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Employment and fiscal effects of investing in universal childcare: a macro-micro simulation analysis for the UK

Jerome De Henau[1]
March 2019

Abstract

This paper analyses the macro-micro linkages between paid and unpaid work, and their fiscal implications, following investment in a public system of universal childcare for all preschool children. Taking the UK as an example of expensive and inadequate childcare provision of uneven quality, the objective of the paper is to show the extent to which large-scale investment in childcare as a form of social infrastructure, often overlooked by policy-makers and economists in their conceptualisation of 'investment', is beneficial to society. It benefits children by improving their access to high quality early education, especially those living in lower income families, and thus improving their life chances and social inclusion. It has larger short-term employment effects than corresponding investment in less labour-intensive industries such as construction; and it fosters gender equality in employment by not only providing many high-quality jobs for women but also allowing many mothers to realise their full potential by freeing up their childcare constraints (and improve their lifetime earnings prospects).

The paper estimates the gross cost for central government of investing in universal full-time full-year childcare with highly qualified and well paid staff using different benchmark scenarios for current pay and qualification levels. It then examines labour demand and supply effects from a gender perspective. Not only childcare investment increases demand for direct and indirect jobs which can be estimated, it also changes the labour supply characteristics of potential candidates as it reduces the budget constraints of carers. Estimations of increased employment and corresponding household income are performed so that tax liabilities and benefit entitlements can be calculated on aggregate to analyse fiscal sustainability considerations. Results show that the net annual funding requirement would only amount to 25% of the gross investment, given behavioural effects on employment and consumption, and thus tax revenue. Moreover, we estimate a fiscal break-even point of the minimum number of years required of increased maternal employment and earnings to yield sufficient tax revenue that recoups the total childcare cost. Results show that if mothers of young children can regain their prior level of earnings (ie are not subjected to a child penalty) then the number of years of gainful employment needed before the policy breaks even fiscally ranges between 7 and 13 years for a typical mother of two children in childcare, which is well within a typical working life-course.

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Introduction

This paper investigates the employment and fiscal effects of investing in free universal childcare provision for pre-school children as one of the bedrocks of the social infrastructure that is currently deficient in the UK and in many other OECD countries (OECD, 2017). Social infrastructure – the delivery of services of care, health and education – is essential to achieve a sustainable economy and as such needs to be properly funded (De Henau et al., 2016; Ilkkaracan, 2017; Elson, 2017). Recent governments across the developed world, reacting to the crisis in public finances in the aftermath of the 2008 financial crash were prompt to cut many public services that form part of the social infrastructure without effective replacement of equivalent quality in the private or voluntary sector. Moreover, many of these services were lacking the level of accessibility, affordability and quality, in particular care services, that the economy required, even prior the crisis (Bargawi et al., 2017).

The race to reducing public deficits seems to have slowed down, at least in the UK, with talks about significant borrowing for public investment; however the uncertainty brought about by a constantly changing economic and political landscape requires exploring alternatives to existing investment policies urgently. In particular examining the case of investing in social infrastructure seems crucial in the current context of state retrenchment and stagnating wages. We examine the idea that investing sufficient funds for providing all children with adequate childcare of high quality, free for their parents at the point of use and regardless of their circumstances, would go a long way to solve current gender and social inequalities, underemployment, low pay and low productivity without draining public finances.

This paper explains in detail the method used to calculate the initial cost of providing universal childcare according to different mixes of staff pay and qualification levels. It then looks at the aggregate employment effects of labour demand and supply. We use standard input-output methods to derive not only indirect but also induced employment effects from increased household consumption and discuss the particularities of such investment in relieving some of the constraints the carers face to finding decent full-time employment should they wish to. By potentially increasing labour supply as well as labour demand, such investment, unlike say an investment of equivalent magnitude in physical infrastructure, may be more efficient in achieving full employment, especially in a context of low unemployment but high underemployment (especially for women). The fiscal impact of increased employment and improved working conditions, especially among mothers of young children, is discussed and estimated in the short and longer term, looking in particular at income tax increases from additional earnings generated by new full-time jobs, increases in consumption and thus indirect expenditure taxes, and reduction of social security spending on means-tested benefits such as Universal Credit.

The next section makes a brief case in favour of universal childcare of high quality and why it would address the issues specific to the various systems of funding in the UK. It is then

followed by a section outlining the conceptual framework of how investing in childcare services would increase employment and fiscal revenue. The section that follows delves in more detail into the costing method to estimate annual funding requirement of childcare provision in different configurations. Then we look at the short-term employment effects from both the demand and the supply side including gender effects. Following this, fiscal considerations are examined, in particular an estimation of the tax revenue from increased employment and reduced social security spending, to assess the fiscal viability of the investment without the need to raise additional taxes. The final section concludes.

Making the case for free universal preschool childcare

A large pool of research findings have shown that lack of affordable and accessible childcare provision is associated with lasting negative effects on gender inequalities over the life course (see reviews in De Henau et al, 2007a and b; De Henau and Himmelweit, 2013; Ilkkaracan et al., 2015). Moreover, access to formal childcare of high quality for a significant number of hours during the week is crucial to improving children's outcomes and life chances, even for very young toddlers and infants, especially those from more disadvantaged backgrounds (Dearing et al., 2015; Havnes and Mogstad, 2011 and 2014; Karoly et al., 2005, Babchishin et al., 2013; Li et al., 2013; Bauchmüller et al., 2014; see also Huston et al., 2015, and Van Lancker, 2013, for a fuller discussion).

Yet despite successive government intervention in the sector, childcare provision in the UK is still largely inaccessible and unaffordable to many parents, and of uneven quality (De Henau et al., 2007a; Harding et al., 2017). The cost to parents is very high in the UK compared to its European neighbours and cost rises have been outstripping general inflation over the last fifteen years (Harding and Cottel, 2018; Butler and Rutter, 2016). Reports analysing UK childcare provision also point to the lack of places for young children, even among private providers. State support necessary to make a childcare system viable is currently too low or inadequate (Harding and Cottel, 2018; Harding et al. 2017; Cory, 2017). The system consists of a complex mix of direct subsidies to providers, tax breaks for families and cash support to low income families. In 2015, public subsidies to providers to offer free childcare for 3-4 year olds (and disadvantaged 2 year olds) only covered for 15 hours a week and for 38 weeks of the year.[2] Moreover, the payment to providers per hour of childcare is below their supply cost. This leads them to recoup the shortfall by raising fees for hours purchased by parents, increasing the already high costs of UK childcare yet further. Since 2017 the increase to 30h of free childcare for working parents risk compounding this problem as funding remains inadequate (Cory, 2017). In addition, a complex system of means-tested cash transfers (tax credits) to families with children, including subsidies to pay for childcare expenses, leads to heavy costs being born by second earners if they work more than short part-time weeks. Despite these forms of support targeted at disadvantaged families, the UK system is characterised by high levels of inequality in use, partly driven by its high costs, even when

[2] This is effectively equivalent to 10h of parental opportunity to take employment if 48 working weeks per annum (p.a.) and commuting time are to be accounted for.

subsidised. Van Lancker (2013) calculated using EU-SILC data for 2009 on FTE childcare use by household income quintiles that children under 3 in the 20% highest income families were six times more likely than those in the bottom 20% to be in formal childcare, compared to just 50% more likely in Germany, Belgium and Italy and 20% in Denmark and Sweden.

