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23 June 2021

Online at <https://mpra.ub.uni-muenchen.de/108620/>
MPRA Paper No. 108620, posted 07 Jul 2021 13:19 UTC

The Importance of Being Earners: Modelling the Implications of Changes to Welfare Contributions on Macroeconomic Recovery.

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Covid-Economics, Issue 82, pp. 99-142, CEPR Press
June 23, 2021

Abstract

This paper demonstrates how changes to welfare generosity during recessions induces a greater than usual economic response. This is predicated on the assumption that welfare recipients are likely to be liquidity-constrained and therefore highly responsive to a change in temporary income. This would result in two conclusions, (i) the effects of fiscal stimulus can be maximised when channelled through welfare and (ii) fiscal consolidation from these programs will have a strong contractionary effect on domestic output. Using tax-benefit microsimulation model UKMOD, we find 71% of means-tested welfare recipients are liquidity-constrained. We use this finding to calibrate an open-economy New Keynesian macroeconomic model to therefore illustrate the economic implications of positive changes to the program's generosity, finding an impact fiscal multiplier of 1.5. For cuts to contributions, we find a negative multiplier of 1.8, implying past cuts to welfare had a sizeable contractionary effect on macroeconomic recovery.

JEL: E62, H53, B22, E21

Keywords: Liquidity-Constrains, UKMOD, Fiscal Policy

Acknowledgments:

I am particularly grateful for the guidance, support and engagement Professor Andrés Velasco has given this work. I would also like to thank Dr Evan Tanner, Dr. Iva Tavessa, Professor Kitty Stewart, Sir Julian Le-Grand, Charles Morris and Sam Anderson for their individual contributions to the ambitions of this paper. The results presented here are in part based on UKMOD version A2.50+. UKMOD is maintained, developed and managed by the Centre for Microsimulation and Policy Analysis (CeMPA) at the University of Essex. The process of extending and updating UKMOD is financially supported by the Nuffield Foundation. The results and their interpretation are the author's responsibility

1. Introduction

Following major contractions in output, governments can stimulate economic activity by purchasing infrastructure or cutting taxes/transferring cash to defined households. The need for such interventions has been made more necessary while monetary policy – which has the power to pull back on or even fully offset any expansionary effect of fiscal stimulus – remains constrained at the zero-lower-bound; this has resulted in fiscal policy taking a renewed frontline role as a stability mechanism (Shoag, 2013).

The efficacy of cash-transfers – which are often the most appropriate method of stimulus delivery due to the comparatively short implementation time – is dependent on recipients choosing to spend the windfall. However, the Barro-Ramsey model in standard consumption theory predicts that temporary income variations will not induce a consumption response as households will save any temporary windfall in anticipation of a future tax rise to pay for it (Barro, 1974). This suggests such households have a marginal propensity to consume (MPC) of 0. If stimulus is not spent and instead saved in its entirety, the ratio of the output increase to stimulus, known as the fiscal multiplier, will be at or close to 0, rendering the intervention ineffective.

This simple model assumes that all households have equal access to alternative sources of cash (savings) or debt (credit markets) to act as a buffer to any income shock to allow the household to finance a permanent level of consumption (Canbary & Grant, 2019). However, a large amount of empirical literature, starting with Hall (1978), has consistently found 20% of households do not adhere to this permanent income hypothesis because they have little savings and/or are excluded from credit markets (hereafter referred to as liquidity-constrained). This inability to draw on alternative sources of liquidity shortens the horizon for financial planning (Campbell & Hercowitz, 2019), resulting in this subset of households being therefore highly sensitive to a change in temporary income (Jappelli, et al., 1998; Jappelli & Pistaferri, 2014; Parker, Souleles and Johnson, 2006; Johnson, et al., 2006). As such, papers that model the fiscal multiplier only for liquidity-constrained households often find strong responses, with Kenichi Tamegawa (2012) concluding:

“The maximum value of the multiplier is obtained when the share of liquidity-constrained households is close to unity” (Tamegawa, 2012)

If liquidity-constrained households are the strongest – and arguably sole – demand-side channel for stimulus, can governments maximise its multiplier by making it available only for these defined households? Historic cash-transfers have, to the best of our knowledge, never been made available to just households with low savings/credit market access. This is likely for two reasons: firstly, it would take a large administrative effort to identify households who meet this criterion, involving a lengthy and dangerous delay while governments audit each household’s total financial assets. Secondly, it would likely be too politically difficult to justify transferring stimulus to these households exclusively as to the general population this could appear to be a somewhat arbitrary criterion for stimulus checks.

Consequently, if the onus for stabilising short-term outcomes has fallen on cash-based fiscal stimulus, but this can only influence economic activity when liquidity-constrained households gain, the policy is at best inefficient if we currently have no realistic way to target them specifically. Many therefore argue fiscal stimulus to be ‘too circumscribed’ (Cochrane, 2010) if it can only influence a small subset of the population. Cochrane’s challenge to any proponent of fiscal stimulus is that they must either disprove the claim that the majority of households consume from their permanent income or find a way for stimulus to better target these liquidity-constrained households.

This paper assesses the role of existing welfare programs in meeting this latter challenge, as means-tested social assistance, by definition, is only available for households with low savings. For instance, the United Kingdom’s (UK) Universal Credit scheme’s strict criteria means that recipients can only claim state assistance if a household’s total savings are less than £16,000 (DWP, 2021). Therefore, these programs appear naturally designed to benefit liquidity-constrained households. If this is the case, the following conclusions would result.

Firstly, fiscal multipliers can be maximised when stimulus is channelled through these programs as they would present the most effective way to transfer cash directly to the

households who are liable to spend it. This presents little administrative challenge, as raising the levels of existing structures can be enacted quickly; the £20 boost to Universal Credit was enacted a few weeks following COVID-19 restrictions (HM Revenue & Customs, 2020). This would also likely be politically feasible, as public support for raising welfare levels during recessions is usually high, with 74% of the public being in favour of the aforementioned boost to Universal Credit (Ipsos MORI, January 2021).

Secondly, fiscal consolidation from cuts to welfare will induce a stronger contraction in domestic consumption and thus output. The Bank of England provide one of the only estimates of MPCs from both increase and falls in income; they find consistently higher estimates from the latter than the former (Bunn, et al., 2017). If liquidity-constrained households are not only the most responsive to a positive change in temporary income but are even more responsive to negative shocks, this implies that consolidating welfare spending would induce a strong contractionary effect on domestic consumption.

This is not the first paper to assess the role of liquidity constraints in strengthening fiscal multipliers but is, to the best of our best knowledge, one of the first in assessing the role of welfare programs in achieving this goal. We believe the study of fiscal multipliers out of welfare programs has only ever been studied once before by Gechert et al (2021) for Germany, who note a similar dismay at the lack of academic attention given to the question. They opt for the popular (s)VAR strategy to estimate the multiplier of exogenous shocks to welfare implementation, finding consistent multipliers of 1.1 as a result of the strong representation of liquidity-constrained households in the program. The AARP similarly studied the general question of how welfare is connected to the domestic economy by using an ‘off-the-shelf’ impact assessment model IMPLAN to measure this, finding it supported \$1.4 trillion in output in one year (Koenig & Myles, 2013). Though compelling, the approach fundamentally lacked any econometric detail, asking the reader to focus solely on the outcome and forego any consideration for how it was arrived at.

The first contribution this paper seeks to make arises by centring its analysis on the United Kingdom, where existing welfare generosity ranks low compared to other European nations. Specifically, the UK's replacement rate, that is the proportion of average income replaced by unemployment benefits,¹ ranks the lowest on a range of measures (Spinnewijn, 2020). This is important, as the reader could agree that welfare programs provide a strong avenue for stimulus but claim that this already happens following a recession when more people become eligible for welfare, known as an automatic fiscal stabiliser. But the ability for the UK's automatic stabiliser to enact the above is weak if its welfare programs are already meagre, meaning the UK government cannot rely on its existing programs to stimulate demand without an additional stimulus boost. As a result, it is common that countries with low automatic stabilisers (such as the UK) enacting higher levels of stimulus during economic crises (Dolls, et al., 2012) and vice versa.

Our paper first confirms the fundamental assumption that welfare programs already target this strong demand side channel by determining how many liquidity-constrained households benefit from the program compared to tax-cuts as an alternative. We do this by using tax-benefit microsimulation model UKMOD which can simulate the distributional consequences from changes to both welfare and tax levels using data from the 2018 Family Resources Survey (FRS). We simulate the effects of changes to welfare policies and tax-rates and compare the number of liquidity-constrained households that gain. As this is a static model, it can only show the 'morning after' effects of a policy or policy reform and cannot initially solve for core macroeconomic outcomes such as the relationship between the program and demand stimulation. This paper therefore takes a novel approach to UKMOD, by using it to test core assumptions we can then use to build an accurate macroeconomic model.

The macroeconomic model we opt for is an open-economy New Keynesian extension of an IS/LM setting created by Tanner (2017). We use this model to solve for core macro variables such as the output gap and thus draw inferences about the multiplier effect

¹ Spinnewijn measures at the start of an unemployment spell for a representative 35-year-old worker with an employed partner and one child earning the respective countries average salary before unemployment spell.

from different fiscal policy designs. As this model is simpler and relies on a number of exogenous parameters, we provide transparent robustness checks that calibrate the model so that its outputs are consistent with historical outcomes. We assess the size of the multiplier from positive and negative changes to welfare contributions on core macroeconomic outcomes, consumption/investment/net exports etc.

