget (HM Treasury, 1998) but was only *credited* to tax-payers in their 1999 tax filings,

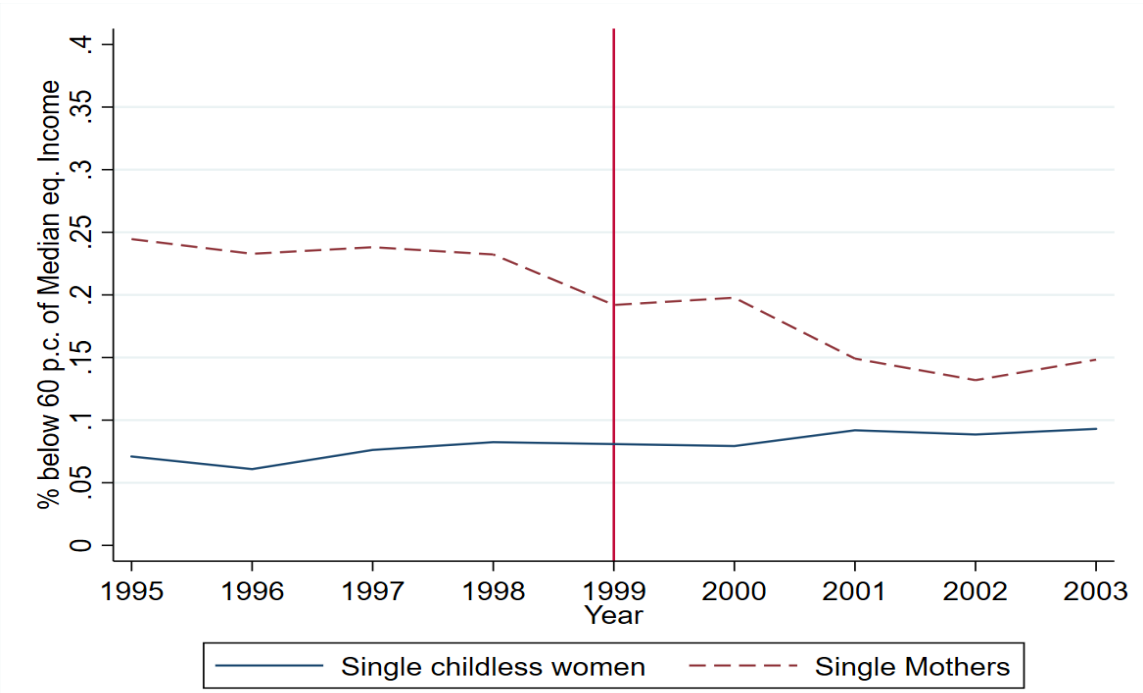

Figure 1: The evolution of the poverty rates of single mothers and single childless women over the period 1994-2003

for this reason the vertical line that denotes treatment is placed on the year 1999.
The bumps in the pre-reform trend of single mothers make the parallel trends assumption unlikely to hold, for this reason I took the approach of Francesconi and Van der Klaauw (2007) and Gregg et al. (2003) who allowed for different time trends for control and treatment group in their preferred model specification. I will extensively outline the model in section 5. To conclude, I report the time trends of the percentage of single women below 100% and 150% of the equivalised median income in Appendix A, Figures 2 and 3 respectively.

5. Methodology

The estimation technique I prefer for this thesis is a OLS linear probability model, preferred to a probit because it doesn't allow fixed effects or a logit model, which only allow fixed effects under strict assumptions (Katz, 2001). The evaluation is performed through a DD estimator using single mothers as the treatment group and single childless women as the control group, given that the WFTC is only administered to working individuals with dependent children. I follow Hoynes and Patel (2018) which use a DD model to evaluate the impact of the US EITC with respect to the poverty rate of single mothers. I am, however, partly using the econometric specification employed in Francesconi and Van der Klaauw (2007) which allows for different linear trends of treatment and control group. In this section, I will start to outline the most basic DD model I will use, after that

I will explain the Francesconi/Van Der Klaauw model and finally my own addition to their model. The first model I estimate is the following:

$$Y_{it} = \alpha_i + \rho * D_{it} + \tau * Post_t + \beta_1 * D_{it} * Post_t + \theta * X_{it} + \varepsilon_{it}$$