One solution that has been suggested is to invest on a broad scale in free full-time formal childcare for all children, with highly trained and well paid staff, akin to a system of free universal school education (De Henau et al. 2007a; Ben-Galim, 2011; Mohun Himmelweit et al., 2014; Butler and Rutter, 2016). This paper looks at the costing and funding possibilities of such investment for children aged between 6 months and 4.5 years of age (when they enter primary school) in the UK. Attempts at costing universal provision have been carried out before, albeit on smaller scales. For example a study by the New Economics Foundation in 2014 looked at various scenarios (pay and qualification) of childcare provision for children aged 6 months to three years in England (Mohun Himmelweit et al., 2014). This paper extends the scope of the NEF study by looking at all pre-school children and for the whole of the UK; it uses similar assumptions with respect to the qualification level of the staff and their pay. However it diverges about the composition and needs of group-based facilities, and uses instead results from the government's own assessment of existing childcare cost structure which were derived for calculating current levels of state subsidy (Department for Education, 2015). Ben-Galim, 2011, investigated universal provision and fiscal effects from maternal labour supply but does not estimate costings and employment effects of improving quality standards. Butler and Rutter (2016) proposed a more modest 15h universal childcare for all 2-4 year-olds, extended to 30h for those with working parents and additional subsidised hours for working parents with means-tested fees but did not examine employment and fiscal effects. By contrast, Ilkkaracan et al. (2015) examined the case of extending childcare provision of high quality in Turkey, albeit not to reach universal coverage. However they complemented their direct costing exercise with estimations of employment and fiscal effects.

This paper combines and extends these previous studies in a number of ways. It adds essential dimensions to understand a fuller short-term economic costing, firstly by looking at the wider employment effects, through indirect and induced employment job creation and, secondly by estimating fiscal revenue generated, not just from income and expenditure taxes but also from interactions with the means-tested benefit system. It also provides estimations of a longitudinal fiscal recoup stemming from increased earnings of mothers.

Overview of the conceptual framework

The conceptual framework is relatively straightforward. We aim for costing free and universal childcare provision, covering all children aged six months to primary school age on a full-time basis. The model also caters for scenarios involving higher qualification and pay for childcare staff not only because high quality provision improves children's development

but also because it makes it more attractive for parents and thus potentially changes labour supply effects (Huston et al., 2015).

Employment will not only be directly created in the childcare industry but also in the wider economy, in the supply chain of the childcare industry – known as indirect employment – and as a result of increased consumption by the newly employed people, creating induced effects (De Henau et al., 2016). Ilkkaracan et al. (2015) only looked at direct and indirect employment effects.

In allocating jobs to potential candidates, the model also changes the pool of employable people. The jobs created will be taken by some people not currently in employment as well as some currently employed part-time, taking into account that their set of constraints and characteristics may be affected by the investment. Ilkkaracan et al. (2015) recognized this by allowing the pool of employable people to extend to people out of the labour force with caring responsibilities but the results of their allocation estimation procedure showed low likelihood of them being picked up partly because their specification didn't allow for changes in caring constraints. However they separately estimated changing labour supply for low income mothers, independently of the labour demand effects, which reinforces the rationale that both should be considered together as argued by De Henau and Himmelweit (2016).

In this paper more specifically, the framework allows for the pool of employable people considered for the job allocation to be extended to those:

- whose childcare constraints (in time and money) were too high for them to supply their labour (mainly mothers of young children), and are now entirely alleviated by the free full-time childcare provision
- whose qualifications were too low and can now be upskilled by the programme since the investment in childcare includes provision for training.

Among those parents with young children already in employment, the reform may have two contradictory effects: an income effect of reducing working hours for those who only worked longer in order to afford the expensive childcare, and a substitution effect of increasing working hours for those currently working part-time because of childcare constraints (so these could be added to the 'employable pool in search of the new full-time jobs).

The job allocation process determines which households gain new employment (or longer hours) and thus higher earnings and how it affects their spending pattern. On average, households with members whose earnings have increased will increase their expenditure on the domestic economy. This will boost aggregate demand and generate induced employment.

From these combined effects, fiscal revenue can be estimated from three main sources:

- additional income tax and social security contributions of the newly employed people (and their employer);
- expenditure taxes from increased consumption in the domestic economy;

- reduced social security spending on those who were out of job or on low income (eg unemployment benefits and tax credits for low-income families with young children).

Calculating the direct costs of free delivery of full-time universal childcare

The model of childcare provision considered here entails a typical facility that is group-based (crèche, nursery or kindergarten) attended by children of different age groups. This is indeed the dominant form of childcare provision used by parents in the UK (Department for Education, 2015). Following an integrated model found in Denmark and Sweden, it also helps prepare children socialise and develop skills to smoothen the transition to primary school (De Henau et al., 2007a; Datta-Gupta and Simonsen, 2007).

In such type of facility, the annual amount to invest in childcare provision for all pre-school children depends on three main parameters:

1. Coverage and opening hours (number of children to be offered a place and opening hours)
2. Staffing requirements, in particular:
    - Ratio of number of children per staff, which typically varies with the child's age
    - Non-contact time of staff (for training and admin work)
    - Level of remuneration and qualification of staff (including cost of initial training and on-costs for pension provision, holiday pay and social security contributions)
3. Non-staff costs (overhead), including building costs (construction / rent / maintenance).

Coverage and opening hours

This model of universal provision assumes that a place is offered to all children from the age of six months[3] to the age at which they enter primary school, on average 4.5 years of age in the UK. This would significantly extend current provision, especially for children under 3, as only about 30% of 0-2 year-olds used formal childcare in 2015, on average for 15h (Eurostat, 2017). Although older children are enrolled at much higher rates, the average number of hours they attend facilities was also low at about 20h in 2015, compared to over 30h in the rest of the EU (Eurostat, 2017).

Opening hours may vary and on average current commercial facilities are providing up to 35h of childcare per week, year-round (compared to the voluntary sector that provides about 30h but with facilities usually only opening during school term, that is 38 weeks a year). The

[3] The choice of starting the provision at six months implies a shorter maternity/paternity leave than currently available in the UK, more in line with other western European countries but still above the EU minimum of 14 weeks.

model here instead assumes coverage for children of any age for a full-time equivalent week of work, accounting for commuting time of one hour per day. A full-time working week is assumed to be 35 hours in this model, as it represents the average working time of women who were employed full-time in 2014 (ONS, 2017).[4] Hence childcare opening hours are set to 40h per week in the model. Childcare provision is also assumed to be available for 48 weeks per year, allowing for a conservative 4-week holiday period taken between parents. The facilities may open year-round but the free provision is costed for 48 weeks. These assumptions differ somewhat from the current political debate. For example, around the 2017 general elections, the Labour Party manifesto offered the most ambitious move towards universal provision, with free 15 hours for all children aged 2 and above, extended to 30h for working parents, and subsidised hours (low capped means-tested fee) for those wanting additional hours and for younger children. This proposal was largely based on a report by the Joseph Rowntree Foundation devising an anti-poverty system of subsidised childcare (Butler and Rutter, 2016). Other parties offered variations of a much less universal or generous system (BBC, 2017). However the model presented here follows a rationale of costing upper bounds of public investment un universal childcare and their effect on the economy; it can be adapted to provide fewer hours or to limit subsidised hours to some families on lower income for example, but limiting accessibility by employment conditions and subsidies by income levels creates other incentive issues, as well as administrative frictions that are difficult to model and not necessarily desirable. In effect, the rationale we are following is to extend to younger ages the current model of universal public education that is thus free at the point of use.