Typically, papers of this nature would attempt to estimate effects using either a quasi/natural statistical experiment or use comprehensive DSGE/(s)VAR models. Regarding the former, changes to welfare contributions happen at either micro-level (such as the regional roll-out of a new welfare program) where there is insufficient micro-data to determine the causal effect from, or the macro-level (country-wide) where it is not possible to disentangle the effect of the welfare reform from other economic factors. Papers instead often opt for the latter set of sophisticated economic models which can estimate comprehensive, dynamic economic outcomes following hypothetical policy shocks. However, such complex models are naturally computationally intensive, making them particularly inaccessible to even seasoned economists (Krugman, 2000). This has brought them into sharp criticism by high profile economists, including Blanchard (2009) and Romer (2016) for their inability to communicate salient economic policy to policy makers. These models are therefore better suited in providing evaluations of economic outcomes for more academic audiences.

The simpler static model employed in this paper can aid more transparent communication of the key macroeconomic relationships and outcomes to a potentially non-technical audience. This approach aims for something of a middle-ground between the two methods above, to test for and demonstrate the intuition of this paper. However, what we gain in transparency we lose in economic precision, so this paper can be seen as an illustration of this position regarding the role of welfare programs in fiscal policy. This gives future papers in this area with more robust models a benchmark to compare results to.

This paper takes a novel approach to optimising fiscal stimulus, assessing the role of existing welfare programs by using transparent and intuitive econometric methods. We

also extend this position to estimate the contractionary effect of cuts to these programs, thus providing a comprehensive account for how changes to the generosity of welfare contributions can influence economic recovery. The paper is organised as follows. A conceptual framework in section 2 will outline key literature on fiscal stimulus and liquidity-constraints. Section 3 will outline the methodology for both the microsimulation technique and the key features of the macroeconomic model. Our findings will then be split the outputs from the microsimulation and the macroeconomic model in section 4 and 5. The implications from both sets of findings are considered in the discussion in section 6.

2. Conceptual Framework

2.1 Review of Literature and Debates Over Fiscal Policy

How effective fiscal policy is in influencing the economic outcomes has been long debated by economists. Investigations of historic fiscal multipliers over the post-war period have taken broadly two forms of inquiry; first, papers that track the observed economic effects of exogenous build ups of post-war military spending as a natural experiment; finding multipliers ranging from 0.6-1.6 (Edelberg et al ,1998; Hall, 2009; Ramey, 2009; Nakamura & Steinsson, 2011). The second kind utilises structural vector autoregressions (SVAR) to empirically test for past multipliers and its determinants, finding multipliers from 1-1.5 (Blanchard and Perotti, 2002; Ramey, 2011; Gechert, 2021). More recently, the 2008 US stimulus package was prominently stated to have a multiplier of 1.6 by the Chair of Council of Economic Advisers to President Obama (as cited in Ilzetki, et al., 2013). This drew sharp criticism from Robert Barro, who argued the output multipliers are near 0 as the gains from government purchases are partially or fully offset by the negative impacts they have on private investment (Barro, 2009). Barro later calculated that the extra \$600bn in this stimulus spending came at the cost of \$900bn fall in private investment (Barro, 2010), implying a multiplier of just 0.6.

How do we reconcile these competing views? It could be that the economic environment today is no longer as hospitable to fiscal interventions as it was in the post-war period. Ilzetki et al (2013) provide evidence for this, by identifying the key characteristics that determine the size of these historic spending multipliers by

employing the same SVAR strategy as Blanchard & Perotti (2002). One notable feature they find of multipliers is that they are strongest in low-debt (<60% debt to GDP) countries. The far less debt in the post-war period compared to Barro's time-frame perhaps provides an answer as to why Blanchard and Perotti find a higher multiplier result. The evolving economic environment, from post-war low- to high-debt economies, could be argued to have initially shifted the consensus on the efficacy of fiscal policy away from large multipliers to more conservative estimates.

But although worldwide debt-GDP has remained high, nominal interest rates have now been persistently constrained at the zero-lower-bound (ZLB) since the great recession. This one factor alone has significant implications for the future of fiscal interventions, as with weakened monetary policy, fiscal multipliers have been shown to be significantly higher (Christiano, et al., 2010; Erceg & Lindé, 2014), with Hall estimating multipliers of 1.7 (Hall, 2009). In normal times, monetary policy leans on fiscal expansions by raising interest rates to increase the cost of borrowing for firms, and returns to saving for households, which reduces private investment and consumption, thus reducing the size of the multiplier. But when monetary policy is already at its minimum value, the proverbial 'brakes' are already released on the economy, creating for a highly responsive environment to fiscal policy, and therefore higher multipliers (ibid). The question becomes which form – government purchases, tax-cuts or cash-transfers – is most effective in stimulating economic activity? There are two considerations in determining efficacy; the time it takes to enact the stimulus; and the amount of windfall spent by households.

Regarding the former, speed of implementation is vital for recovery strategies, as without a strong monetary response, economies will be in near freefall until fiscal policy can be executed. The longer the implementation-lag, the deeper the recession (Tsurugaa & Wake, 2019). This issue is not exclusive to government purchases, which are often infrastructure based and therefore slow, as tax-cuts can similarly only be delivered to households according to the natural tax schedule (Romer & Romer, 2010). For short-term recovery, governments instead opt for cash-transfers at the onset of the

recession to avoid these implementation lags. For instance, the United Kingdom was able to enact its furlough program in 2020 three days before lockdown even began.

The efficacy of cash-transfers will depend on the amount of the temporary transfer that is spent by households, measured by the marginal propensity to consume (MPC). Economists have long been sceptical that households would ever spend a temporary gain (implying an MPC of 0), as the majority of households will only consume out of their permanent, as opposed to temporary, income and therefore save the entirety of the windfall in anticipation of future tax rises to pay for the stimulus (Barro, 1974; Cochrane, 2010). Although this has been found to apply to well over the majority of households (Hall & Mishkin, 1982; Canbary & Grant, 2019), households with low-savings and little access to credit markets are in fact highly responsive to both positive and negative temporary income changes (Johnson, et al., 2006). For these households, studies have estimated MPCs as high as 0.9² (Canbary & Grant, 2019) as they cannot smooth consumption out over the life course.

2.2 Defining Liquidity Constraints

There is some variation in how previous studies have formally defined a liquidity-constrained household, given the fact ‘low savings’ is an ambiguous term. There are four compelling sets of criteria that attempt to isolate households from sources of plausible earnings: (i) savings, (ii) market earnings, (iii) home-owners or (iv) credit markets. The first is captured by the Zeldes definition, which classifies liquidity constraints as households with total wealth of less than two months disposable income. Although this neatly captures a lack of savings relative to a household’s given earnings, measurement of household wealth is often prone to error and datasets often do not collect it for this reason (Jappelli, et al., 1998). Further, this definition only works if the relationship between wealth and liquidity constraints is perfectly monotonic (Dolls, et al., 2012).

Runkle (1991) therefore focuses on the second and third sources by considering all unemployed households without a mortgage as liquidity-constrained. The clear logic

² Meaning for these households, 90% of the income gain will be spent in the domestic economy

behind this approach is that unemployed households (where there is no adult working) with no income and no ability to liquidate the capital stored up in their home will have little opportunity to smooth out the temporary income shock. The fourth is perhaps the most difficult to obtain data for, as credit market statistics will be held only by private stakeholders. It is therefore common to use survey data that directly asks households about their access to credit, as Jappelli et al (1998) and Dolls et al (2012) do, such as with the FCA financial lives survey which asks participants if they have had a rejected credit application (FCA, 11 February 2021, p. 123).

Due to data and methodological constraints explained below, we opt for a combination of the second and third measure. As we will be using tax-benefit model UKMOD to determine which forms of fiscal stimulus target liquidity-constrained households the most, we are therefore limited by the variables available in Financial Resources Survey (FRS) dataset the model relies on, meaning we cannot at this stage use the FCA dataset. Unfortunately, there is little data on savings/wealth, meaning we cannot take the first approach in its entirety. Instead, we build off the second approach, identifying all households who do not own their own home and with no working adults³ to be liquidity-constrained. Lastly, we include a fifth source of income; (v) the household having no investment income.

2.3 The MPC for Liquidity-constrained Households

Many papers that attempt to identify MPCs for households from transitional gains often differentiate between representative and liquidity-constrained households for this reason, as the consumption response for a household with low savings and without credit market access will be higher than the population. A summary of this literature is presented in Table 1, which shows that MPCs are consistently found to be higher for liquidity-constrained households than typical households under range of scenarios and country-settings. For each study, we see far higher MPCs when looking at just liquidity-constrained households than at the overall population.

