

When is the Government Transfer Multiplier Large?

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Abstract

Transfers to individuals were a larger part of the 2009 U.S. stimulus package than government purchases. Using a two-agent New Keynesian model, this paper shows analytically that the multiplier on targeted transfers to financially constrained households is (i) larger than the purchase multiplier if the zero lower bound (ZLB) binds, and (ii) is more sensitive to the degree of monetary accommodation

of inflation. Targeted transfers provide the same boost to demand as purchases, but lower aggregate supply relative to purchases, as those receiving transfers want to work less. When the aggregate demand curve inverts, such as when the zero lower bound binds, the extra inflation from lower supply boosts the multiplier. This result also holds quantitatively in a medium-scale version of the model.

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WHEN IS THE GOVERNMENT *TRANSFER* MULTIPLIER LARGE?

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1. INTRODUCTION

In the years preceding the Global Financial Crisis, the role of macroeconomic management had largely fallen to central banks, with fiscal policy playing a secondary role. But with the magnitude of the global recession, and the Zero Lower Bound (ZLB) on nominal interest rates binding in the United States and other countries, fiscal policy has now taken a more prominent role in policymakers' attempts to stimulate the economy. This has led to a renewed interest in the response of output to an increase in government purchases: the government purchase multiplier.

Despite the focus on the government purchase multiplier in the literature (Woodford (2011), Christiano *et al* (2011), Cogan *et al* (2010), Werning (2012), Eggertsson (2010b)), the majority of the increase in government spending during the Global Financial Crisis consisted of government transfers to households, not government purchases. According to Oh and Reis (2012), 75 per cent of the increase in US government spending between 2007 and 2009 consisted of transfers, with similar proportions for other OECD countries. Transfers were around 35-80% of the 2009 American Recovery and Reinvestment Act (ARRA) (depending on the classification of intergovernmental payments), and consisted of the bulk of

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earlier stimulus packages in 2001 and in 2008.¹ In representative agent models, government transfers have no effect. This has led Cogan and Taylor (2010) to conclude: “Basic economic theory implies that temporary increases in transfer payments have a much smaller impact than government purchases” (p22).

This paper examines the determinants of the government transfer multiplier in a closed-economy two-agent model with nominal rigidities where around a third of the population is financially constrained. In our model, the fiscal package consists of a targeted transfer to financially constrained households, funded by lump-sum taxes on the unconstrained households. The targeted transfer doesn’t represent a specific stimulus measure, but rather provides an analytical benchmark which (i) isolates effects of transfers on *supply* (which have been overlooked in the literature) and (ii) can be easily adjusted for the level of targeting of a particular policy (by scaling the multiplier by the degree of targeting).² We call the transfer multiplier “large” if it is (i) greater than the purchases multiplier (for analytical results), and/or (ii) greater than one (for quantitative results).³

Our main result is that the transfer multiplier is extremely sensitive to the monetary policy rule of the central bank — much more so than the purchases multiplier. When the central bank responds aggressively to inflation, the transfer multiplier is small — often close to zero for very aggressive monetary policy rules — and is smaller than the purchases multiplier. However, when the Zero Lower Bound (ZLB) on nominal interest rates binds, the targeted transfer multiplier is almost always larger than the purchases multiplier, and is usually larger than one.

The transfer multiplier is extremely sensitive to the central bank’s monetary policy rule because targeted transfers generate more inflation than government purchases. While both

¹See Online Appendix 8 for a discussion. According to NIPA definitions, 89% of ARRA current expenditures were classified as transfer payments. Drautzburg and Uhlig (2015) argue that 59% of the ARRA is transfers.

²An alternative assumption is that transfers are completely untargeted, which would usually underestimate the transfer multiplier, and requires a less straightforward adjustment for imperfect targeting. In Section 5 (extensions) we report untargeted multipliers.