Staffing requirements

As childcare provision is a labour-intensive service, staff costs are the largest contributor to total running costs. The number of staff required per facility is determined by the regulatory child/staff ratios for each child's age group. These statutory ratios differ between countries but are typically lower the younger the child. Most facilities in England currently provide more staff per child than what statutory ratios require. The reason for this put forward by providers is that extra staffing is needed to cover not just for sickness and breaks but also to deal with specific needs (social or physical) of some children that could take significant staff time away from the group (Department for Education, 2015). Table 1 shows the different ratios by age group and the distribution of children by centre. Current centres catering for preschool children (using commercial facilities as benchmark) have an average of 49 places available. Our model assumes similar total capacity of centres although with a different age mix since current facilities have fewer younger children attending. The modelled age mix represents the age mix under universal provision (last column of Table 1).

[4] Note that by taking the women's average as reference instead of the overall average, the model implies a shorter working week for all. This does not mean that the system is intended to portray childcare as a woman's issue that needs to fit around women's typical hours; instead it suggests a change in the working time norm for men, so as to promote more time for them to get involved in caring activities (see De Henau and Himmelweit, 2013, for a discussion).

Table 1 child/staff ratio and distribution of age groups per centre

	Child / staff ratio		Distrib. of age group	
	Current	Statutory	Current	Universal
6 month- & 1 year-olds	2.5	3	20%	37%
2 year-olds	3.2	4	32%	28%
3 & 4 year-olds	6	8	49%	38%

Source: Department for Education (2015), ONS (2014a) and own model

Staff in the new settings are assumed to work 35h a week following the model's full-time working hours norm. This includes contact time with children as well as non-contact time to deal with administrative matters and other business (training, parents, social services). Non-contact time is estimated to be 16% of staff working time (averaged across both supervisory and non-supervisory staff, that is staff on higher and lower qualification respectively) and is used in our model setting.

Table 2 shows the current mix of qualifications found in existing (commercial and voluntary) facilities and their corresponding hourly wage rate (using 2014 data). It shows (first column) that the vast majority of staff is currently qualified at A-level (58%) (upper secondary school) and very few childcare workers have at least a university undergraduate degree (14%). By contrast the scenario of a high quality universal provision assumes a different mix (second column). In such a scenario, only two levels of qualification are considered: it is assumed that supervisory staff (which on average account for 45% of childcare workers across age groups in a typical facility according to regulatory ratios) are at a graduate level of qualification (level 6 – Bachelor's degree) while all remaining non-supervisory staff are at least at level 3 (A-level – upper secondary school).

Table 2 Distribution of qualification levels and staff gross pay by centre (2014 prices)

	% of qual. staff	% of qual. staff	£ hourly pay	£ hourly pay
	High	Current	Teacher	Current
No qualif.	0%	4%	10.72	6.10
Level 1	0%	0%	10.72	6.10
Level 2	0%	6%	11.77	6.70
Level 3 (A-level)	55%	58%	14.06	8.00
Level 4	0%	10%	16.52	9.40
Level 5	0%	7%	16.69	9.50
Level 6 (Degree)	45%	12%	18.80	10.70
Level 7	0%	2%	23.55	13.40
Level 8	0%	0%	18.98	10.80

Source: Department for Education (2015; 2014) and own model. A-level is roughly equivalent to upper secondary school qualification. 'Teacher' stands for a pay scale based on primary schools pay structure.

Table 2 also shows two different hourly pay scales that are considered in the model. The 'current' pay scale shows that staff at lower levels of qualification are paid on average at the 2014 National Minimum Wage (last column).

A second pay scale entails a more generous package for each qualification than current wages (second to last column). This is based on the pay scale of primary school teachers, using similar pay levels for equivalent qualifications: as such level 6 childcare workers would be paid £18.80 an hour because it is the corresponding hourly pay of primary school teachers with a degree prevailing in 2014 (accounting for equivalent working hours annually). This would be a 76% pay rise on the current £10.70 hourly rate for this level of qualification in existing commercial facilities. In order to preserve the scale of relative pay levels between qualifications, the model assumes that each level of qualification receives the same 76% rise on their current pay. Therefore in a scenario of higher qualification levels, less qualified staff (level 3) would be paid £14.06 an hour, well above the median wage rate of all UK employees, which was £11.61 in 2014.

The other staff-related cost elements to take into account are:

- provision for sickness and holiday to replace absent staff, estimated at 10% of contact time in current facilities (assumed throughout all scenarios of the model);
- provision for pension contributions at 14.1% of gross salary[5] and employer's social security contributions (National Insurance);
- provision for training costs (initial and recurring), on average set at 1% of gross pay in current facilities. The model uses similar figures for the scenario of current qualifications but requires a boost to 1.8% of gross pay in the high-qualification option in order to fund initial degree-level training to 45% of staff.[6]

Overheads

Overheads are based on existing (current) non-staff cost in commercial and voluntary settings, found to be around 28% and 23% of total costs respectively (Department for Education, 2015). In the new universal setting, overhead costs include provision for repayment mortgage (for acquiring or constructing the actual buildings) at 2% APR over 25 years.[7] We assume overhead costs to be fixed across scenarios and set at 25% of total costs of

[5] Current commercial settings (as well as voluntary) offer on average a 1% pension contribution for salaries above £10,000. The model of universal provision instead assumes contributions to be equivalent to those found in the public sector, at 14.1% of gross salary.

[6] Calculated as follows: a three-year training to get a qualified teacher degree costs about £21,000 (Allen et al., 2016), that is £7000 per year (in 2014 prices). This is equal to 36% of the current annual pay of Level 6 childcare workers (=£19,474 = 10.70 x 35 x 52). If we spread that cost over say 20 years of career (meaning only a twentieth of staff needs new training each year) and for only 45% of them (the higher qualification level to be considered), then the percentage of gross salary to be earmarked per year is 36%/20*0.45 = 0.81%, which is added to current level of on-the-job training provision at 1% of gross salary. Obviously if the qualified staff is paid at the higher wage, the training cost would be a lower proportion of their annual pay but the percentage is not adjusted in the model. The overestimation is negligible (about 0.3% of total annual investment).

[7] A typical basic primary school building costs about £500,000 for 50 children (assuming strict proportionality to a full primary school establishment, based on Talbot et al., 2013). At 2% APR over 25 years, the annual

current commercial settings of equivalent capacity/provision. This is about £100,000 per facility per year.