³ We drop this unemployment requirement when looking at tax-cuts, explained below

Table 1: Literature Estimates of MPCs

Author(s)	Context/Sample	MPC Estimates		Notes
		Overall	Liquidity-constrained	
Agarwal and Qian (2014)	2011 Growth dividend (Singapore)	0.8	0.5-0.75	Estimate is at both announcement & dismemberment
Johnson, Parker and Souleles (2006)	2001 US Income Tax Rebates	0.2-0.4	Larger	First of many papers that uses random timing of stimulus-based welfare number
Johnson, Parker Souleles and McClelland (2013)	2008 US Stimulus Payment	0.5-0.9	Larger	Same method as above
Tullio Jappelli & Luigi Pistaferri (2014)	2010 Italian Dataset	0.48	0.7	Low 'cash-on-hand' households exhibit larger MPCs
Zara Canbary and Charles Grant (2019)	1986-2010 UK FRS Dataset	0.5-0.94	0.75-0.94 (higher following recessions)	Find only 50% of households consume from permanent income
Fisher et al (2019)	1999-2013 US PSID Dataset	0.2-0.6	Larger	MPC tapers off to 0 after the 3 rd wealth quintile
Tal Gross, Matthew Notowidigdo, and Jialan Wang. (2016)	US Consumer Credit Panel (CCP)	-	0.37 (20-30% higher during great recession)	Measure effects of bankruptcy flag removal on consumption
Crossley et al (2021)	Survey over COVID-19	0.11	-	Do not test for liquidity-constrained households specifically

Despite the fact these estimates are found from variance in study type, each consistently shows that the MPC is highest for liquidity-constrained consumers. This is likely because the basic intuition is the same, households with low access to alternative sources of cash will be responsive to temporary income changes. For our analysis, we take Canbary and Grant's estimates as true representations of the MPC for liquidity-constrained households as their estimates are for the UK (thus eliminating the effects of any country specific factors) and is estimated from the dataset we use in UKMOD. We then apply this MPC to the percentage of liquidity-constrained households within welfare programs identified in our microsimulation exercise. For these liquidity-constrained households

we can assume with some certainty a change in temporary income will induce a strong change in consumption as they do not have alternative income sources to draw on.

Existing literature has identified the need for cash-based fiscal stimulus and specified the households it needs to target, but there is a gap in understanding how best to achieve this. Therefore, this paper explores the role of welfare policies in meeting this challenge and will evaluate if existing programs already benefit liquidity-constrained households. If so, we will be able to illustrate the economic consequences of positive and negative changes to welfare using a macroeconomic model.

3. Methodology

For studies of this nature, there are two possible methodological candidates. The first is to test for economic outcomes following real-world changes in welfare contributions by determining their causal effect using quasi/natural experiments. However, this has not been possible due to data constraints, as the changes we can track are on a micro scale whereas the available data on economic indicators (such as consumption levels) are aggregated. Further, this approach does not give us a plausible avenue to explain why we observe a given outcome. This paper is based off existing economic intuition about the role of liquidity-constrained households in strengthening the effects of fiscal stimulus, but quasi/natural experiments do not give us the opportunity to determine if it is this that is driving our results or if it is being driven by some other factor.

Instead, studies of this sort opt for the alternative class of methodologies is through the use of sophisticated economic models such as with a DSGE or (s)VAR framework. Though powerful, these computationally intensive methods struggle to communicate results to a non-statistical audience (Krugman, 2000) and have therefore been criticised for their lack transparency (Romer, 2016).

Our methodological approach has been chosen as something of a middle-ground between these two approaches, that is built off real-world observations and estimates results using a less intensive New Keynesian extension of an IS/LM macroeconomic model. Therefore, our methodology is split into two approaches. The paper first tests for

the fundamental assumption that welfare programs target liquidity-constrained households through the use of microsimulation model UKMOD. We then estimate the fiscal multiplier effects of a hypothetical change in the levels of contributions using this macroeconomic model.

3.1 Microsimulation through UKMOD

We first confirm the fundamental assumption that existing welfare programs target liquidity-constrained households using the tax-benefit microsimulation model UKMOD. This model is built from the 2018 Financial Resources Survey (FRS) which provides figures on the personal and financial characteristics of the population, and welfare recipients specifically. This official dataset provided by the Office for National Statistics (ONS) is a continuous survey of UK households, comparable to EU-SLIC, which provides statistics on income sources and general characteristics including home ownership.

The UKMOD microsimulation model opens up opportunities to simulate tax-benefit changes and assess the distributional consequences. Specifically, we can simulate an increase in benefit levels and determine what proportion of those who gain are liquidity-constrained. We therefore code 1 for those who see an income change and 0 otherwise. We apply this analysis to each type of UK benefit to determine the presence of any heterogeneity across programs. It is likely that means-tested benefits are better able to target liquidity-constrained households than non-means tested benefits, as the former is designed to specifically target financially precarious households whereas the eligibility for the latter is not necessarily savings/credit related (e.g., child benefit). This UKMOD model focuses analysis on taxes and benefits applied to the whole of the UK and assumes full benefit take-up and tax-compliance at the household unit level. As this is a controlled microsimulation experiment, we do not have to worry about endogeneity issues, as we are able to isolate the effects of the given changes to taxes and/or benefits. Improvements to this approach are specified in section 6, specifically how new datasets can be added and more analysis across different time periods would improve the overall precision of our estimates and their generalisability.

We can compare these results to cuts in tax-rates to see how many liquidity-constrained household's gain. As it is common for stimulus through tax-cuts to be targeted at 'lower' income households, such as the 2001 US tax-rebate (Johnson, et al., 2006), we therefore simulate this tax-cut on the lowest those tax-bands; again coding 1 for those who see an income change and 0 otherwise. As mentioned above, there are a number of ways to define 'liquidity-constrained' households and we include 'unemployment' as a key feature. However, for tax cuts this would result in no liquidity-constrained households gaining as they would not be earning market income under this strict definition. Therefore, for the tax-cut stimulus simulation we drop the unemployment criteria (keeping the no investment and/or non-homeowner measure).

This can provide a robust account of how different designs of stimulus can target more or less liquidity-constrained households which is presented below. This can therefore help us identify what is the appropriate average MPC for welfare recipients or those who benefit from a tax-cut.

3.2 Constructing a Macroeconomic Model

If welfare programs do target liquidity-constrained households, we can illustrate the implications of stimulus through these strong demand-side welfare programs by calibrating a macroeconomic model. The model we use is detailed in Appendix A and specified in full in Tanner (2017), but here we outline how the IS curve, interest rates and output gap are calculated. This allows us to produce multiplier estimates of fiscal shocks measured as a percentage of potential output. First, we substitute the rescaled equations in Appendix A for consumption, investments and net exports into a New Keynesian GDP identity, including a measure for government purchases gp_t :

$$Y_t = Y^P * [1 + (1 - \sigma_{cyc})\{(1 - \tau)(gap_t)\} - tp_t] + \varphi_{Ir}(r_t - \bar{r}) + gp_t$$

φ_{Ir} is a response parameter scaled to potential output, so that $\varphi_{Ir} = \alpha_r/Y^P$. We then subtract and divide both sides by potential output to solve for the output gap IS curve:

$$gap_t = \frac{\varphi_{Ir}(r_t - \bar{r}) + gp_t - (1 - \sigma_{cyc})tp_t}{\tilde{\sigma}_{cyc}}$$

Note, this by construction takes the form of the traditional Keynesian multiplier (1/savings), as $\tilde{\sigma}_{cyc} = 1 - (1 - \tilde{\sigma}_{cyc})(1 - \tau) = 1/\tilde{\sigma}_{cyc}$. We can differentiate between fiscal policy designs by firstly including two different parameters for fiscal intervention, gp_t government purchases and tax policy tp_t (cash transfers therefore the inverse of tp_t). We then solve to include net exports which is captured by the terms-of-trade parameter TT_t .

$$gap_t = \frac{(\varphi_{Ir} - \eta_{nx})(r_t - \bar{r}) + fp_t - \tilde{\eta}_{nx} \ln(TT_t)}{\{1 - [(1 - \sigma_{cyc})(1 - \tau) + im_{cyc}]\}}$$

Both measures of fiscal policy are now summarised into one identity $fp_t = gp_t - (1 - \sigma_{cyc})tp_t$. Here, our response parameters summarise the above by $\eta_{nx} = \eta_x - \eta_{im}$ and $\tilde{\eta}_{nx} = \eta_x(1 - \nu) + \eta_{im}\nu$. We can think of TT_t as foreign demand, as improvements in trade terms improve the IS curve will shift to the right. We solve for equilibrium output by first flipping the above to create an expression for the real interest rate:

$$r_t = r^{NAT} \frac{\{1 - [(1 - \sigma_{cyc})(1 - \tau) + im_{cyc}]\}gap_t - [fp_t - \tilde{\eta}_{nx} \ln(TT_t)]}{\varphi_{Ir} - \eta_{nx}}$$

We then solve for the equilibrium output gap by combining the above equation with the equilibrium of real interest rates:

$$gap_t^{eq} = \frac{\beta_\pi(\pi^e - \pi^t) + \beta_{ss}(ss_t) + efp_t \left[\beta_{efp} + \frac{\eta_{nx}}{(\varphi_{Ir} - \eta_{nx})} \right] + \frac{[fp_t - \tilde{\eta}_{nx} \ln(TT_t)]}{(\varphi_{Ir} - \eta_{nx})} + r^{disc}}{\left[\frac{1 - [(1 - \sigma_{cyc})(1 - \tau) + im_{cyc}]}{(\varphi_{Ir} - \eta_{nx})} - \beta_{gap} \right]}$$

We simulate the effects of welfare expansions by imputing a one-off tax policy tp_t of -1% and solving for the effects on output (consumption, investment etc.) by

comparing the percentage change from period 1 to period 2 (the latter with the policy shock). We input this into a demand shock component which eventually interacts with the MPC $(1 - \sigma_{cyc})$. This builds this intuition that MPC size is what leverages the size of the economic response. The inclusion of the MPC estimate allows us to model effects of any scenario based on its distributional effects to different households. This can show the implications for fiscal policy to both Ricardian equivalence/permanent income households with an MPC of 0 or liquidity-constrained households with an MPC > 0 defined using Table 1. Further, this model can show how fiscal policy can appreciate or depreciate the real exchange rate depending on the relative strength of the monetary response in a more transparent and intuitive way than complex DSGE methods. This is of key importance for this paper, as it can show in a credible way how different monetary conditions (ZLB) can strongly influence the effectiveness of fiscal policy.