Where Y_{it} is a dummy variable that takes value 1 if individual i is below the poverty line at time t. α_i represents the individual fixed effects which capture the time-invariant unobserved factors that influence whether an individual is below the poverty line or not. D_{it} is a dummy variable that takes value 1 if the woman is a single mother, and ρ captures the pre-reform differences in poverty rates between single childless women and single mothers. $Post_t$ is a dummy variable that takes value 1 for the years including and after 1999, the year of the reform. τ measures the difference, in average poverty rate across the two groups, with respect to the pre-reform period. The coefficient of interest of this model is β_1, which captures the causal effect of the WFTC on the poverty rate of single mothers relative to that of single childless women.
The data section outlined that there are several differences between the baseline socio-economic and financial situation characteristics of single childless women and single mothers. For this reason, I include in my model X_{it}, which controls for within-individual variations across time of, for example, the number of dependent children and housing tenure, which are not picked up by the individual fixed effects. ε_{it} represents the error term.
As anticipated in section 4.3, the validity of the previously outlined model relies on the parallel trends assumption which, after analysing Figure 1, is unlikely to hold. Therefore, to improve the first model I allow for differential linear trends and control for the reforms that took place in the same year as the WFTC reform and affected single childless women and single mothers in the same way. The second model I estimate is the following:

$$Y_{it} = \alpha_i + \rho * D_{it} + (\lambda_1 + \lambda_2 * D_{it}) * Year_t + (\tau_1 + \tau_2 * (Year_t - 1999)) * Post_t + \beta_2 * D_{it} * Post_t + \\ + \theta * X_{it} + \varepsilon_{it}$$

Where $Year_t$ is the time variable that varies at the yearly level. λ_1 represents the pre-reform time trend of the poverty rate of single childless women, whereas λ_2 interacted with D_{it} represents the same trend for single mothers.
$\tau_2 * (Year_t - 1999) * Post_t$, is another addition inspired by the model of Francesconi and Van der Klaauw (2007), and controls for the possible shocks to the average poverty rate Y_{it} common to both treatment and control group, that happened after the 1999 WFTC reform ($Year_t - 1999 * Post_t$). In my setting it controls for reforms that happened at the same time as the WFTC, such as the introduction of the NMW and the Income Support reforms (Outlined in Section 2), which affected both single childless women and single mothers at the same time. By assuming that single women and single mothers reacted in the same way to these reforms, they can be assumed to be properly controlled for. Once we control for all of the contemporaneous reforms, what remains is β_2, which captures the causal effect of the WFTC (the main reform that impacted childless single women and single mothers differently) on the poverty rate of single mothers relative to that of single childless

women.
Lastly, by observing Figure 1, it is also evident that the WFTC reform did not have a one-off effect on the poverty rate of single mothers, after which said measure remained constant and on a stable trend. In fact, it can be argued that the WFTC reform changed the post-reform trend, prompting a more gradual decrease of the poverty rate of single mothers. This is consistent with Chetty et al. (2013)'s argument that states that the impact of credits like the EITC/WFTC on earnings also depends on how knowledgeable citizens are about their existence. Hence, I argue here that it is likely that it took time for single mothers in the UK to completely adjust to the new credit and take full advantage of it. For this reason, I add in my last model specification an interaction between $D_{it} * Post_t$ and the time trend $Year_t$. The final model I estimate is:

$$Y_{it} = \alpha_i + \rho * D_{it} + (\lambda_1 + \lambda_2 * D_{it}) * Year_t + (\tau_1 + \tau_2 * (Year_t - 1999)) * Post_t + \\ \beta_3 * D_{it} * Post_t + \pi * D_{it} * Post_t * Year_t + \theta * X_{it} + \varepsilon_{it}$$

As anticipated, the peculiarity of this model is the addition of the term $D_{it} * Post_t * Year_t$, which represents the post reform time trend of the poverty rate of single mothers. Consequently, π measures the difference between the post reform trend and the general trend captured by λ_2. The expectation is that I will find π to be negative.
Finally, because I allow for fixed effects in all of my model specifications, I use standard errors clustered at the individual level, which account for serial correlation within the clusters and thus increase the consistency of my results with respect to the critique expressed by Bertrand, Duflo, and Mullainathan (2004), who imply that without aptly correcting for serial correlation the DD estimator may severely suffer from *Type I* error. This means that with traditional OLS standard errors the researcher finds statistically significant results at rates that are anomalously high.