Overall costing for different scenarios

With all this data at hand, the calculations of total cost per facility are as follows:

1) Multiply the number of children in each age group by contact hours per week (i.e. offered provision) to obtain total contact hours per week per age group
2) Divide this by respective child/staff ratios to obtain the total number of staff contact hours per week per age group.
3) Multiply staff contact hours by additional non-contact time (16% non-contact hours for admin and special cases + 10% sickness/holiday cover) to get total staff time per week per age group.
4) Divide this number by the full-time working hours of each staff member per week to obtain the number of staff (FTE) per age group needed in the facility to run the place during opening hours
5) Add total FTE staff across age groups and multiply by number of opening/covered weeks
6) In parallel, multiply hourly pay of each qualification level by the number of hours per week and weeks per year the staff is paid to obtain annual pay for staff members at each qualification level.
7) Multiply annual pay by on-costs provision for pension, NIC and training costs for each qualification level.
8) Multiply the proportion of each qualification level in the chosen facility (current or universal) by the annual staff cost of each qualification level and then by the total number of staff (obtained in step 5) to obtain the facility's total annual staff cost.
9) Add overhead cost to staff cost to obtain total facility cost per annum
10) Multiply total cost by the number of facilities needed in the UK, to obtain total annual gross investment

All scenarios assume universal enrolment capacity at 40h a week for 48 weeks a year. Only the level of pay, qualification mix and child/staff ratios are made to vary. As for the other cost parameters (overheads, non-contact time, training, pension contributions etc.), they are also fixed at the levels previously described. Table 3 shows the total gross annual investment of providing universal childcare according to these different scenarios.

Varying the qualification mix does not affect total costs much (comparing scenarios 1 and 3). The main impact on total costs arises from the other two variables – pay scales and child/staff ratios. This is expected given the labour intensive nature of the service.

repayment would be £25,358 which is about 7% of the estimated total cost for a commercial facility in our model. Government calculations on the other hand estimate that rent and mortgage repayment of existing commercial facilities surveyed only constitute 5% of total costs. Since some new centres will make use of existing facilities in primary schools, it is likely to be lower than 7% so we have retained the 5% rate for estate costs as more relevant.

Table 3 Gross annual investment of universal childcare for different scenarios

	Child/staff ratios	Pay scale	Qualification Level	Gross investment	
				(£m)	(% GDP)
Scenario 1	current	current	current	31,610	1.7%
Scenario 2	statutory	current	high	29,289	1.6%
Scenario 3	current	current	high	34,697	1.9%
Scenario 4	statutory	teacher	high	47,211	2.6%
Scenario 5	current	teacher	high	56,931	3.1%

Note: See Table 1 for details of child/staff ratios and Table 2 for details of pay scales and qualification levels.

The initial gross investment needed appears very high.[8] It contrasts with current levels of public subsidies at around £5bn a year (0.27% of GDP) and to a rough estimate of £4bn a year spent by families out of pocket.[9] The latter two figures obviously reflect lower use of childcare compared to a universal provision. If all families with children under 5 were using existing (commercial or voluntary) provision the total cost would be close to that of scenario 1. The unpaid contribution by grandparents is not negligible either. The insurance company RIAS estimated that the unpaid contribution of grandparents to providing care to their grandchildren amounted to about £17bn a year in 2014, with 9.1 million grandparents providing at least one hour of childcare per week, for an average of 9.1 hours per week (RIAS, 2014).

Labour demand effects

The main immediate employment effect is to create jobs in the childcare sector. A number of childcare workers already exist so the model assumes that all their jobs would simply be replaced by jobs with the same characteristics as those of the newly created jobs under each of the scenarios considered.[10]

In all scenarios the profile of the childcare worker is similar in terms of number of hours worked per week (all on 35 hours in the universal provision as well as current provision on average) for 52 weeks of pay. So the number of direct (full-time equivalent) jobs created will

[8] Note also that it represents the total annual cost of providing for all children, not the additional cost on top of existing provision as it aims to replace the existing system entirely.

[9] It is difficult to estimate the amount spent privately on childcare as very few sources have reliable data. The 2014 microdata from the Living Cost and Food Survey records expenditure on childcare for families with a child under 5 (the estimate is £3.8bn a year based on a 52-week payment scheme, but it is not clear whether this is gross or net of public transfers in the form of employer vouchers and tax credits). The same goes for the Department of Education's Childcare and Early Years Survey of Parents 2014-15 from which we can estimate a figure of £4bn a year spent by parents on children aged under 5, again possibly gross of tax credits and childcare vouchers (Department for Education, 2016).

[10] However some of the existing jobs are for childcare provided to older children in after-school settings so not all existing jobs will be overhauled in practice but the model ignores this and overhauls them all as it is difficult to isolate the proportion of time spent by childcare workers on childcare delivered to older children only.

only depend on the parameters of child/staff ratios.[11] The explanation of the method will focus on two scenarios (scenarios 3 and 5 in Table 3) that differ according to the level of pay, one of the main determinants of the effects of such investment in the wider economy.

Indeed direct employment is not the only employment effect to consider. An indirect effect stems from employment created through increased demand for inputs from other sectors into the additional childcare services (food, construction, transport, etc.). One method of estimating such effects is by using input-output tables (Antonopoulos et al., 2011; Ilkkaraçan et al., 2015; De Henau et al., 2016). The ONS provides estimates of such indirect effects using input-output data for 2010, for different industries of the UK economy; in particular it provides figures of the indirect employment multipliers of each industry (also called Type I multipliers). For example, the 2010 education industry multiplier was 1.17. This means that for every 1000 jobs created directly from investment in education, 170 jobs are created in the wider economy through indirect effects on employment in the industries supplying inputs to the education sector (and input-output tables can be used to identify the number of jobs created in each of these other industries).

In the 2010 ONS input-output tables, the social care work industry which includes non-educational childcare services had a Type I employment multiplier of 2.76 (for non-market activities, that is, those that are provided publicly). However, given the structure of care services (mainly procured from private providers), it is not clear what this multiplier would be if the care provision was fully integrated within the public sector, that is publicly funded and delivered. In comparison, private sector care services activities (childcare and social care combined) had a much lower multiplier of 1.34. Ilkkaraçan et al. (2015) also point to an aggregation problem of using the social care industry to calculate the multiplier of the childcare sector, given the difference between the resources needed for long-term adult care and childcare. They construct their own synthetic childcare industry based on their own survey of the industry's cost structure. This model instead adopts the multiplier of the education industry given that the profile of the new system of universal childcare with higher qualifications will tend to resemble the pre-primary education system. However the education industry is not sub-divided into pre-primary, primary, secondary and tertiary levels in the input-output tables, so we use the overall education sector multiplier of 1.17, bearing in mind that it could suffer aggregation bias.

In the cost calculations above, I have assumed that total care costings include the 25% non-staff costs (overheads), which are fixed regardless of the pay rise of childcare staff in other scenarios. These overheads reflect the indirect uses needed for producing childcare. In the Education industry of the input-output table, 25% of the total output of the education sector is made of intermediate inputs. So (at least on aggregate) the assumption of using the multiplier for the education sector as a whole is not implausible.[12]

[11] It would also be related to the number of hours of childcare offered but these do not vary in the selected scenarios.