We can therefore compare the effects of the expansion in a number of scenarios which are (i) during a minor recession where monetary policy has room to respond to both the recession and expansion, (ii) during a major recession at the zero-lower-bound with a capital outflow scenario. We then replicate this latter analysis by decreasing welfare contributions.

Of course, this model does have a number of notable constraints that limit what can and cannot be inferred from its estimates. Firstly, this is only a static model in the same form as UKMOD, meaning we cannot forecast into the future what the outcome will be after multiple rounds of spending. Many papers that estimate fiscal multipliers do this (see Blanchard & Perotti, 2002; Ilzetki et al, 2013) to see how long it takes for the effect to equalise; we are unable to make such analysis from this model. Secondly, such New Keynesian models have multiple exogenous variables which are independent from the policy change. Notably, our nominal exchange rate S_t (see Appendix A) is exogenously defined, meaning it is not connected to the given economic conditions so an appreciation in the current account following stimulus will not result in capital inflows. We therefore incorporate this with a forcing variable by decreasing external financial pressure by 0.1% to induce a capital inflow scenario, consistent with the set-up Tanner (2017) performs. For simplicity we assume this inflow is linear across MPC estimates,

when in reality it will be dependent on the output response. Although this may help us avoid overestimating some results, the approach is imprecise in nature and is less convincing than a model that is able to do this naturally.

The ‘Lucas Critique’ refers in part to this problem of believing elements of structural equations to be exogenous, as even aspects of consumption are never truly independent from government policy (Sargent, 1987). As such papers opt for the more sophisticated models of SVAR and DSGE models mentioned earlier which are far better able to overcome these limitations.

Therefore, this model should be taken as an economic illustration of the above argument rather than a direct forecast for the UK. It would be a worthwhile exercise to cross-check this model with one of these other approaches, as Pappa et al (2015) do when assessing the impact of tax avoidance on fiscal consolidation. Such further research opportunities are addressed in section 6.

3.3 Robustness Checks

Because of these fundamental limitations in the precision and interpretability of our model, we believe it necessary to disclose its relative power by cross-checking its outputs from historical events to what they were in reality. We do this on the key variables that exert the strongest influence over our model, real and nominal interest rates along with inflation shown in Figure 1. We take historical data on output gaps calculated by the Office for Budget Responsibility (OBR, 2020) and past estimations of the natural rate of interest by Goldby et al (2015) and input this into the model to allow it to forecast what the outcomes would have been in the past and compare them to reality.

This exercise can also be helpful in choosing the values of certain exogenous parameters, such as those that make up the central bank’s Taylor Rule or fundamental features of an economy such as the elasticity of short run aggregate supply. We therefore choose a number of parameters to minimise the distance between historic outputs and the predictions of our model. In doing so we obtain the following parameters in Table 2, taken either from existing papers or calibrated ourselves.

Table 2: List of Exogenous Parameters

Parameter	Description	Source	Value
π^e	Inflation expectation	Assumption	0.02
π^t	Inflation target	Assumption	0.02
β_π	Inflation weight	Author's calibration	2
β_{gap}	Output gap weight	Author's calibration	1
β_{SS}	Supply-shock weight	Author's calibration	1
η_{SRAS}	Short run elasticity of aggregate supply	Author's calibration	2
r^{NAT}	Natural rate of interest ⁴	Evans (2020)	0.015
im_{cyc}	Short-run propensity to import	Author's calculation ⁵	0.126
tp_t	Tax policy (one-off)	Policy shock	-0.01
r^{disc}	Deviation from Taylor-Rule ⁶	Assumption	0
efp_t	External financial pressures	Assumption	-0.01
θ	Transmission of external shock to exchange rate	Tanner (2017)	0.10
σ_{cyc}	Marginal propensity to consume (MPC)	Canbary and Grant (2019)	0.85 ⁷
ν	Importance of imports	Tanner (2017)	0.03
η_x	Response function to export prices	Tanner (2017)	0.72
η_{im}	Response function to import prices	Tanner (2017)	-0.72
τ	Tax share ⁸	IFS (2019)	0.25

For nominal interest rates in Figure 1 panel a, we are able to track pre and post zero-lower-bound levels well. Our model naturally ‘recommends’ highly negative interest rates, as it does not consider zero to being a limiting factor like a central bank will would. As such, in our future estimates below we set up the model to stop itself at 0 if the output from interest rate policy is negative to avoid creating highly negative interest rates.

If we simply subtract inflation from this predicted output (0 if negative), we obtain the following measure of ‘real interest rates’ in panel b, which if we compare to the same from actual outputs (real inflation subtracted from nominal rates) we see a high degree of similarity. We could compare this to actual real interest figures, such as those done by

⁴ For robustness checks we use yearly estimates rather than this long-run value

⁵ See Appendix B

⁶ Although we consider this 0, we use this for force adjustments where necessary to keep interest rates ≥ 0

⁷ Calibrated as an average of their estimate range for liquidity-constrained households

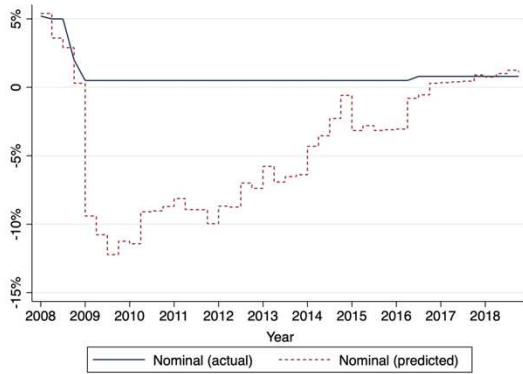
⁸ Calibrated to reflect low-income households

the World Bank, however their inflation deflators are not the same as ours so the outputs would not be interpretable.

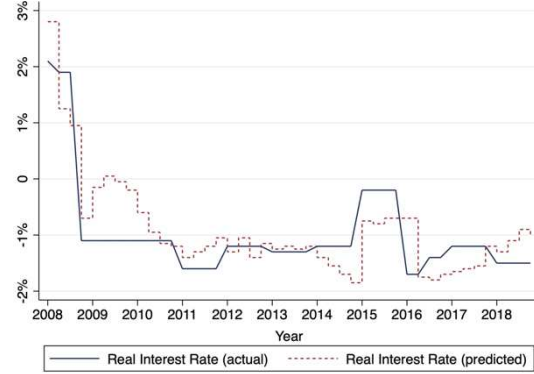
We simulate the effect of the 2015/16 oil shock by imputing a supply shock (ss) of 1%, as this episode had a substantial effect on inflation (Bank of England, 2016). As such, although our inflation in panel c is able to track real inflation fairly well, supply shocks must be simulated manually as the model cannot predict this itself otherwise it would have not noticed the 2015/16 oil price shock as this would not have been that well reflected in the output gap.

Figure 1: Robustness Checks

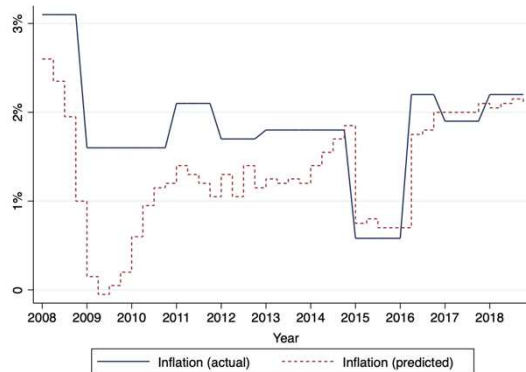
(a) Nominal Interest Rate



(b) Real Interest Rate



(c) Inflation



Overall, although our model is constrained in a number of areas, it is able to match historic outputs fairly well, at times with some adjustments. We are confident that this gives us a credible basis to illustrate the effects of exogenous changes to fiscal policy through welfare.

4. Findings: Microsimulation

The microsimulation exercise using UKMOD allowed us to first estimate that 30% of all households are liquidity-constrained using the criteria mentioned in Section 2, which is similar to Hall's (1978) 20% estimate. This at first confirms the concern that fiscal stimulus targeted at the broad population will be inefficient at targeting liquidity-constrained households.

4.1 Liquidity-constrained households by benefit category

When we simulate the effects of a change in welfare contributions, we see the following distributional consequences for liquidity-constrained households⁹. From broad welfare programs, we find in total 58.4% recipients are liquidity-constrained. But when we start to look within the different welfare programs that make up this finding in Figure 2, there is some important variations. First is the difference between means-tested and non-means-tested programs.