5.1. Threats to Causal Identification

In section 4.3, after analysing the pre-reform trends of the poverty rates of treatment and control group, it was concluded that these were arguably not running parallel. To overcome this first obstacle I allowed for different time trends for treatment and control group in my main model specification. The difference between the β coefficient of models 1 (without linear trends) and model 2 (including linear trends) will prove how consequential their addition to the model is.
Another issue is represented by the exogeneity of the being a single childless woman or a lone mother. Starting by the findings of the literature, there's no clear consensus as to whether the WFTC creates incentives or disincentives on childbirth: Ohinata (2011) finds a 4 p.p. reduction, Francesconi and Van der Klaauw (2007) no significant effect. The individual fixed effects do not allow us to control for time-varying shocks that may induce single childless women to give birth and become single mothers. This consideration means that my analysis may suffer from a *composition effect*: there's the risk that the reduction in poverty observed in Figure 1 may not be due to the WFTC but simply to richer single childless women (*see Table 2*) entering lone motherhood and thus

reducing the poverty rate. However, the mechanism is not entirely clear as common sense would want single childless women that give birth to also exit the "single" status. I will nonetheless test for this threat in the robustness checks section (6.3).
Finally the identifying assumption of the model is that there are no other reforms that affect the *relative* poverty rates of single mothers and childless single women. If other reforms implemented at the same time as the WFTC reform, boosted the net income of single mothers in a different way as to that of single childless women, then the estimates may be biased, Francesconi and Van der Klaauw (2007) point to the fact that the Income support reforms of the period 1998-1999 may be problematic in that respect. This is plausible given that Income Support assigns a cash bonus of 2.5£ p.w. to lone parents with young dependent children. However, as discussed in section 2.1, the Income Support does not target the very same individuals as the WFTC, and it the IS "child bonus" is considerably less generous than WFTC payments.

6. Results

I outline in Table 3 the results of the three different models I estimated to evaluate the impact of the WFTC on the poverty rates of single mothers. The model presented in column 1 of Table 3 is the first DD model specified in section 5, with the "Treatment Effect" coefficient being the β of the model. In column 2 I present the results for the second model with different linear trends, inspired by Francesconi & Van der Klaauw, and in the third column I include the indicator of the post-reform trend of single mothers labeled "Single Mothers Post-Reform Trend".
All of the three models include the set of controls summarised in Table 1: age categorised in 3 different tiers (16-24, 25-34, 35-59), education level, housing tenure. Ethnicity, on the other hand, is accounted for by the individual fixed effects. All of these indicators are likely to be correlated with both the poverty rate and lone mother status and, hence, add explanatory power to our model. Additionally, in Section 6.2 I explain the results of my analysis of the impact of the WFTC on the percentage of people below 100% and 150% of Median equivalised UK household income. The implications of this set of results are important and give context on the categories of women that benefited the most from the WFTC expansion. Finally, in Section 6.3 I test the robustness of my results to the concern of a composition effect.

6.1. Interpretation of the Results

The coefficient that captures the one-off treatment effect of the WFTC reform on the poverty rate of single mothers is "Treatment Effect", and in all three models is given by an interaction of the post-reform period and the treatment group indicator.
Regardless of the model specification, after allowing for individual fixed effects, *becoming* a single mother is associated with an increase in the poverty rate, with respect to single childless women. Said increase amounts to 0.37 p.p. in the first model, 6.2 p.p. in the second and around 2 p.p. in the third. However, the "Single Mothers" coefficient is statistically not significant in all of the three models, which is probably due to the fact that the gap in poverty rates between treatment

Table 3: *The Effects of the WFTC on the % of Single Mothers below the Poverty Line*

	(1) Standard Controls	(2) Linear Trends	(3) Post-Reform Trend
Treatment Effect (β)	-0.0776***	-0.00849	0.102
	(0.0236)	(0.0339)	(0.0734)
Single Mothers	0.00360	0.0618	0.0197
	(0.0392)	(0.0466)	(0.0562)
Post-Reform Period	0.0377***	0.00199	0.0105
	(0.0113)	(0.0144)	(0.0143)
Time Trend		0.00994*	0.00402
		(0.00560)	(0.00574)
Treatment Group Trend		-0.0178**	-0.000230
		(0.00744)	(0.0132)
Change in Slope (τ_2)		-0.000731	0.00821
		(0.00672)	(0.00705)
Single Mothers Post-Reform Trend			-0.0269*
			(0.0159)
Education & Tenure Controls	✓	✓	✓
Individual FE	✓	✓	✓
Observations	7151	7151	7151
R^2	0.0232	0.0252	0.0261