[12] By fixing the overhead at a level that reflects current costs, regardless of the rise in staff costs stemming from higher qualification and/or higher pay in the other scenarios, it is assumed that input to the childcare industry are

A second type of employment multiplier is the induced impact on aggregate demand (also known as Type II multiplier), stemming from an increase in consumption by the newly employed population (from both direct and indirect effects). Estimates of such a multiplier were obtained using a method developed by the Scottish Government (2015), and applied in De Henau et al. (2016). The magnitude of the induced effects will mainly depend on the level of pay received by childcare staff, since indirect job creation is relatively small given the low Type I multiplier. If their pay scale is on par with primary school teachers as per scenario 5, then it is reasonable to assume that Type II multipliers found for the education industry can be used. However for scenario 3, with childcare jobs still paid at current levels found in the childcare sector after the reform (by level of qualification) it is difficult to assume that the same effect on consumption can be obtained. Therefore induced effects closer to those observed in the social care sector are considered instead.

Table 4 summarises the various employment effects for both scenarios (scenario 3 at current pay scale and scenario 5 at teacher pay scale). The Type II multiplier used in the teacher pay scenario (scenario 5) is 1.48 and that used in the current pay scale scenario (scenario 3) is 1.34. Employment figures are in full-time equivalent. Table 4 also shows the gendered composition of the new jobs, reflecting the current gender segregation pattern of industries. The bottom of the table shows the change in employment rate, overall and by gender, for each scenario as well as the change in the gender employment gap between men's employment rate and women's employment rate (all aged 16-64).

Between 1.5 million and 1.7 million additional FTE jobs could be created from investing in universal childcare, of which 1.1 million in the childcare industry itself.[13] The model keeps the existing share of women in the childcare industry (98%) when allocating the new jobs to men and women. A more sophisticated model could be devised to allocate jobs more precisely, for example by matching characteristics of jobs to suitable candidates among the pool of 'employable' people (see below). Since our focus is on aggregate effects rather than distributional effects, we opted for a simpler model and assumed the status quo in the characteristics of potential candidates.

Overall female employment rate (aged 16-64) in 2014 was 68% in headcount and 53% in FTE (based on female full-time hours). Depending on the pay scenario and if existing industrial gender segregation remains then female employment rates would rise by between 6.1 and 6.5 percentage points. This would nearly halve the ten-point headcount employment

not a function of staff pay, that is food, electricity, toys and building maintenance do not become more expensive simply because the staff if better paid.

[13] These estimates are the net employment creation in childcare and other sectors, on top of existing childcare jobs and those existing in the wider economy to supply the sector and as a result of the consumption of the households of existing childcare workers. Rather than calculating the induced effects of increasing the wages of current childcare workers, we have removed their jobs entirely (and thus computed the indirect and induced effect of divesting from the current childcare industry) and replaced them by the brand new universal childcare system.

gap between all men and women aged 16-64 which has remained unchanged since 2009 (ONS, 2017).

Table 4 Number of new jobs created in childcare and more widely by pay level

000s	All	Women	Men	% women
Childcare	1,119	1,096	22	98%
Other jobs (Scenario 3)	383	161	222	42%
Other jobs (Scenario 5)	567	238	329	42%
Total (Scenario 3)	1,502	1,257	245	84%
Total (Scenario 5)	1,686	1,334	351	79%
Employment rate change (ppt)				Empl. gap change (ppt)
Scenario 3	3.7%	6.1%	1.2%	-4.9%
Scenario 5	4.1%	6.5%	1.7%	-4.8%

Source: own calculations

Labour supply and means-tested benefits

As discussed above, boosting availability of high quality childcare is expected to free up time of the current unpaid carers of pre-school children allowing them to consider taking up paid employment or increase their working hours (substitution effect). It may also reduce the hours of those currently full-time who are only doing so in order to pay for childcare (income effect). The magnitude and net direction of this supply-side effect will depend on the number of unpaid carers whose time would be freed up relative to the number of jobs created in the childcare sector, and on the unpaid carers' willingness and capacity to supply more or less labour.

A more complete model of labour supply would be needed to estimate the composition of the new employable pool along with a job-matching model similar to those developed by the Levy Economics Institute for the analysis of investment in care that pairs up the characteristics of the new jobs with those of the expanded pool of employable people (Antonopoulos et al., 2011; Ilkkaracan et al., 2015). De Henau and Himmelweit (2016) explain the rationale and derive a method for doing so. Further developments of such a model would include joint estimations of childcare and employment decisions as designed by Vanleenhove (2013) and Kornstad and Thoresen (2007). This would allow the estimation of substituting existing formal and informal childcare arrangements for the new universal provision. However estimating the parameters of such a model for the UK is not straightforward given the current inexistence of a full-time free accessible childcare system. Using variations in childcare costs is the only way to derive sensitivities in employment and childcare choices but would not be able to account for quality improvement given the general suboptimal quality of existing services (especially staff pay). Instead our simplified model

calibrates potential behavioural effects on male and childless women's behaviour as described below.

Another issue to address is the existing interaction of childcare subsidies with the tax-benefit system. Because a large part of the current system of childcare state support is targeted at low income families, the (dis)incentive effects of means-tested benefits cannot be ignored, as discussed in De Henau (2017). A simple way to consider the effects of the tax-benefit system and childcare costs is to compare net gains of employment pre- and post-reform. On the basis that labour market candidates value financial incentives to some extent, they will want to know how much disposable income (after childcare costs) is gained by their household if they were to take up (full-time) employment as a proportion of the gross earnings gain before and after the reform. If the system guarantees access to childcare of high quality it is more likely that parents will be responsive to cost incentives rather than a combination of costs and quality preferences. If the financial gain is substantially larger after the reform, mothers are much more likely to supply their labour (given that fathers are largely insensitive to childcare provision), controlling for a given set of other characteristics such as their level of education, age and family composition and employment.

Universal credit and families with young children

The prime suspects of those expected to change their employment behaviour because of improved childcare options would be mothers with young children under primary-school age. In the UK, these mothers are also an important group attracting significant amounts of means-tested benefits (tax credits) as a result of not being (fully) employed and having children.[14] One method to estimate the potential change in tax credits is to assess the likelihood that mothers of young children in low income households would take up the new jobs and estimate the new income of their family and the extent to which they would still qualify for some means-tested benefits. By aggregating the change in entitlements across all families affected, it is possible to estimate the change in total spending on social security benefits as a result of the reform, which would contribute to reduce the net cost of the childcare investment.

Universal Credit (UC) is a means-tested cash benefit that is gradually being rolled-out to replace most existing working-age means-tested benefits, including the Child Tax Credit and the childcare element in the Working Tax Credit, both aimed at low income families with children. Under UC with average childcare costs, I showed in De Henau (2017) that for couple households with two pre-school-aged children in which one partner works full-time on median wages and the other is considering returning to work full-time (at the same wage rate as their partner), the net gain from employment after subsidised childcare costs are taken into account would be only 14% of the gross gain, while it would be 65% under free childcare

[14] Estimations using the Family Resources Survey 2014-15 show for example that half of families with children under 5 were entitled to receiving Universal Credit or the equivalent in legacy benefits. While 40% of these families included a mother not in employment, they attracted 71% of the total UC entitlement spending on families with pre-school children.

provision. Returning to a part-time job would result in net gains of 23% and 63% respectively. So at median wages, there is definitely a stronger incentive to return to paid employment in a system of free childcare provision.