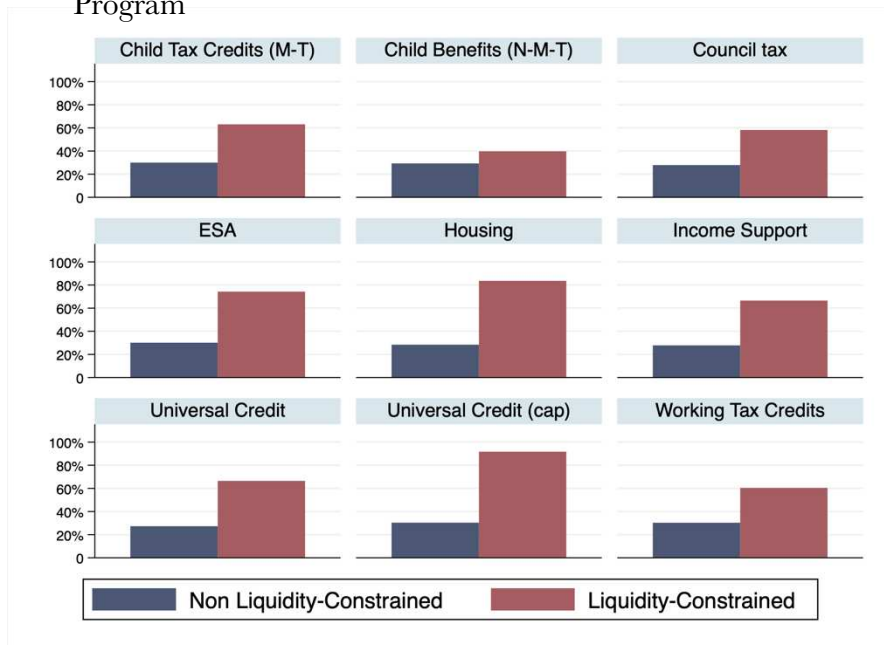
We take the difference between child tax credits and child benefits as an example of this, as both are similar in design but only the former is means-tested. For the non-means-tested program, only 39% of recipients can be classified as liquidity-constrained compared to 63% of recipients from the means-tested equivalent. This is consistent with the intuition of this paper that the reason welfare programs can target liquidity-constrained households is because the criteria to be eligible for means-tested welfare is very similar to what we would consider a household to be liquidity-constrained (e.g., having low levels of savings). When we look at the rest of the means-tested programs, we see a consistently high proportion of recipients being liquidity-constrained. Notably, we can infer that 91% of households impacted by the Universal Credit cap are liquidity-constrained. Overall, we find 71% of means-tested welfare recipients are liquidity-constrained, but just 27% are in non-means-tested programs; similar to the wider population. This intuitive, as without strict eligibility criteria in non-means-tested programs the demographic make-up of recipients will more broadly reflect the population.

⁹ These are the same for both positive and negative changes to contributions

4.2 Liquidity-constrained households by Tax Cut

We then repeat this exercise by simulating the effects of a tax-cut to lower-income households to provide some contextual clarity to the above finding. Specifically, we are interested in determining if the above implication is limited to just welfare programs, or if tax-cuts also have this ability to benefit liquidity-constrained households.

Figure 2: Liquidity-Constrained Recipients by Welfare Program

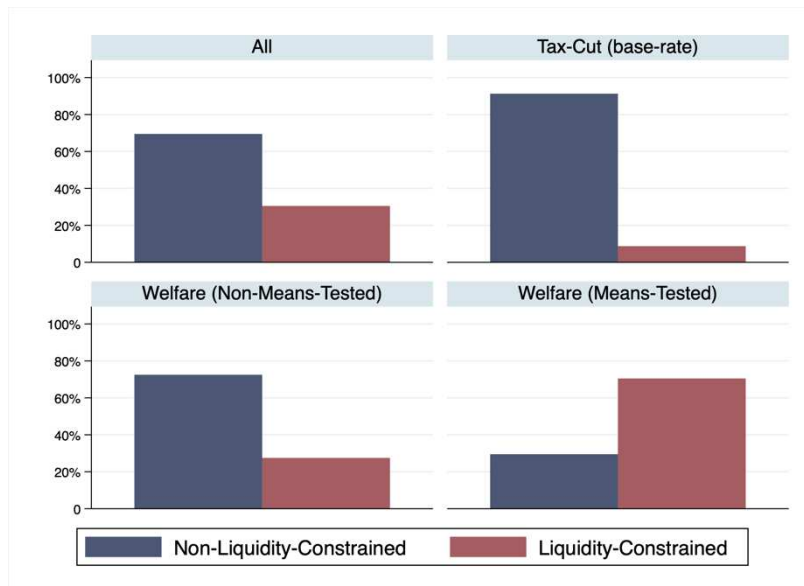


Source: Authors Calculation through UKMOD

We use UKMOD to simulate a tax-cut through from a 1% reduction in the liability within lowest basic-rate (£12,571-£50,270) tax band. We again code households who see a rise in disposable income 1 and solve for liquidity-constrained and non-liquidity-constrained households. We only simulate a tax-cut for the bottom band to make for a plausible comparison for stimulus through welfare programs. Our analysis in Figure 3 shows tax-cuts, even on the lowest income band, are particularly inefficient in benefiting liquidity-constrained households especially when compared to welfare programs; this is despite dropping unemployment from the definition of liquidity-constrained households for this analysis. We find 8.7% of households who benefited from tax-cuts through the base-rate are liquidity-constrained; this reflects the fact that although liquidity-

constraints will likely correlate with income (low savings households will likely have low incomes) they do not do so perfectly.

Figure 3: Liquidity-Constrained Recipients by Welfare and Tax Bands



Source: Authors Calculation through UKMOD

These findings prove the difficulty in designing fiscal stimulus to target liquidity-constrained households due to the fact they only make up 30% of the population. Even tax-cuts to low-income households are imprecise in nature in achieving this aim. Instead, we can conclude from these findings that welfare programs present the most effective way to target these households as a result of their means-tested eligibility criteria closely matching what we would consider liquidity-constraints. Further, the reverse is also true, that fiscal consolidation by tax rises will not target as many liquidity-constrained households as cuts in welfare contributions will. The implications of these findings are discussed in section 6.

5. Findings: Macroeconomic Model

Now that we have established that fiscal policy through welfare programs can target liquidity-constrained households, we can use our macro model to illustrate why this will strengthen the effect of fiscal stimulus and consolidation. Our model does not have the capacity to consider the implications for how the stimulus is financed on our estimates. Therefore, we could assume in all instances that stimulus is money-financed by ‘helicopter-drops’ by the central-bank, as such financing arrangements have little to no effect on multipliers and are similar to debt-financed¹⁰ stimulus in a zero-lower-bound environment (*Galí, 2019*).

5.1 Scenario 1: Positive changes to welfare contributions

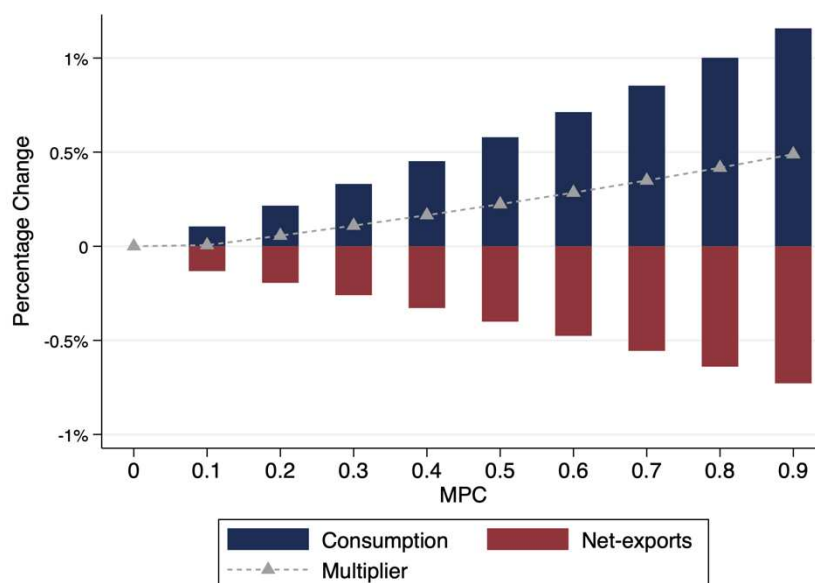
5.1.1 After a 3% drop in consumption (non-ZLB)

We begin by estimating fiscal multipliers from expansions in social security contributions during ‘normal times’ recessions, meaning central banks have the capacity and mandate to respond to any expansionary effects. This is simulated by a 3% fall in baseline consumption. Figure 4 shows the effects of expansionary efforts from each MPC size, with higher MPCs naturally influencing a stronger increase consumption and decrease in net-exports. This displays why the Barro-Ramsey consumption has such strong implications for the efficacy of fiscal stimulus, as an MPC of 0, as displayed, would induce no economic response.

Both relationships are linear, which reflects the central bank’s ability to control the expansionary effects and avoid exponential increases under a pre-determined schedule. Under this scenario, the base-rate rises from 0.4 to 0.6 as the MPC rises. Looking at just consumption, the break-even point of 1 (where governments induce more consumption than they put in) comes once all beneficiaries spend more than 80% of their stimulus. But the multiplier effect is positive, meaning that although the central bank controls the strength of the response, it does not fully offset it as the Taylor Rule construction only recommends small incremental increases according to its policy rules.

¹⁰ See Max Corden (2010) for further detail on the long-run effects debt-financed stimulus

Figure 4: Increase in Welfare Contributions on Consumption and Net-Exports by MPC Size (Scenario 1.1)



Source: Authors Calculation

Consistent with standard Keynesian theory, the effectiveness of expansionary effects is constrained through the presence of leakages from savings ($1-MPC$) and imports. Regarding the latter, if households spend their windfall on imported goods the gain will not be spent in the domestic economy. Although we are not aware of existing estimates of the percentage of household expenditure spent on imports, we calculate this ourselves by multiplying the household expenditure on each commodity by the import penetration of the given commodity,¹¹ finding 12% of household spending involves imported goods. We perform this for each household income group and find, surprisingly, no significant variation when we compare across income deciles as we would expect when looking at the expenditure of specific commodities (negative correlation between food expenditure and income). As the expansionary effects naturally result in a partial strengthening of economic conditions, we see imports become cheaper and the reverse for exports, resulting in a net loss.