³The government purchases multiplier literature focuses on a multiplier greater than one — the cutoff we follow here — because it means that the government purchase must crowd in private sector activity, and consumption or investment. One could argue that an analogous approach would suggest that the transfer multiplier is large if it is above zero, though we prefer the more conservative threshold of unity.

targeted transfers and purchases boost aggregate demand, only purchases increase aggregate supply (as wealth effects on labour supply cancel across households for transfers). In normal times (when the central bank follows a Taylor rule), this extra inflation *reduces* the transfer multiplier relative to the purchase multiplier: the central bank raises real interest rates, reducing consumption demand from unconstrained households. However, when the ZLB binds, the extra inflation *increases* the transfer multiplier relative to the purchases multiplier, as it reduces real interest rates (increasing demand from unconstrained households). We show analytically in Section 3 that the transfer multiplier is larger than the purchases multiplier whenever the economy's aggregate demand (AD) curve inverts — that is, an increase in inflation is associated with higher aggregate demand. The AD curve is always inverted at the ZLB, and is occasionally inverted away from the ZLB as higher inflation can also raise consumption demand from constrained households (through lower markups and higher wages).⁴

A secondary finding is that sticky wages reduce the difference between the targeted transfer multiplier and the purchases multiplier (we show this numerically in Section 4.1). As wages become increasingly sticky, wealth effects on labour supply become weak, and hence the aggregate supply response to transfers is similar to that of purchases. Targeted transfer and purchase multipliers are also identical when preferences imply that wealth effects on labour supply are zero (such as Greenwood–Hercowitz–Huffman (GHH) preferences).⁵ Given the importance of this mechanism, we review the evidence on labour supply elasticities in Section

⁴We call the tendency for higher inflation to reduce demand from unconstrained households the *Taylor Principle Effect*. As the model also includes financially constrained households, inflation has a secondary effect: higher inflation reduces markups, increasing wages, incomes and hence demand of constrained households. We call this increase in demand from constrained households the *Disposable Income Effect*. When the Disposable Income Effect outweighs the Taylor Principle Effect, the aggregate demand curve inverts. While the ZLB binding is a sufficient condition for the inversion of the aggregate demand curve, inversion can also occur under a Taylor rule when fiscal policy is not very persistent, the share of constrained households is high, or prices are very sticky.

⁵In the absence of wealth effects, the efficacy of transfer-based stimulus comes down to targeting transfers at constrained households — halving the fraction of transfers going to constrained households also halves the transfer multiplier. Without wealth effects, imperfect targeting means that the transfer multiplier would be smaller than the purchase multiplier conditional on the same expenditure profile over time — the basis of the traditional intuition that purchase-based stimulus is more effective. On the other hand, it is easier to implement immediate transitory increase in transfers — which has the highest multipliers under a Taylor rule — whereas a timely implementation of a transitory increase in government spending is very difficult.

3.1 and Online Appendix 9, and find that the literature does find evidence in favour of wealth effects on labour supply, albeit ones that are modest in size.

What does this mean for the quantitative size of transfer multipliers? In Section 4, we calculate the size of output multipliers using a medium-scale DSGE model calibrated to match the response of consumption to a transfers shock from the 2001 Bush tax rebates, as estimated by Johnson *et al* (2006).⁶ We find that a once-off 1 per cent of GDP targeted transfer or government purchase raises the present value of output by about 0.9 per cent.⁷ Policies with a persistence similar to that of the transfer component of the 2009 US stimulus package (quarterly auto-correlation of 0.9), have a long-run present value multiplier of around 0.25 for targeted transfers, or 0.4 for purchases in normal times. If monetary policy is constrained by the ZLB for five years, the targeted transfer multiplier is around 1.3 for once-off stimulus, and 1.7 for persistent stimulus (with purchase multipliers being around 1.3 in either case). If transfers are completely untargeted, the transfer multiplier is around 0.5 (with 5 years of ZLB), though it can be above one if the ZLB binds for an extended period with a slightly higher share of constrained households (for example, during a recession with tightened borrowing constraints).

For policymakers seeking to stimulate the economy during a recession, our results suggest that the transfer multiplier tends to be large when (i) transfers are targeted at the financially constrained (who are more likely to spend the transfer); and, (ii) the ZLB binds during the time of the fiscal stimulus (when wealth effects on labour supply increase inflation).⁸

Related Literature Although there are many recent papers examining the effect of government purchases in DSGE models (for example, Christiano *et al* (2011), Cogan *et*

⁶Johnson *et al* (2006) find that around 20-40 per cent of once-off Bush transfers were spent in the months that they arrived, and the consumption response was around one-for-one for those with low levels of liquid assets and close to zero for those with high levels of liquid assets. This is inconsistent with a standard frictionless model, where only the present value of the payments — and not their timing — affect consumption, but consistent with our model where around a third of households are financially constrained.