Using the Landman Economics tax-benefit microsimulation model, we can assess the entitlement of *all* families with children under 5 pre and post-reform, not just of synthetic examples used in De Henau (2017). According to the 2014-15 Family Resources Survey data used by the Landman Economics model, about 40% of mothers with children under 5 were not in employment, 31% were working part-time and 29% were working full-time. 64% of lone mothers and 34% of partnered mothers were not in employment. This gives a full-time equivalent employment rate of about 45%, to be compared with full-time equivalent employment rates of 82% for childless women aged 25-34 and 84% for fathers of children aged under 5.[15]

Finding the right comparison group (the counterfactual for those without childcare constraints) is nearly impossible given the singularities that each mother faced when making decisions about having children and remaining or moving into employment. However for this behavioural calibration exercise, which focuses on aggregate effects rather than distributional micro-economic effects of the reform, we have chosen as comparison group childless women aged 25-34 rather than fathers. Indeed they are likely to represent similar 'employability' characteristics to mothers of young children except for the fact that they don't have childcare constraints.

A few caveats of such calibration are worth mentioning: the reference group of childless women aged 25-34 is slightly younger and thus may face better employment opportunities than older mothers as their educational attainment has improved for example. On the other hand some currently childless women of that age may have a child in the near future and the focus here is not whether we can change existing mothers' employment but whether a system of free universal childcare is likely to yield higher employment rates among *future* mothers of young children. Therefore using the employment pattern of this age group reflects the idea of pre-birth employment possibilities.

Some mothers currently working full-time may no longer need to do so to pay for childcare and may reduce their hours to enjoy more time with their children; by contrast others may decide to work more to provide for increased children's consumption and living standards, which they couldn't or didn't see the point of doing before the reform because of childcare costs wiping out any additional earning gain. These substitution and income effects may or may not cancel each other. Also, some mothers not currently in employment may have decided to raise their children at home regardless of the quality and attractiveness of a universal childcare system. We suspect the latter to be a minority as social norms have

[15] Figures for fathers and childless women are taken from the Labour Force Survey (April 2014 to March 2015 quarters).

evolved towards at least some involvement with the labour market, even with young children (Paull et al., 2002).

Bearing that in mind, the pattern of true employment after reform for mothers of young children may still reflect slightly higher rate of non-employment and part-time employment than for the reference group of childless women aged 25-34. However it is also likely that childless women of childbearing age may have already adapted to a future pattern of care by opting for part-time employment. Adda et al. (2017) show that women anticipate the employment constraints of raising children (in the current system they are facing) while men do not. Given that fathers' (full-time) employment rates are greater than childless women aged 25-34, it is reasonable to assume the latter group to represent a plausible employment calibration scenario in the absence of childcare constraints. In such a scenario, only 12.5% of mothers would remain without employment, 10% would work part-time and 77.5% would now work full-time, the respective figures found for childless women aged 25-34.

As a result the simulated UC entitlement drastically changes for many of these families. In order to calculate the total UC entitlement in the new system and after mothers' behavioural change, we have assumed a random allocation of jobs for mothers with young children in the absence of a parametric model discussed above. We have also given them a wage rate that suits scenarios 3 and 5 respectively. Table 4 above showed the number of jobs created in each scenario, with childcare jobs split 55-45 between less qualified, non-supervisory, and more qualified, supervisory jobs. As for the non-childcare jobs (indirect and induced effects), they are assumed to be paid at the median wage rate in the economy, which was £11.61 in 2014 (ONS, 2014b).

The assumptions used in the calculations are:

- Scenario 3: the weighted average of the three wage rates is £9.60 and the simulation for this scenario assumes that 50% of jobs go to less qualified childcare paid at £8.01 (in fact they represent 46% of the jobs) and the other 50% go to jobs paid at £11 (which is between the wage rates of the other two groups of jobs at £10.70 and £11.60).
- Scenario 5: the weighted average of the three rates is £15.10 (childcare staff are at much higher rates than in scenario 3, £14.10 and £18.80 respectively). However the simulation has retained that all jobs would be paid at £14 minimum (in part to reflect that the tax-benefit system is not linear in earnings).

Within the current childcare system and take-up, total simulated UC entitlements of families with children under 5 would add up to £16,670 million a year (at 2014-15 prices), spread across 1.7 million recipient families.[16] The post-reform situation with corresponding changes in employment patterns of these families as described above would reduce total spending in

[16] The calculations use the Landman tax-benefit microsimulation model. It assumes full roll-out of UC by 2021 with the characteristics as known in April 2017 and elements priced at 2014 levels.

simulated UC entitlements by £7 billion in Scenario 3, with 400,000 fewer recipient families. In scenario 5, the reduction would be by £8.8 billion, with 700,000 fewer recipient families.[17]

Universal Credit and the unemployed

This reduction in UC spending for families with young children only captures part of the potential effect on means-tested benefits. As only about 900,000 jobs will be taken up by these mothers if their employment rate reaches that of young childless women, this leaves a substantial number of additional jobs to fill. We have assumed that the next group most likely to take up the jobs (in childcare and other industries) are unemployed people without children. Being out of work but looking for a job, most of them are entitled to some social security benefits, mainly under UC (former job-seeker allowance and income support benefits). For childless unemployed people, only age and partnership status determine the amount they are entitled to (in the absence of any other source of income which we have assumed). If they were to take up jobs on a full-time basis and paid at the wage rates of each scenario, the amount of UC they would be entitled to would drop to zero. Implicitly both the Levy method and the macro-level allocation that we have just used assume that all jobs created will be assigned so we do not have to estimate whether these people are employable at all.[18] Again because we are only interested in calculating changes in overall cash benefit spending, only the change in their entitlement matters and childless unemployed people are those with the lowest entitlement, hence the amount saved in UC spending could be considered as a lower bound.

There were about 1 million unemployed people without children in 2014, about 45% in couple and 55% single. Any job taken on at least 30 hours a week at the lowest wage rate in either scenario above (£8 in scenario 3 and £14 in scenario 5) would no longer attract any UC for these people. The total reduction is therefore simply the number of those people moving into employment multiplied by their former entitlement. In scenario 5, the remaining jobs created account for three quarters of the number of people in that group. This would yield a further reduction in total UC spending of £3.6 million. In scenario 3, with fewer jobs created in total, the remainder accounts for 59% of that group, yielding a £2.8bn reduction in UC spending.

Fiscal considerations

Tax revenue from employment and consumption

Given that all jobs created are assumed to be taken up one way or another, the results of the labour demand effects can be used to estimate the income tax revenue from additional

[17] More details of amounts by family types and employment status are available from author upon request.
[18] Although in the Levy method, if some of them had very low propensities to be employed, other people in the rest of the employable pool (eg older unemployed parents) could take precedence.

earnings. This can be added to the reduced spending on UC calculated in the previous section.