Note: *Clustered SE in parentheses* ***$p < 0.01$, ** $p < 0.05$, *$p < 0.1$

and control varies considerably over time, as it can be seen in Figure 1.
It is however interesting to analyse how the estimated treatment effect changes between the different model specifications.
Model 1 suggests that after the implementation of the WFTC, the poverty rate of lone mothers decreased by a statistically significant 7.6 percentage points. This would be an incredibly sizable effect and would conclusively lead us to consider the WFTC as a success in reducing the poverty rate of a group that before the reform had lower employment rates, lower income and a higher poverty rate than single childless women. However, as anticipated in Section 5, Model 1 is both unable to capture the different linear trends of the groups and the gradual reduction in the poverty rate that came after the reform, and it is therefore the least internally valid of my three models.
When it comes to Model 2 (*Column 2*), in order to have a meaningful discussion of the treatment effect it is necessary to first comment on the two "Time Trend" coefficients. While the overall trend is almost flat and only hints at a yearly increase of the poverty rate of 0.9 p.p., single mothers' poverty rate is recognised to be on a decreasing trend, with the coefficient implying that the poverty rate of single mothers *relative* to that of single childless women is experiencing an average yearly decrease of 1.8 p.p. This is a first important result because it means that the model recognises the reduction of the poverty rate of single mothers shown in Figure 1, even though the problem lies in the fact that this reduction is not attributed to the WFTC reform but to a general decreasing trend. In fact, in Model 2, the one-off treatment effect captured by the β coefficient becomes smaller (0.8 p.p. reduction) and statistically not significant. This implies that after controlling for different linear trends and the contemporaneous reforms (coeff. τ_2), the effect of the WFTC reform on the poverty rate of single mothers relative to that of single childless women is almost null. Said finding seems a bit suspicious after looking at Figure 1 and at the time trend of the treatment group, and it points to a potential shortcoming of model 2: not being able to allow for a more gradual treatment effect.

As started earlier, Model 3 addresses this concern by including the "Single Mothers Post-Reform Trend" coefficient. This coefficient accounts for a shift in the time trend of the poverty rate of single mothers relative to single childless women, that happens after the WFTC reform. While the "Treatment Group Trend" coefficient measured the difference between the overall time trend of single childless women and single mothers' trend, this final coefficient measures the difference between the pre-reform and the post-reform trend of single mothers *vis-a-vis* single childless women. The interpretation is the following: the poverty rate of single mothers after the WFTC reform in 1999 experienced an average yearly decrease of 2.7 p.p. relative to that of single childless women, significant at the 10% level. Model 3 is my preferred model specification as it best fits the data visualised in Figure 1.
In the next subsection I will outline the effect of the WFTC on the percentage of single women below 100% and 150% of Median Income, to test whether the WFTC had a positive effect on lone parents who were plausibly already working and see whether, on top of benefiting from a positive mechanical, they also experienced a positive labour supply effect on their income.

6.2. 100% and 150% of Median Income

In the previous subsection I first presented the results of the statistical analysis I conducted and subsequently showed how sensitive these were to changes in the modeling of the poverty rate.
As an addition to the analysis of the poverty rate in section 6.1, in this subsection I will study the impact of the WFTC reform on different multiples of the UK median equivalised income. Before I start, I will refer to Figure 2 and Table 5 (*Appendix*) when discussing the impact of the WFTC on the percentage of single women below 100% of median income and to Figure 3 and Table 6 (*Appendix*) when referring to the impact on the percentage of single women below 150% of median income.
When looking at model 1 in Tables 5 and 6, it is important to notice that the "Treatment Effect" coefficient is larger in magnitude than the coefficient estimated in Table 3: In Table 5 it implies that the WFTC led to a reduction in the percentage of single mothers below median eq. income of 16.8 p.p. and In Table 6 it implies a reduction of the percentage of single mothers below 150% of median eq. income of 11.6 p.p.
The same phenomenon is present to a smaller degree for model 2 and in the "Single Mothers Post-Reform Trend" coefficient in Model 3, Tables 5 and 6. In model 2, by looking at the treatment group's trend it is possible to see that the two alternative measures of poverty of single mothers are on a stronger decreasing **overall trend** than the percentage of single mothers below the HBAI poverty line. The percentage of single mothers below median eq. income (Table 5) is decreasing by an yearly average 4.06 p.p. *relative* to single childless women, and the percentage of single mothers below 150% of median eq. income (Table 6) is decreasing by an yearly average of 3.4 p.p.. Finally, Model 3 in Table 5 and 6 suggests that single mothers had a stronger decreasing **post-reform trend** relative to single childless women. From Table 5, it can be seen that after the reform the percentage of single mothers below median eq. income decreased by an yearly average of 3.89 p.p. (significant at the 5% level) and, from Table 6, the percentage of single mothers below 150% of median eq. income decreased an yearly average of almost 3 p.p. (significant at the 10% level).
It is not easy to concile this set of results with those from section 6.1. Moreover, without any further statistical tests it is only possible to argue for a possible explanation and present its limitations. In section 2, I outlined how the WFTC had, first, a positive mechanical effect on income and second a behavioural effect on labour supply decisions of single parents. The behavioural effect on income is theoretically positive on unemployed single parents and more ambiguous, potentially negative on already employed single parents.
The results from section 6.2 seem to suggest that the effect of the WFTC was stronger for people with incomes above 60% of median eq. income but below 100% and 150% of the same threshold. The single mothers with incomes within said bands are likely to have been already employed. Hence, this points to the fact that, contrary to the theory, the behavioural labour supply effect of the WFTC was, at least *plausibly*, positive for already employed women as well. The mechanism would run as follows: employed single women after the reform received 1) more generous payments 2) a proper childcare credit (they could afford more childcare); and for these reasons they may have also decided to increase even further their weekly hours of paid work from, say, 16h p.w. to 24 or