⁷That is, the multiplier for a policy similar to the 2001 Bush tax cuts would be around 0.3 ($0.9 \times 1/3$) if it was untargeted.

⁸The findings of this paper apply most closely to once-off small cash stimulus payments like the 2001 and 2008 Bush tax rebates, rather than unemployment transfers, which might have additional effects. As our model is linear, the effect of the transfer does not depend on either the size of the payment or how far output is below steady state.

al (2010), Woodford (2011) and Uhlig (2010), Eggertsson (2010b)), there are only a few papers that consider transfers in a setting similar to ours. One of the closest papers is contemporaneous work by Bilbiie, Monacelli and Perotti (2013) who use a saver-borrower New Keynesian model and find a positive transfer multiplier with sticky prices, and a small or zero transfer multiplier with flexible prices. We also find these results, but we extend the literature to (i) study the transfer multiplier at the ZLB, and (ii) compare the size of purchase and transfer multipliers (neither of which are discussed by Bilbiie *et al* 2013).

Our paper is also related to Mehrotra (2017), who studies the effect of untargeted transfers in a two-agent New Keynesian model with a debt-elastic interest spread. Mehrotra (2017) also finds a transfer multiplier close to zero with flexible prices, a modest transfer multiplier with sticky prices and a Taylor Rule, and a larger transfer multiplier at the ZLB (though smaller than the purchase multiplier). Mehrotra's transfer multipliers are generally smaller than ours because (i) his "borrower" households face a debt-elastic interest spread rather than being fully financially constrained, (ii) for most of the analysis he considers deficit-financed untargeted transfers, rather than (mostly) targeted transfers as we do. Mehrotra (2017) does not characterise the transfer multiplier analytically in the general case with either a Taylor Rule or at the ZLB, though he does consider analytical expressions in a number of special cases. Neither Mehrotra (2017) nor Bilbiie *et al* (2013) include a medium-scale model with features like capital and sticky wages in order to quantify the effects of a transfer shock.

Several papers find an inverted aggregate demand curve or the Keynesian "paradox of toil" (Bilbiie 2008, Eggertsson and Krugman 2012, Eggertsson 2012, 2010a, 2010b), but none of these papers considers transfers.⁹ Coenen *et al* (2012) (among others) consider the effects of fiscal stimulus in large scale DSGE models used at policy institutions. While their quantitative transfer multipliers are broadly similar to ours, the use of large models makes it

⁹Kaplan and Violante (2014) show that wealthy households can behave in a hand-to-mouth fashion if they hold low levels of liquid assets, but they do not discuss the effects of transfers on output. Monacelli and Perotti (2011) use a model similar to Bilbiie *et al* (2013) and find that the government purchase multiplier is larger when taxes are levied on the savers (rather than the borrowers). They briefly discuss the effects of fiscal transfers, and find a positive impact multiplier. Drautzburg and Uhlig (2015) investigate the effects of the ARRA in a model similar to Smets and Wouters (2007) with distortionary taxes. While they do consider transfers (as it was part of the ARRA), it is not a focus of their paper.

difficult to describe mechanisms (which is a focus of our paper). Coenen *et al* (2012) also do not mention our key finding: that transfer multipliers are much more sensitive to the degree of monetary accommodation (relative to purchase multipliers).

More broadly, our paper is related to Oh and Reis (2012) and Athreya *et al* (2016), who study transfers in a heterogeneous agent model and find small (positive or negative) multipliers. While these papers provide a much more detailed characterization of the income distribution, transfer policies and savings behaviour, they also simplify the monetary policy response — usually to a strict form of price-level targeting. We take the opposite path of simplifying the income distribution, but analysing a range of monetary policy responses. Interestingly, we also find small transfer multipliers with a strict form of price-level targeting, even when transfers are targeted at households with a high MPC. This reinforces our main finding that the degree of monetary accommodation is a key determinant of the transfer multiplier — without allowing for some monetary accommodation of inflation, the transfer multiplier is likely to be small.¹⁰

The rest of the paper is organised as follows: Section 2 presents the model; Section 3 presents analytical results in a simplified model; Section 4 presents quantitative results using the full model; Section 5 presents several extensions and Section 6 concludes.