For childcare jobs, estimating the revenue raised by additional personal income tax and social security contributions (SSC) of employers and employees is straightforward since the jobs are assumed to be at a fixed wage rate determined in each scenario and on 35h full-time equivalent (which for the purpose of tax calculations will assume full-time jobs only). For non-childcare jobs, we have simply calculated income tax and SSC liabilities due on the mean annual earnings of all employees for each industry in which the jobs are created (the distribution of which can be identified using the input-output tables). A full matching model with individual wage estimation would give more accurate results individually although on aggregate, the tax intake may be similar. If anything, given the progressivity of the UK tax system, using average earnings underestimates income tax revenue for the Treasury as earnings above the mean increase the total tax intake proportionally more than those below the mean reduce it. [19] Additional annual direct tax and SSC revenue is estimated at £8.8bn in scenario 3 and £18.6bn in scenario 5.

In order to calculate indirect tax revenue from household consumption expenditure (V.A.T. and excise duties), I have applied the average indirect tax incidence observed for non-retired households in the mid-range of incomes (quintiles 2, 3 and 4), using ONS data for the tax year 2014-15 (Table 4 of ONS, 2016): the average proportion of indirect tax paid out of gross household income across these quintiles is 12.3%.[20] So we assume that any increase in gross income from the employment effects will attract a proportional 12.3% indirect tax revenue. This yields an extra £3.9bn in tax revenue in scenario 3 and £6.7bn in scenario 5. [21]

Net funding needs

The total amount of tax revenue and reduced social security spending can be calculated from these different sources, including the amount currently spent on childcare subsidies (£5bn in 2014-15). These sums can be deducted from the annual gross investment to derive a sense of 'short-term fiscal sustainability', that is the net funding need that the investment will require from additional taxation or borrowing.

Table 5 shows a summary of the estimation results for different scenarios with the remaining funding needs at the bottom. It shows that the 'self-funding' yield ranges from 75% in scenario 5 (the highest quality and best working conditions) to 83% in scenario 1 (with

[19] Moreover, the number of jobs created in the wider economy is measured in full-time equivalent and so for the tax calculations it is assumed that the jobs are full-time. However the mean earnings are calculated across all jobs in each industry, not just full-time jobs, providing a lower estimate of the total income tax and SSC revenue.

[20] This is the most plausible simple assumption about the households in which those new jobs would be located in terms of income distribution. The indirect tax incidence varies between 14% in the 3rd decile group and 11% in the 8th decile group.

[21] Note that the calculations have taken into account the tax impact (direct and indirect tax) of existing childcare jobs and related jobs (indirect and induced) that were removed and replaced by the new system at higher wages.

current low qualification mix and low pay). Scenario 4 estimates the costings with the same pay and qualification parameters as in scenario 5 but for statutory child/staff ratios. This reduces the initial gross investment by about £10bn and the net funding needs by £2.7bn (though the self-funding rate is similar).

Perhaps partly to reflect lower qualifications and pay, statutory requirements in the UK are actually quite high for European standards. A government audit of 15 OECD countries in 2012 showed ratios for 2y olds averaging 1:6 in the Netherlands and Ireland and 1:8 in France (Department for Education, 2013). Denmark, Sweden and Germany do not have national statutory requirements for group facilities. The report stresses that France, Sweden Denmark, Germany and the Netherlands require higher qualification levels than currently found in the UK.

Table 5 Fiscal effects of different scenarios of universal childcare provision (2014 prices)

	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**
Parameters					
Child/staff ratio	current	statut.	current	statut.	current
Pay level	current	current	current	teacher	teacher
Qualific. level	current	high	high	high	high
Costing (£m)					
Gross annual cost	-31,606	-29,286	-34,692	-47,206	-56,924
(in % of GDP)	-1.7%	-1.6%	-1.9%	-2.6%	-3.1%
Direct tax revenue	7,946	6,871	8,780	14,770	18,580
Indirect tax revenue	3,626	3,016	3,910	5,295	6,737
UC bill reduction	9,763	8,147	9,763	10,634	12,413
Current childcare funding	5,000	5,000	5,000	5,000	5,000
Net funding gap	-5,271	-6,251	-7,239	-11,506	-14,195
(in % of GDP)	-0.29%	-0.34%	-0.39%	-0.63%	-0.77%
% self-funding	83%	79%	79%	76%	75%

Source: own calculations. Note: 'UC' stands for Universal Credit

Moreover the statutory requirement for 3-4y olds authorises a ratio that can go up to 13 children per staff (rather than 8) if the facility has at least one childcare staff with a degree. Having only one graduate employee seems to be satisfactory according to the guidance. Thus keeping the ratio at 1:8 rather than the current 1:6 (for 3-4y) with 45% of staff holding a relevant degree could still be considered high quality. Therefore Scenario 4 could still be a high quality goalpost but less expensive in both gross and net terms than Scenario 5. It would however create 400,000 fewer jobs.

In any case, the net funding requirement remains substantial ranging between £6bn and 14bn. Funding the remainder is a political discussion. For example, the tax cuts afforded by the government since 2010 through raising the income tax thresholds above inflation and cutting and freezing alcohol and fuel duties are measures with doubtful effects on earnings and economic activity, given the stagnating productivity that accompanied the rise in employment (Houlder, 2014). Yet these policies costed the Exchequer close to £20bn annually by 2015, well above the £14bn funding requirement of the most ambitious scenario 5 (OBR, 2015). In an era of austerity with multiple confounding fiscal measures on consumption and investment (eg rise in VAT and benefit cuts), it is not clear (and under-researched) how the government can claim that such measures have boosted economic activity. The case is much clearer when it comes to direct public investment since the direct creation of jobs is undisputable. The other argument is one of investment in social infrastructure. Considering childcare provision effectively as infrastructure in the same way as broadband, wind farms and railways are physical infrastructure would in theory allow stricter orthodox governments to accept funding such programmes through public borrowing on the grounds that they provide public benefits over the longer term (Elson, 2017; De Henau et al., 2016). Even in a narrow sense, it is possible to estimate fiscal benefits of childcare by looking at gains in mothers' lifetime earnings.

Longitudinal fiscal effects from maternal employment

A growing literature following on the footsteps of James Heckman's work on the return on investment in early education, showed that public investment in good quality programmes of targeted childcare had positive net present values, with benefits outstripping costs due to reduced spending on welfare, crime and health, as well as increased employment and lifetime earnings for both the children themselves and their parents more immediately. A recent study by Heckman's team found positive annual lifetime return on investment of public early education and care programmes targeted at disadvantaged children in North Carolina (Garcia et al, 2016). While a full-blown longitudinal model is beyond the scope of this analysis, it is possible to simulate some of the components of those effects, in particular the change in lifetime earnings of mothers as a result of the universal provision. A net present value method can be adopted for a typical mother on average earnings. The stream of benefits to be discounted are the annual additional fiscal revenue stemming from a reduction of the child-related earning penalty observed for most mothers in the current system. The stream of costs to be discounted is the total cost of childcare over the years of coverage. If the former is at least equal to the latter, then the programme is deemed self-funding. We can actually calculate a break-even point in terms of the number of years needed for benefits to outstrip the costs and check that these are within the range of a typical working life.