32 hours p.w., thus increasing their weekly income. Moreover, this view is also consistent with the finding that the effect of the WFTC was smaller on the percentage of people below 150% of median eq. income. This comes as a direct consequence of the existence of the taper rate: if weekly income is too high then the credit is gradually reduced and the mechanical effect becomes smaller.
The great limitation of this explanation is that it is argumentative only and it doesn't come accompanied with a thorough study of the income distribution of single women in the UK and their employment trends. I will leave to future researchers to take up my thesis and investigate this issue.

6.3. Robustness Checks

Table 4: *Robustness Check: The 3 models using only those that have no changes in their Treatment status*

	(1) Standard Controls	(2) Linear Trends	(3) Post-Reform Trend
Treatment Effect	-0.102***	-0.0258	0.144*
	(0.0271)	(0.0378)	(0.0778)
Single Mothers	0.0552	0.126	0.0730
	(0.0724)	(0.0780)	(0.0822)
Post-Reform Period	0.0339***	-0.00218	0.00923
	(0.0115)	(0.0144)	(0.0142)
Time Trend		0.0117**	0.00363
		(0.00581)	(0.00593)
Treatment Group Trend		-0.0197**	0.00746
		(0.00807)	(0.0146)
Change in Slope (τ_2)		-0.00483	0.00751
		(0.00688)	(0.00717)
Single Mothers Post-Reform Trend			-0.0418**
			(0.0172)
Education & Tenure Controls	✓	✓	✓
Individual FE	✓	✓	✓
Observations	6451	6451	6451
R^2	0.0216	0.0240	0.0261

Note: *Clustered SE in parentheses* ***$p < 0.01$, ** $p < 0.05$, *$p < 0.1$

Table 4 displays the results for the main robustness check of this thesis: testing for the presence of a *composition effect*. The dependent variable I use in Table 4 is the baseline poverty rate. The procedure I follow is simple. First I computed the first difference of the *treatment* variable for each of the individual cross-wave identifiers I gathered (*pid* in the BHPS), then I took the summation of the first differences, for each of the identifiers. The *pid*s with a summation that equals 0 are the ones considered to not have changed status. Said procedure yields 6451 observations, meaning exactly 700 (10% of the sample) single women changed their treatment status between 1995 and 2003.

The first thing to notice is that these changes in status are definitely not a marginal phenomenon as commented before, but actually took place for a small but still consistent portion of the sample considered. Having said that, it is foreseeable that by computing the same regression over a different and smaller sample the coefficients of interest will change to a small extent, hence the purpose of this subsection will be to check whether these changes fundamentally alter the substance of my results.

In the first model the coefficient of interest changes from a reduction in the poverty rate single mothers of 7.7 p.p. to one of around 10.2 p.p.. In the second model the treatment effect remains small and not statistically significant. In the third model the "Single Mothers Post-Reform Trend" coefficient becomes more negative and implies a negative post-reform trend for single mothers of -4.2 p.p. per year (significant at the 5% level). It can be said that the removal of the single women that changed their treatment status decreases the coefficient of interests in Models 1 and 3 and does not alter the treatment effect of Model 2, and more generally does not alter their sign and magnitude substantially. It is however difficult to clearly disentangle the composition effects from the consequences of having a smaller sample size, and this certainly points to a limitation of my research, which can be improved by using different surveys that interview larger amounts of people on a yearly basis such as the FRS or the LFS.