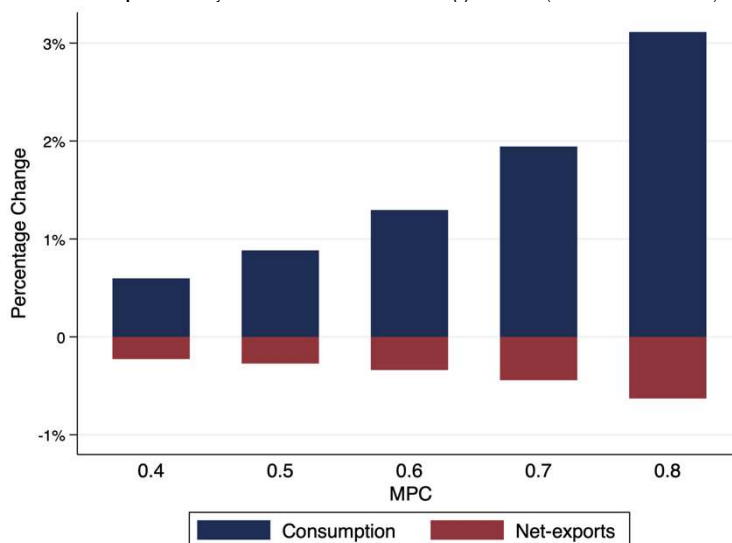
¹¹ See Appendix B

5.1.2 After a 5% drop in consumption (ZLB)

Scenario 1.2 looks at the above conditions but now increasing the size of recession to a 5% drop in baseline consumption to constrain interest rates at the zero-lower-bound. This is displayed in Figure 5 where we start to see a more exponential rise in output following the expansion. Many economic models suggest higher multipliers from fiscal expansions under this scenario, notably Hall (2009). We find similarly that under this scenario, not only is the consumption response greater (including a shallower fall in net exports), but the marginal increase in the multiplier is also positive as the MPC rises. This reflects the effect of idle monetary policy following an expansion from fiscal stimulus. We now focus just on the MPCs of 0.4-0.8 as these are the plausible MPC range of liquidity-constrained households. In doing so we see most of the ‘heavy lifting’ in terms of output increases is being done by the strong consumption response, hence why the size of the MPC is important in leveraging this output reaction.

As mentioned above, we induce a capital inflow scenario by decreasing external financial pressures. This results in a higher import response, depressing net exports and the multiplier. This finding is consistent with other papers that induce capital outflows in workhorse macro models, such as Blanchard et al (2015) who find short-run contractionary effects from capital inflows through a reduction in net exports from

Figure 5: Increase in Welfare Contributions on Consumption and Net-Exports by MPC Size During ZLB (Scenario 1.2)



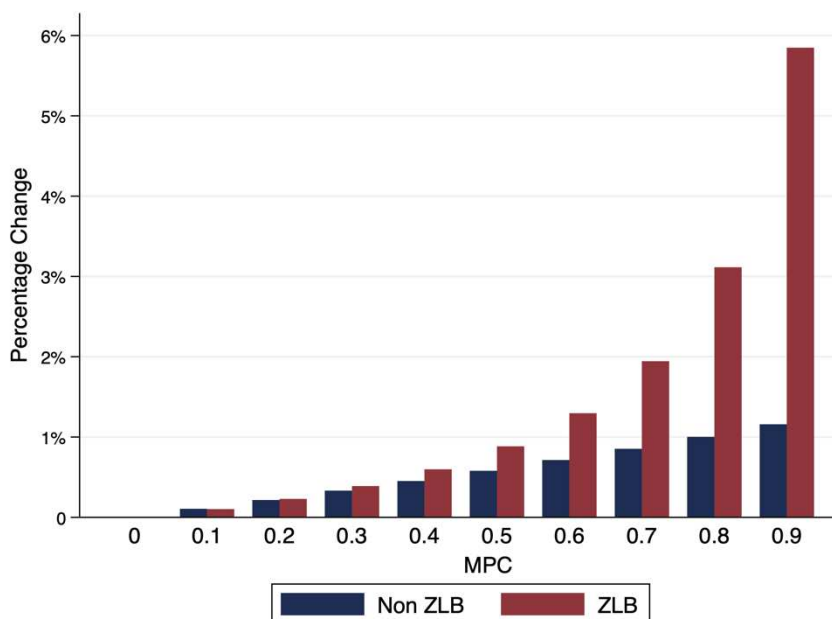
Source: Authors Calculation

currency appreciation. The small response in net-exports reflects the central banks inability to defend the exchange rate, resulting in a smaller fall in net-exports.

The scenarios presented are all under demand-push recessions, meaning the recession is caused by some shock to aggregate demand (in our case consumption). Of course, this is not the only form a recession can take. A ‘cost-push’ recession caused, for example, by a shock to the production process (such as a rise in oil prices) which increases inflation and causes a contraction in output is conceivable. This situation is often described as an impossible scenario for policy makers as measures – such as stimulus through welfare programs – can recover some of the output lost but at the cost of further increased inflation. When we simulate this potential scenario, we find no response in our output estimates – as one would expect – but although a supply shock does decrease output and increase inflation, the fiscal intervention has little further increase in inflation under this scenario than it does when there is no supply shock. Instead, we find inflation is far more sensitive to increases when inflation expectations are above the central bank target. Under both normal times and a zero-lower-bound scenario, any increase in inflation expectation translates one-for-one into inflation increases. Therefore, the starting position of inflation is important for policy makers to consider, as our results suggest the 1% intervention increases inflation by 0.8%, but inflation from stimulus often takes time to materialise due to price ‘stickiness’ (Galí, 2019). Therefore, it is important for the policy maker to consider existing inflation levels and a measure of future expectations. Policy makers must, as always, be cognisant of the fact that expansions can cause inflationary pressures, which during a zero-lower-bound scenario can be particularly strong.

We can show with this model the implications of transferring stimulus to this strong-demand side channel and show how the presence of zero-lower-bound interest strengthens the effect of the stimulus boost. Figure 6 compares just consumption responses under Scenario 1.1 under a normal interest setting and Scenario 1.2 which zero-lower-bound interest rates. We can see this exponential rise clearly here under the latter, reflecting the highly responsive economic environment created without the presence of a monetary response.

Figure 6: Increase in Welfare Contributions on Consumption by MPC Size



Source: Authors Calculation

5.2 Scenario 2: Negative changes to welfare contributions

5.2.1 After a 5% drop in consumption (ZLB)

This second scenario assess the impacts from a fall in contributions for these liquidity-constrained households. This is in part motivated by the finding that households, especially with low savings, are more responsive to negative income shocks than positive (Bunn, et al., 2017). This decision was taken by the UK through a number of welfare reforms between 2013-16, notably through the introduction of a ceiling on the amount of welfare a household could receive, known as the ‘benefit cap’.

We therefore take the above setting of a major contraction in output under a zero-lower-bound scenario, but now reverse the sign of the policy shock to test for the effects from cuts to welfare contributions. We also reverse the external financial pressure parameter to induce a small capital outflow response to the depreciation of the current account that follows, consistent with Tanner (2017).

Our results show, just as scenario 1.2 finds, an exponential effect during the presence of zero-lower-bound interest rates. Overall, we find the same results as in 1.2 but now with the sign reversed, resulting in a strong fall in consumption as the MPC rises and a shallow increase in net-exports due to capital outflows. Figures 5 and 6 can therefore be flipped to show the effects of cuts to contributions on different MPC sizes.

5.3 Summary

So far, we have shown the response for each MPC assumption. For the summary we make a decision about the average MPC of all those who benefit from stimulus through welfare or through tax-cuts based on the above microsimulation exercise. We found a strong presence of liquidity-constrained households within existing welfare programs, particularly means-tested, from our microsimulation exercise; therefore, it is appropriate to consider a high proportion of welfare recipients as obtaining the high MPC range specified by Canary and Grant (2019). However, not all welfare recipients are liquidity-constrained, therefore we assume that the remaining 29% have an MPC of 0, which will lower the average MPC of all welfare recipients. We take an average from Canary and Grant's range of 0.85 and apply it to 71% of households who benefit and assume 0 for the rest¹², resulting in average MPC of 0.59 out of positive income shocks. This can be strengthened if the policy maker directs stimulus through specific welfare programs such as housing benefit which impact's 84% of liquidity-constrained households, but for our estimates we take the average across all means-tested programs. We further apply this analysis to stimulus through tax-cuts to provide a valid comparison. We found only 8.7% of beneficiaries from cuts to the lowest 'personal allowance' tax band would be liquidity-constrained. Applying the same rules above

¹² This is a strict interpretation of the Barro-Ramsey consumption model which may understate results, but we believe there is merit in providing conservative estimates

results in an average MPC of 0.8 from tax-cuts to this tax-band; we should note that this is a lower estimate than the estimates of average MPC from the US tax cut of 0.20-0.40 (Johnson, et al., 2006).

For cuts to contributions, we take use Bunn et al's (2017) MPC estimate for households with low net liquid assets to income ratio of around 0.9, which somewhat resembles the Zeldes definition of liquidity-constraints. Again, we apply this to 71% of means-tested welfare recipients and assume 0 otherwise, yielding an average MPC of 0.63 out of negative income shocks. Using these estimates, we simulate the effects of positive and negative changes to welfare contributions in scenario 1.2 (zero-lower-bound interest rates) and compare them to stimulus through tax-cuts, obtaining the following results presented in Table 2.