Using data from the Labour Force Survey, we can estimate average gender earning gaps for parents of two children as a proxy for the child-induced lifetime earning penalty (in real terms). Focusing on parents with two children in the age group 25-59, Table 6 shows the main parameters of earning differentials. The main benchmark group chosen is fathers of a

similar age.[22] Table 6 shows that the gender earning gap among employees who are parents of two children is 45%, which accounts for differences in hourly pay and in weekly hours of paid work. However we are interested in the gap in average/lifetime earnings for all parents so we have to weigh these figures by the respective employment rate of fathers and mothers. Row (a) shows exactly this. Calculating the gender gap in mean earnings averaged across all parents equates to a measure of the gender lifetime gap that could be closed under a universal childcare system where childcare constraints are eliminated. If so then offsetting the total childcare costs for two children will take 8 years in scenario 5 of high quality, high-pay universal childcare. That is, it would take a minimum of 8 years for the Treasury to accumulate enough tax revenue stemming from changes in mothers' labour supply that would pay for 8 years of childcare cost (4 years for each child).

Table 6 Age-adjusted gender earning gaps of parents and fiscal amount recouped[1]

£		Fathers	Mothers	Gender gap	No. years to break even
	Mean earnings of employees p.a.	35,762	19,804	45%	
	Employment rate	93.3%	72.8%	20.5 ppts	
(a)	Mean earnings of all parents	33,380	14,425	57%	8
(b)	Mean earnings of employed fathers vs all mothers	35,762	14,425	60%	7
		Women (25-39y) w/o chi	Mothers	Gender gap	No. years to break even
	Mean earnings of employees p.a.	30,413	19,804	35%	
	Employment rate	87.5%	72.8%	14.6 ppts	
(c)	Mean earnings of all women	26,596	14,425	46%	13
(d)	Mean earnings of FT employed childless women vs all mothers	30,413	14,425	53%	10

Source: own calculations using 2014-15 Labour Force Survey (four quarters April 2014 to March 2015)

[1] Note: mothers in age group 25-59y. Age-adjusted earnings of fathers based on age group 23-57y

The lower panel of Table 6 estimates an alternative benchmark based on women aged 25-39 without children, as a proxy for earning and employment patterns of women before they have their first child.[23] The break-even point shown in row (c) is higher using this benchmark but

[22] However, since men become fathers on average two years later than women, keeping the same age group for both genders would yield slightly higher earnings for men that are simply the effect of their becoming fathers later. A quick fix to standardise age differences is to select fathers in the age group 23-57y instead of 25-59. Differences in earnings are small however. Similar points are raised in Costa Dias et al. (2017).

[23] We do so by projecting their earnings into later years from 40 to 59 using the average earnings of 35-39 as benchmark (we assume their earnings stay at that level afterwards, mirroring the male trajectory). Taking the observed average wages of childless women aged 25-59 would bias the results because many childless women aged 40 and above could actually be mothers whose children have grown up since LFS data do not record children who left the household.

remains within the range of most mothers' potential working lives.[24] However this is not a perfect comparator either because some of these women will have had their child at a very young age (and in the LFS data only dependent children present in the household are counted) or may anticipate having a child which affects their employment choices ex ante, as shown in Adda et al. (2017). Rows (b) and (d) offer alternative, less plausible scenarios by which the reference group is those in employment only, reflecting the possibility of a system in which only mothers in employment use childcare. Interpretation of results in (a) and (c) could be that all children attend childcare but not all their mothers are in paid employment. Therefore we assume here that mothers adopt the employment pattern of those without childcare constraints – fathers or childless women respectively – which reflects other reasons for not being in paid employment such as studying, incapacity or lack of suitable jobs).

Table 7 shows the results of a more finely grained analysis by level of education. This is because education is a strong predictor of employment and earning prospects and the opportunity costs of having children varies greatly between women of different educational attainments. Low-educated mothers with two children face a gender employment rate gap that is twice the size of that faced by highly-educated mothers (29 points versus 15 points). Their average earnings, weighted by their employment rate, is 67% lower than that of their male counterparts. The gap is lower for highly-educated mothers though they still earn 51% less than their male counterparts on average. As a result it would take 8 years to recoup the childcare costs of their two children. It would take 9 years for those on mid-level of education (A-level or equivalent, i.e upper secondary school) and 11 years for low educated mothers.

Table 7 Age-adjusted gender earning gap of parents with two children by level of education (25-59y)[1]

£	Fathers	Mothers	Gender gap	No. years to break even
Earnings low-educated	25,366	12,716	50%	
mid-educated	31,951	14,632	54%	
highly-educated	44,635	25,741	42%	
Empl. rate low-educated	88.4%	59.0%	29.4 ppts	
mid-educated	94.8%	77.3%	17.4 ppts	
highly-educated	96.5%	81.9%	14.6 ppts	
Weighted earn. low-educated	22,433	7,505	67%	11
mid-educated	30,273	11,312	63%	9
highly-educated	43,064	21,082	51%	8

Source: own calculations using 2014-15 Labour Force Survey (four quarters April 2014 to March 2015).
[1] Note: Age-adjusted earnings of fathers taken from the group 23-57y

[24] The average age of first-time mothers is 30 in the LFS data.

Conclusion

While current childcare policy and future plans remain vastly inadequate to address the challenges of quality, accessibility and affordability of childcare in the UK, arguments around lack of funding were often the prime reason for opposing increased investment in the sector. The aim of this paper was to examine such claims and in doing so make a positive fiscal case. As the costings results show, investing in free universal childcare of the highest quality requires significant amount of annual spending, about ten times the amount of public spending on childcare committed by the government for the foreseeable future. Our results show that funding an ambitious childcare investment programme and sustaining it year on year is by no means unaffordable, even within the existing fiscal structure of the UK. Taking account of the tax revenue and reduced social security spending stemming from the many direct and indirect jobs created in the economy, only around £2.50 for every £10 spent would require additional funding on a year-on-year basis. The net funding requirement of up to £14bn a year remains below the tax give-aways afforded by the government since 2010 despite an era of austerity, with effects on earnings and employment far less clear than those stemming from direct investment in social infrastructure.

In any case results also show that over the longer-term fiscal benefits are likely to recoup the total investment in childcare, based on simulations of typical families (mothers with two children on average earnings). With different benchmarks of earning potential, our calculations have shown that again within the existing fiscal structure, the investment can reach break-even point in between 8 and 13 years, well within the range of common working lives after child birth. Such reduction in gender earning gaps is also another policy objective in its own right, improving women's economic independence. Maternal employment could be greatly improved if the right incentives are provided and there is a genuine system of affordable, accessible and high-quality childcare. Moreover employment created in childcare and in the wider economy could disproportionately benefit women. Our calculations show that this would reduce overall gender employment gaps by almost half.

However the main benefit of childcare remains that of investing in children's well-being and social and cognitive development. There is also an economic case for this in that it would raise productivity in the future through better education, social skills and greater ability to adapt to fast-changing technology-driven labour markets. It would also reduce inequalities in life chances and offer opportunities to improve everyone's quality of life as well as social cohesion. Both of these arguments justify public spending as these benefits have a public good element, the social infrastructure aspect of childcare. Quantifying long-term benefits for children and society more widely is more complicated but not impossible as Garcia et al. (2016) have shown. It is however beyond the scope of this study. Instead further more immediate research could focus on refining the job-matching model and the interaction of tax-benefits with labour supply decisions. It could also extend the modelling to examine changes in the means-tested social security benefits system to improve work incentives even within a new system of free childcare.

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