7. Discussion & Conclusion

The results section left us with two main take-away messages. The first is that the WFTC reform did not prompt a clear one-off reduction in the poverty rate of single mothers. Rather, it inverted the post-reform time trend, inducing an average yearly reduction of the poverty rate of single mothers of around 2.7 p.p., significant at the 10% level. This more gradual process, as anticipated in Section 5, is consistent with the findings of (Chetty et al., 2013) on the effects of knowledge about EITC tax schedules on recipients' earnings. From section 6, it appears that, with time, lone parents became more aware of the renewed WFTC and thus were better able to reap the benefits of the increased generosity of the payments and childcare credit. The second take-away message is that, it appears that the WFTC reform had a strong "labour supply" effect and induced lone mothers already in the workforce to increase even further their hours of work. Working more hours has the consequence of increasing income and that is why the post-reform time trend of the percentage of single mothers below median income is decreasing at a yearly rate of 3.9 p.p. I outlined the weaknesses of this reasoning in Section 6.2, it needs to be noted however that many papers such as Francesconi and Van der Klaauw (2007) and Blundell et al. (2000a) do document a substantial increase in the employment rate of single mothers. Finally, to answer the research question, it can be said that the WFTC reform reduced the poverty rate of single mothers in a gradual way and had a positive effect for single mothers in other percentiles of the UK income distribution.

On a policy perspective, the WFTC reform has important implications. By looking at Figure 1 and Table 3 it is clear that it is an effective anti-poverty tool. However, were the UK government concerned about obtaining a substantial immediate effect then the reform of such an important credit should be accompanied by a substantial information campaign. The motivation of this

recommendation comes from the work of Chetty, Looney, and Kroft (2009), which conclude (in a different setting, but still providing valuable insights) that consumers react more to taxes that are more salient. Thus, making the WFTC even more salient through an information campaign would potentially increase take-up among subsets of the population that do not have direct access to a tax advisor. Additionally, the smaller effect observed on the poorer subset of single women analysed (those below 60 % of median eq. income), suggest that the WFTC is helpful in improving conditions for the working poor but in order to help those in deep-poverty, who are at the margins of the labor force, it may still be necessary to rely in other forms of welfare such as Income Support.
Moreover, my approach suffers from two considerable limitations that may influence the validity of my results. The first may lie in the selection of the model. In Section 4.3 I pointed out to the fact the poverty rate of single mothers appeared to be dropping already between 1998 and 1999, before the policy was implemented, and in general followed a less stable trend than the poverty rate of single childless women, thus causing a violation of the parallel trends assumption. In order to overcome such obstacle, I decided to control for the different time trends of the two groups. However, if single mothers somehow anticipated the policy reform, as it is possible since it was approved in the 1998 budget (HM Treasury, 1998), and reacted to the announcement by changing their behaviour and, for example, started looking for a job in order to become eligible, another, possibly more effective, way to study the treatment effect of the WFTC would have been to conduct an event study. This is because event studies are the most suitable method to study dynamic treatment effects, and allow to capture both the *anticipation* and the *post-reform reactions* of the treated, better than the DD estimator. This limitation is reinforced by the argument I make about the gradual effect that the WFTC reform had on the poverty rate of single mothers **after** the reform in 1999. Moreover, without properly controlling for business cycle variables it is difficult to establish whether the observed decline in poverty rate between 1998 and and 2003 is due to the anticipation and gradual reaction to the reform or just to favorable macroeconomic conditions.
The second issue lies in the sample selection process. In this thesis I selected as treatment and control group working-age single women, without imposing any further restriction on the sample. However, as outlined in Section 2, the WFTC is a credit targeted specifically at low income individuals and it is gradually reduced starting from a earnings threshold of 90 £ p.w. For this reason, it would have been even better to find a way to specifically single out low earnings individual, either by applying restrictions on household net income, or by selecting, as Eissa and Liebman (1996) and Francesconi and Van der Klaauw (2007) did, a sub-sample of single women with low-education, which would probably better capture the target populations of the WFTC. The more precise targeting would remove from the estimation observations from high-income (or education) individuals that were likely unaffected by the reform.
A final consideration should also be dedicated to the choice of dataset. The BHPS is an incredibly useful resource as it follows the same individual over time and, thus, allows the use of panel data techniques such as individual fixed effects. However, one of its weaknesses is that it has a much smaller size than other repeated cross-sections surveys such as the Family Resource Survey and the Labour Force Survey. Especially when testing for the composition effect I believe it would have

been better to have a larger dataset to conclusively disentangle the effect on the coefficients of a smaller sample size from that deriving from the suspect of a composition effect. Moreover, when employing double and triple interactions between variables, having a larger sample helps in reducing standard errors and obtaining more precise estimates.