2. MODEL

We examine the effect of government transfers and purchases in a New Keynesian DSGE model with two types of agents that differ in their access to financial markets. The unconstrained Ricardian household (agent 1) has full access to financial markets, and the constrained Hand-to-Mouth household (agent 2, HtM) consumes his entire income each period in a hand-to-mouth fashion as in Galí *et al* (2007). Although simple, the two agent setup captures a number of empirical regularities such as a positive propensity to consume out of temporary transfers (Johnson *et al* 2006), a positive response of consumption to government

¹⁰A number of papers, including Davig and Leeper (2011) and Leeper *et al* (2017), find that a combination of an active fiscal policy and passive monetary policy can generate large fiscal multipliers. In contrast, in our paper fiscal policy is always passive. Although we assume a balanced budget in every period, we also assume taxes are lump sum and only levied on the unconstrained households who are Ricardian. Hence the timing of tax payments and the size of the government deficit do not affect the economy.

purchase shocks (Galí *et al* 2007) and imperfect consumption smoothing (Campbell and Mankiw 1989).

In our setup, the government levies lump-sum taxes on the Ricardian household to pay for government purchases and transfers to the HtM household. The Ricardian household owns capital (which they rent to intermediate goods firms). Retailers then transform intermediate goods into final goods. Retailers' prices are sticky in the Calvo sense and so aggregate demand and monetary policy will matter for real outcomes. Wages are sticky as in Erceg *et al* (2000) and Galí (2008). We log-linearise the model, and solve it quantitatively in Section 4. In Section 3 we present a simplified version of the model which can be solved analytically. A full list of non-linear and linearised equations are listed in Online Appendix 6.

2.1. The Ricardian household's problem. The Ricardian household consists of a unit mass of individuals, indexed by $i \in [0, 1]$. Different individuals within the household provide differentiated labour inputs to intermediate-goods producers (see Online Appendix 6 for more detail on the HH's problem). The only heterogeneity across individual members of the household is whether they are able to change their nominal wage each period (as wages are sticky in a Calvo sense). There are complete markets *within* the household, so consumption and all other variables are equalised across individuals and so we drop the i index for these variables.¹¹ Actual hours are determined by the demand of the firm at the given (sticky) wage (discussed further in Section 2.4 below). Each individual chooses real consumption ($c_{1,t}$), *desired* labour hours ($L_{1,t}(i)$), real debt ($-b_t$) and investment (I_t) to maximise his utility, taking real interest rates (R_{t-1}/π_t), lump-sum taxes (Tax_t), real wages ($w_{1,t}(i) = W_{1,t}(i)/P_t$), the real gross rate of return on capital (MPK_t) and profits from retailers (Π_t) as given.¹² Therefore the Ricardian household member's problem is:

¹¹We omit these Arrow securities from the household's budget constraint.

¹²In the full model, we assume that the HtM HH receives a transfer of $1 - \alpha$ share of *steady state* capital income (net of depreciation) and retailers' profits, and pays a share $1 - \alpha$ of government spending (though new government spending is paid for by the Ricardian HH). This means that the HtM HH receives a share of $1 - \alpha$ of total consumption, which equalizes steady state labour supply across households, which simplifies the steady state.

$$(2.1) \quad \max_{\{c_{1,t}, b_t, I_t, L_{1,t}(i)\}} E_0 \sum_{t=0}^{\infty} (\beta)^t U(c_{1,t}, L_{1,t}(i))$$

where $U(c_{1,t}, L_{1,t}(i)) = \ln(c_{1,t}) - \frac{L_{1,t}^{\varphi+1}(i)}{\varphi+1}$ and subject to budget, capital accumulation, and labour demand constraints:

$$(2.2) \quad c_{1,t} + I_t + b_t = (R_{t-1}/\pi_t)b_{t-1} + MPK_t K_{t-1} + w_{1,t}(i)L_{1,t}(i) + \Pi_t - Tax_t$$

$$(2.3) \quad K_t = (1 - \delta)K_{t-1} + [1 - S(I_t/I_{t-1})]I_t$$

$$(2.4) \quad L_{1,t}(i) = (W_{1,t}^*(i)/W_{1,t})^{-\varepsilon_w} L_{1,t}$$

Here φ^{-1} is the Frisch elasticity of labour supply.