Table 2: Multiplier Estimates from Tax-Cuts and Changes in Welfare Contributions

	Tax-Changes	Welfare Changes	
	Stimulus	Stimulus	Consolidation
<i>MPC</i>	<i>0.08</i>	<i>0.59</i>	<i>0.63</i>
Consumption	0.16	1.25	-1.46
Investment	0.04	0.59	-0.70
Net-exports	-0.16	-0.33	0.36
Multiplier	0.05	1.51	-1.79

We now further solve for investment which yields some interesting results. A standard IS/LM framework suggests investment is directly proportional to savings, so we would expect as the less is saved and more consumed (as the MPC rises) investments should fall as Barro (2009) argues. Our results suggest the opposite, that stimulus has a positive effect on investment and is rising with the MPC. This has been observed in reality, where the US stimulus checks improved firm level investment due to the increased profitability at the firm level following the higher economic activity (Correa-Caro, et al., 2018). Our investment equation summarises the effect of stimulus on investment into two countervailing forces: the reduction in savings increasing the real interest rate

reducing investment and the improved output gap increasing it. Our New Keynesian model therefore suggests the latter force is stronger than the former, likely as a result of the zero-lower-bound environment.

Overall, our show a strong multiplier effect from positive increases particularly as a result of the positive effect on consumption, yielding a positive impact multiplier of 1.51. When we compare this to tax-cuts we see a far lower estimate, with very little impact on the economy as a result of the far lower average MPC from beneficiaries. For cuts to contributions, we find a negative multiplier of 1.79 again as a result of the substantial contractionary effect on domestic consumption as a result of the higher MPC from negative income shocks. Our results are clearly sensitive to the size of the MPC, as in our model there is little difference between the positive and negative MPCs from welfare changes, but we see noticeably different outcomes. This reflects the exponential nature of Figure 6, which after an MPC of 0.5 grows rapidly. This gives further weight to the necessity of comparing this paper's results with estimates from models with greater precision.

6. Discussion

Our results have confirmed the key intuition of this paper, that welfare programs target liquidity-constrained households and subsequent changes to the contributions level of means-tested programs will has a strong effect on economic outcomes. Our model suggests every 1-unit increase in means-tested welfare will result in an increase output by 1.5 by improving both consumption and investment, whereas every 1-unit cut will result in a 1.8 fall in output. This results in two clear policy implications: the economic effects of stimulus can be maximised when directed through welfare programs, whereas fiscal consolidation from these programs will have a strong negative effect on output.

It is obvious that these results run contrary to past policy decisions by the UK government. Specifically, over the course of 2010-15 we saw a strategy of tax cuts to the top marginal rate and cuts in welfare contributions notably with the introduction of a 'benefit cap' in 2013. The latter was justified on the grounds of debt consolidation, with the stated aim to:

“Secure the economic well-being of the country by reducing spending on benefits.” (House of Commons Work and Pensions Committee, 2019)

This paper implies that the logic of this approach is inverted, as tax cuts would have not benefited many, if any, liquidity-constrained households but cuts to welfare would have, specifically by the imposition of this benefit cap. This corresponds with a popular narrative in the UK surrounding welfare, which often resorts to notions of ‘economic cost’, implying a policy trade-off between social and economic objectives.

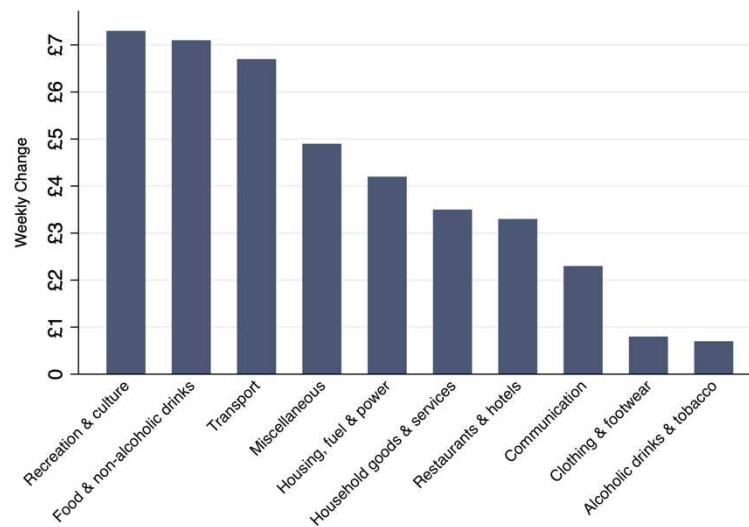
This policy framing of welfare as a necessary social instrument during good times but an economic extravagance during recessions once the economic environment worsens, this naturally sets the program up for retrenchment (Gamble, 2016). This runs contrary to the results presented so far, that raising welfare can *contribute* to recovery, not deepen it. This paper confronts the lack of appreciation for the economic gains from welfare programs which may be leading to these counter-productive measures.

These findings have clear implications for the 2020 COVID-19 induced recession, as the Bank of England’s research during the crisis showed build-up of savings in older households with higher levels of income and savings (Bank of England, May 2021), whereas households with lower savings prior to the crisis have seen rises in debt (Brewer & Handscomb, 2021). This distribution from low to high savings households with high liquidity will not result in a consumption response which is key for the UK’s short-term recovery post restrictions. This paper not only echoes that concern but highlights how the £20 boost to Universal Credit could be an important source of demand in alleviating this effect. Its withdrawal in Q4 2021 could likely have strong contractionary effects on domestic output and exacerbate the macroeconomic effects of the expiry to the job-retention-scheme scheduled for the same period.

Further, we can speculate where these gains induced from Universal Credit currently support by looking at official consumption figures by household income. We can estimate the marginal gain as incomes move from the bottom decile to the second by showing the difference in weekly spend on each commodity displayed in Figure 7. This

shows as incomes rise at the lower end of the income distribution, recreation & culture along with food & alcoholic are the sectors that gain the most. Coincidentally, these are the sectors that have been impacted the most by COVID-19 restrictions (Brewer, et al., 2021), so future demand post restrictions in these sectors could be aided if lower-income households see their incomes rise.

Figure 7: Change in Weekly Expenditure by Sector Between Bottom and Second Income Deciles



Calculated by taking the difference in weekly expenditure by COICOP sector between the bottom and second income decile. Source: ONS (2019)

As this paper intends to serve as a benchmark for future research, there are number of areas we recommended further explorations into. First and foremost, we have written at length regarding what we can and cannot infer from our macroeconomic model. As such a first exercise would be to cross-check these results against others more sophisticated DSGE/(s)VAR methods, in a similar vain to Pappa et al (2015). These methods may provide a more accurate account of this position and will have the further advantage of comparing these results over time. Testing this papers intuition against these robust frameworks would be an important exercise in upgrading our economic ‘illustration’ to providing precise forecasts. An improvement could also be made into our microsimulation efforts to identify liquidity-constrained households. Specifically, with the introduction of survey data in credit-constraints, similar to Dolls et al (2012), with the introduction of data from the FCA dataset mentioned earlier. Our dataset is only

from 2018, so this could further be applied to multiple years to assess how our results change over time, specifically if the onset of the 2020 recession changed the number of liquidity-constrained households in the population and their presence in welfare programs.

Similarly, studies that can observe this in reality could provide confirmation on the causal linkage between welfare contributions and economic outcomes. Specifically, the roll-out of Universal Credit – which has acted as a virtual cut to contributions (IFS, 2019) – was initially rolled-out according to randomly chosen ‘NUTS 3’ regions between 2015-2018 (DWP, 2018). This presents the opportunity for a natural experiment into the effects this has had on regional economic outcomes, notably consumption. However, to date there is no consumption data that corresponds to ‘NUTS 3’ regions, only the larger ‘NUTS 2’ level, making causal inference near impossible. If this data, or if other indicators of economic activity becomes available, there may be an opportunity to test for these effects in this paper regarding the contractionary effects of welfare cuts on regional economic outcomes.

Lastly, as the assumption of this paper is that fiscal stimulus cannot target liquidity-constrained households in part due to administrative challenges, there may be an opportunity for Central Bank Digital Currencies (CBDCs) to meet this challenge. At the time of writing CBDCs are still being developed by the Bank of England and the Treasury, but these may offer an opportunity for future monetary and/or fiscal stimulus if it has the capability to collect data on financial assets. This is a programmability choice that it designs can take, which would allow for governments and central banks to put in place the infrastructure necessary to be able to identify and transfer cash to liquidity-constrained households (Dyson & Hodgson, 2016). Therefore, the logic of this paper can be extended to an exploration into how CBDCs can assist stimulus designs and minimise traditional trade-offs between efficacy and feasibility that this paper has sought to answer.

7. Conclusion

Our paper began by explaining that in the presence of zero-lower-bound interest rates, fiscal policy can and must take a frontline role as an economic stability mechanism, but its effectiveness is constrained so long as it currently has no way to target liquidity-constrained households specifically. The goal of this paper was to therefore determine if existing welfare programs can meet this challenge by identifying the proportion of these households already claiming welfare and illustrating the implications of changes to contributions levels with a macroeconomic model. We found a strong presence of liquidity-constrained households within these programs, specifically those that require means-testing. This implies two conclusions; first governments can use these means-tested welfare programs as an efficient means of transferring cash-based fiscal stimulus those households who are liable to spend it. Our macroeconomic model estimated a strong impact fiscal multiplier of 1.5 from increases in these contributions. The second conclusion is that cuts to these programs will have a stronger than usual contractionary response on domestic consumption if the households that will see their income fall are even more sensitive to such reductions in their income than they are to positive changes. Our model estimated negative multipliers of 1.8, suggesting that the cuts to welfare contributions, that formed a key part of the UK's austerity measures, would have likely had a strong contractionary effect on domestic output. This paper therefore offers a unique contribution to fiscal policy literature by identifying the role existing welfare programs play in strengthening their effects on macroeconomic outcomes.