I would then recommend future researchers to take up the same topic and build on it by applying the three recommendations I will lay out here. First, I think it is now necessary to follow the approach of Kleven's (2019) "reappraisal" and evaluate the performance of the WFTC since its inception in the 80s to its most recent reform in 2020, which created the Universal Tax Credit [9]. This long-term approach will allow the researcher to specifically separate 1) the effects of the WFTC from those of other contemporary reforms 2) the effects of the WFTC from those of the business cycle.

Second, as I anticipated, I would recommend future researchers to take up my claim that the gradual effect of the WFTC is attributable to the gradual spread of information about the credit, consistent with Chetty et al. (2013)'s view on the American EITC. To test this line of reasoning it would be necessary to compare the anti-poverty effects of the WFTC in high-knowledge areas with the same effects in lower knowledge areas, something I do not do in my thesis. Obviously, to carry out this research it would be necessary to use high quality data, with zip-code level identifiers and precise information about household income.

Finally, it will be relevant to use the measure of poverty of Gundersen and Ziliak (2004), which, as mentioned earlier, captures not only the poverty headcount but also the depth of poverty. Said measure permits us to also evaluate the effect of the WFTC on poverty on its intensive margin as well, rather than focusing on the extensive margin only, and could certainly enrich the literature and guide future policy.

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[9] `https://www.gov.uk/universal-credit`

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8. APPENDIX

8.1. Appendix A

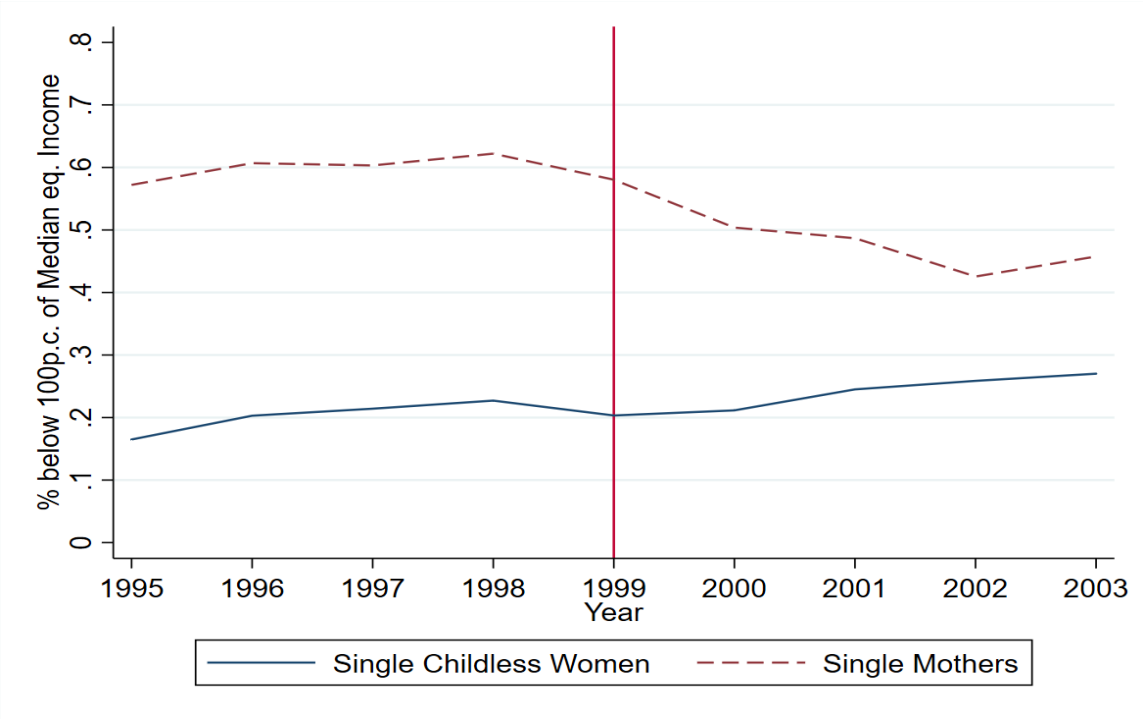

Figure 2: The evolution of the percentage of single mothers and single childless women below 100% of median income over the period 1994-2003

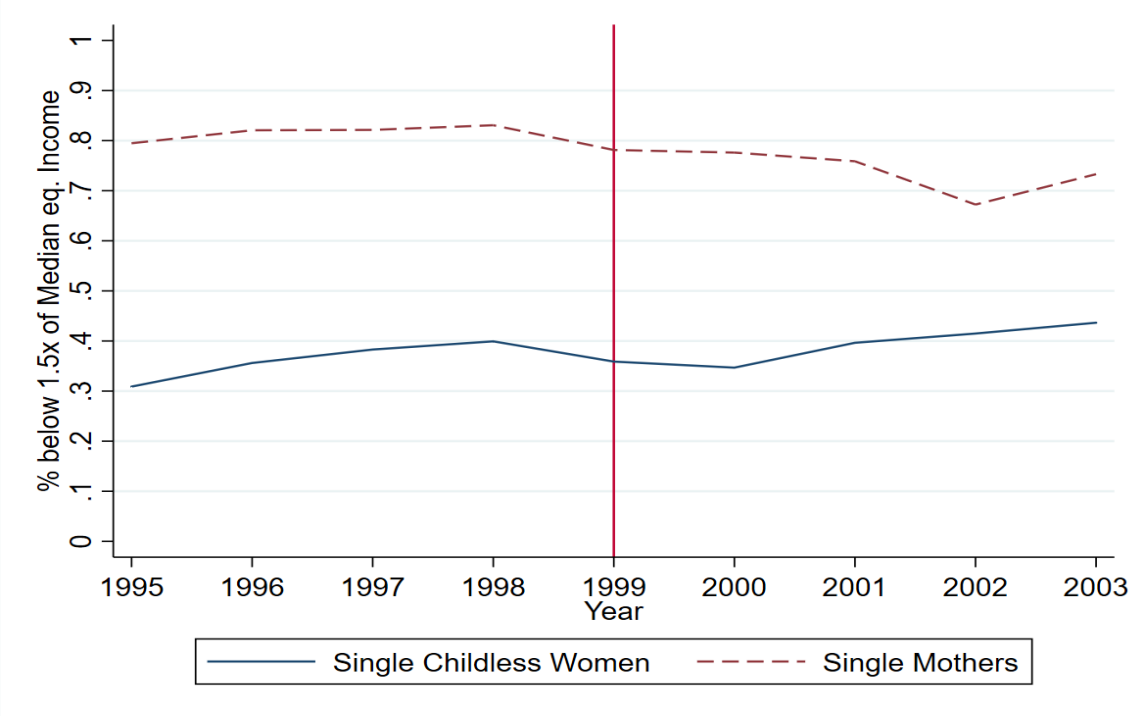

Figure 3: The evolution of the percentage of single mothers and single childless women below 150% of median income over the period 1994-2003

8.2. Appendix B

Table 5: *The Effects of the WFTC on the % of Single Mothers below Median Income*

	(1) Standard Controls	(2) Linear Trends	(3) Post-Reform Trend
Treatment Effect	-0.168***	-0.0103	0.149*
	(0.0276)	(0.0356)	(0.0788)
Single Mothers	0.165***	0.299***	0.238***
	(0.0457)	(0.0569)	(0.0627)
Post-Reform Period	0.102***	-0.0214	-0.00914
	(0.0163)	(0.0196)	(0.0199)
Time Trend		0.0384***	0.0298***
		(0.00636)	(0.00675)
Treatment Group Trend		-0.0406***	-0.0152
		(0.00821)	(0.0135)
Changes In Slope (τ_2)		-0.0108	0.00216
		(0.00735)	(0.00821)
Single Mothers Post-Reform Trend			-0.0389**
			(0.0171)
Education & Tenure Controls	✓	✓	✓
Individual FE	✓	✓	✓
Observations	7151	7151	7151
R^2	0.0682	0.0793	0.0805

Note: *Clustered SE in parentheses* ***$p < 0.01$, ** $p < 0.05$, *$p < 0.1$

Table 6: *The Effects of the WFTC on the % of Single Mothers below 1.5x of Median Income*

	(1) Standard Controls	(2) Linear Trends	(3) Post-Reform Trend
Treatment Effect	-0.116***	0.0143	0.137*
	(0.0254)	(0.0314)	(0.0761)
Single Mothers	0.202***	0.313***	0.266***
	(0.0524)	(0.0613)	(0.0664)
Post-Reform Period	0.0681***	-0.0616***	-0.0522**
	(0.0168)	(0.0222)	(0.0229)
Time Trend		0.0430***	0.0365***
		(0.00721)	(0.00828)
Treatment Group Trend		-0.0335***	-0.0140
		(0.00772)	(0.0128)
Change In Slope(τ_2)		-0.0168**	-0.00690
		(0.00808)	(0.0103)
Single Mothers Post-Reform Trend			-0.0298*
			(0.0166)
Education & Tenure Controls	✓	✓	✓
Individual FE	✓	✓	✓
Observations	7151	7151	7151
R^2	0.0937	0.104	0.105

Note: *Clustered SE in parentheses* ***$p < 0.01$, ** $p < 0.05$, *$p < 0.1$