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Appendix A

Consumption

Our model starts from the standard ‘textbook’ consumption function, we differentiate autonomous (α_{C0}) and induced (α_{CY}) consumption dynamics; alternatively. Taxes are defined as a constant tax share τ and a one-off lump sum tax component TP_t .

$$C_t = \alpha_{C0} + \alpha_{CY}(Y_t(1 - \tau) - TP_t)$$

Such a simple equation, for instance, cannot capture the differential effects of households who are able to follow the permanent income hypothesis (PIH) compared to liquidity-constrained households; this is the key consideration of this paper. Therefore, we extend the following functions to include these effects. Autonomous consumption is now defined as:

$$\alpha_{C0} = Y^P * [(1 - \sigma) - (1 - \sigma_{CY})](1 - \tau)$$

Here we include long and short run savings rates of σ and σ_{CY} respectively. This allows α_{CY} to be interpreted as the pre-tax short run marginal propensity to consume $(1 - \sigma_{CY})$ out of potential output Y^P . Therefore, we can reinterpret α_{C0} as:

$$\alpha_{C0} = Y^P * (1 - \sigma)(1 - \tau) = Y^P * (1 - \tilde{\sigma})$$

Where $(1 - \tilde{\sigma}) = (1 - \sigma) * (1 - \tau)$, therefore taking the form of long run savings adjusted for tax. Therefore, the linear equation can now be presented as:

$$C_t = (1 - \tilde{\sigma})Y^P + (1 - \sigma_{cyc})\{[(1 - \tau)(Y_t - Y^P)] - TP_t\}$$

Where $(1 - \tilde{\sigma})Y^P$ is our long run APC component out of potential output and $\{[(1 - \tau)(Y_t - Y^P)] - TP_t\}$ is our short run component. Strict interpretation of the PIH and/or Ricardian Equivalence (REH) suggests $(1 - \sigma_{CY})=0$ as argued by John Cochrane (Cochrane, 2010). Under this argument negative TP_t (any tax cut/transfer form of fiscal policy) will have no effect. This fundamental assumption of this paper is that $(1 - \sigma_{CY})>0$ for welfare recipients, therefore negative TP_t will induce a consumption response.

Investment

We start as above with an extension to a simple framework. We start by assuming a natural real rate of interest (\bar{r}) that would hold a zero-output-gap at a steady state of marginal capital to depreciation.

$$I_t = \tilde{\alpha}_{I0} + \alpha_{Ir}(r_t - \bar{r})$$

Where $\tilde{\alpha}_{I0}$ represents autonomous investment in terms of potential output. For now, we assume investment exactly equals savings so that $\tilde{\alpha}_{I0}$ must equal: $\psi Y^P = \sigma * (1 - \tau)Y^P$. Where ψ is the depreciation of the capital stock at the steady state of investment.

Net Exports

In extending the above to include external shocks we begin by including international trade. The level of both exports and imports is assumed to comprise both a long run component (as a constant fraction of potential output) and short run component which is dependent on deviations of relative price of exports from long-run trends:

$$X_t = Y^P[x + \eta_x * rpx_t]$$

$$IM = Y^P[im + im_{cyc} * gap_t + \eta_{im} * rpim_t]$$

Here, x and IM denote exports and imports respectively, these are determined by long-run external prices and productivity levels in the relevant traded good sectors. For imports we include both long run import share im (determined by long-run external prices and productive capacity) and im_{cyc} as a short-run marginal propensity to import¹³ along with the output gap $gap_t = \left(\frac{Y_t}{Y^P} - 1\right)$. The η parameters are a response function (assumed to be >0) to $rp x_t$ and $rp im_t$ which are the percentage deviation of the relative price of exports and imports to their long-run parameters RPX_t $RPIM_t$ defined as:

$$RPX_t = \left[\frac{S_t * P_t^X}{P_t} \right]$$

$$RPIM_t = \left[\frac{S_t * P_t^{IM}}{P_t} \right]$$

S_t is the nominal exchange rate, P_t^X and P_t^{IM} are the world currency price of exports and imports, while P_t is the domestic price level. The short run $rp x_t$ and $rp im_t$ parameters are therefore determined by the real exchange rate q_t and the scaled external terms of trade TT_t which is simply $TT_t = P_t^X / P_t^{IM}$:

$$rp x_t = q_t + (1 - \nu) \ln(TT_t)$$

$$rp im_t = q_t - \nu \ln(TT_t)$$

Where ν is the relative importance of imports, q_t is determined by:

$$Q_t = \left[\frac{S_t * P_t^{EXT}}{P_t} \right]$$

¹³ See appendix for how we calibrate this parameter

P_t^{EXT} corresponds to level of external prices which can be written as a weighted average of export and import prices:

$$P_t^{EXT} = (P_t^x)^{\nu} (P_t^{IM})^{(1-\nu)}$$

We then extend this model to incorporate domestic and foreign components. First, we create a baseline using r^{*EXT} as the sum of the external natural rate of interest and RP as the risk premium, such that $r^* = r^{*EXT} + rp^*$ so that the steady state natural interest rate converges towards to the steady state marginal product of capital net of depreciation. This allows us to summarise external financial pressures as the divergence between external interest rates plus risk premium to their baseline values, such that $efp_t = [r_t^{EXT} + rp_t] - [r^{*EXT} + RP^*]$. In assuming that domestic and external financial pressures are symmetric (e.g., tight domestic monetary policy will lead to a fall in the relative prices of exports and imports through real exchange rate appreciation) we can rewrite the above equation so that:

$$rpx_t = q_t + (1 - \nu) \ln(TT_t) = [r^* - r_t] + efp_t + (1 - \nu) \ln(TT_t)$$

$$rpim_t = q_t - \nu \ln(TT_t) = [r^* - r_t] + efp_t - \nu \ln(TT_t)$$

Where $[R^* - R_t]$ represents domestic monetary policy, $efp_t + (1 - \nu) \ln(TT_t)$ represents external shocks. We can therefore rewrite the first equation so that export (supply) and import (demand) equations can be written as¹⁴

$$X_t = Y^P [x + \eta_x * (r^* - r_t) + \eta_x efp_t + \eta_x (1 - \nu) \ln(TT_t)]$$

$$IM = Y^P [im + im_{cyc} * gap_t + \eta_{im} * (r^* - r_t) + \eta_x efp_t - \eta_x \nu \ln(TT_t)]$$

Monetary Response

¹⁴ Green denotes exogenous variables and red for exogenous

Assuming a Taylor Rule construction, monetary policy takes the following form:

$$r^{NOM} = r^{NAT} + \pi^e + \beta_{\pi}(\pi - \pi^t) + \beta_{gap}(gap) + \beta_{efp}(efp_t) + r^{disc}$$

A clear assumption here is that we assume π^e exogenous which allows us to compute output gaps without more computationally intensive frameworks. We include efp_t to incorporate the typical considerations of international financial shocks on the central Bank's setting of interest rates in an open economy. Inflation is determined by according to traditional Phillips Curve framework:

$$\pi = \pi^e - \frac{1}{\eta_{SRAS}}(gap - SS) + \theta efp_t$$

We determine short-run elasticity of supply by η_{SRAS} , θ represents the fraction of efp_t that impacts the real exchange rate. As is important for this paper, the inverse of the above setting represents the real interest rate when nominal interest rates are at the zero-lower-bound (ZLB). The equilibrium of real interest rates is therefore a combination of above:

$$r_t = r^{NAT} + \beta_{\pi}(\pi^e - \pi^t) + \beta_{gap}(gap) + \beta_{ss}(ss_t) + \beta_{efp}(efp_t) + r^{disc}$$

The response parameters determine the strength of the Bank's response to a given component, where:

$$\beta_{gap} = \frac{\beta_{\pi^{-1}}}{\eta} + \beta_{gap}$$

Appendix B

I calibrate im_{cyc} by multiplying the average weekly spend of welfare recipients on each commodity (ONS Data) by the import penetration of the given commodity. Formally:

$$im_{cyc} = \sum_{d=1}^D \left(Yd \sum_{i=1}^i C_{id} \cdot IM_{id} \right)$$

Here, we sum weekly spend Yd by the given commodity C_{id} and multiply that given commodity by the import penetration IM_{id} . We do this for each income decile d to check for any variation across income groups. There may be imprecisions in this approach, as we assume the percentage spend on each commodity involves an equal proportion of imported goods.

Appendix C

Figure 4: Scenario 1.1

MPC	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Consumption	0.00	0.11	0.22	0.33	0.45	0.58	0.71	0.85	1.00	1.16
Investment	0.00	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.06	0.06
Net-exports	0.00	-0.13	-0.19	-0.26	-0.33	-0.40	-0.48	-0.56	-0.64	-0.73
Multiplier	0.00	0.01	0.06	0.11	0.17	0.22	0.28	0.35	0.42	0.49

Figure 5: Scenario 1.2

MPC	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Consumption	0.00	0.10	0.23	0.39	0.60	0.88	1.30	1.94	3.11	5.85
Investment	0.00	0.01	0.08	0.16	0.26	0.41	0.62	0.95	1.54	2.93
Net-exports	0.00	-0.15	-0.17	-0.19	-0.23	-0.27	-0.34	-0.44	-0.63	-1.07
Multiplier	0.00	-0.03	0.14	0.35	0.63	1.02	1.58	2.45	4.03	7.71

Figure 6: Consumption Changes

MPC	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Non ZLB	0.00	0.11	0.22	0.33	0.45	0.58	0.71	0.85	1.00	1.16
ZLB	0.00	0.10	0.23	0.39	0.60	0.88	1.30	1.94	3.11	5.85