The capital adjustment cost takes form of an cost $S(\cdot)$ to produce an extra unit of capital when $I_t \neq I_{t-1}$ in Equation 2.3. Following Christiano *et al* (2005), Altig *et al* (2011) and Smets and Wouters (2007), $S(1) = S'(1) = 0$ and $S''(1) > 0$ in steady state. Relative to an adjustment cost penalising changes in the capital stock $(K_t - K_{t-1})^2$, this formulation is better able to replicate the hump-shaped response of investment to a monetary policy shock in Christiano *et al* (2005). In log-linear terms, investment (\hat{i}_t), depends on its own lagged and (expected) future value, as well as shadow price of capital \hat{q}_t (Equation 2.5).

$$(2.5) \quad \hat{i}_t = \frac{1}{1 + \beta} \hat{i}_{t-1} + \frac{\beta}{1 + \beta} E_t \hat{i}_{t+1} + \frac{1}{(1 + \beta)S''} \hat{q}_t$$

The shadow price of capital \hat{q}_t is determined by its expected future price, the expected marginal product of capital, and the opportunity cost of investing in a risk-free bond.

$$(2.6) \quad \hat{q}_t = \beta(1 - \delta)E_t\hat{q}_{t+1} + [1 - \beta(1 - \delta)]E_tMP\hat{K}_{t+1} - (\hat{R}_t - E_t\hat{\pi}_{t+1})$$

The Ricardian household's problem in the simple model is similar, except that there is no capital or investment, and labour markets are competitive with flexible wages. Hence in the simple model $L_{1,t}(i) = L_{1,t}$ and $w_{1,t}(i) = w_{1,t}\forall i$.

2.2. The Hand-to-Mouth (HtM) household's problem. The HtM household member's problem is much simpler than that of the Ricardian household: each individual household member $i \in [0, 1]$ only has to choose desired labour hours ($L_{2,t}(i)$) as he/she can not smooth consumption over time. Real consumption ($c_{2,t}$) is equal to labour income plus lump-sum transfers (Tr_t) from the government, and will be equal across household members due to our assumption of perfect within-household insurance of Calvo wage shocks. In the simple model, $L_{2,t}(i) = L_{2,t}$ and $w_{2,t}(i) = w_{2,t} \forall i$ as labour markets are competitive.

$$(2.7) \quad \max_{\{c_{2,t}, L_{2,t}(i)\}} E_0 \sum_{t=0}^{\infty} \beta_2^t U(c_{2,t}, L_{2,t}(i))$$

where $U(c_{2,t}, L_{2,t}(i)) = \ln(c_{2,t}) - \frac{L_{2,t}^{\varphi+1}(i)}{\varphi + 1}$ such that:

$$(2.8) \quad w_{2,t}(i)L_{2,t}(i) + Tr_t = c_{2,t}$$

$$(2.9) \quad L_{2,t}(i) = (W_{2,t}^*(i)/W_{2,t})^{-\varepsilon_w} L_{2,t}$$

2.3. Sticky prices, Retailers, Intermediate and Final Output. Intermediate output is Cobb-Douglas in capital and aggregate labour, and is produced by a unit continuum of

competitive intermediate goods producers. Aggregate labour is Cobb-Douglas in the labour inputs of the two households.¹³ There is no capital ($\mu = 0$) in the simple model.

$$(2.10) \quad Y_t = K_{t-1}^\mu L_t^{1-\mu} \quad \text{where} \quad L_t = L_{1,t}^\alpha L_{2,t}^{(1-\alpha)}$$

As in Bernanke *et al* (1999) and Iacoviello (2005), final output is produced by a unit continuum of retailers, indexed by l , who buy intermediate output Y_t at price P_t^{int} in a competitive market, costlessly differentiate it, and sell a variety of final output $Y_{l,t}$ at price $P_{l,t}$. Aggregate final output is given by the index $Y_t^f = \left(\int_0^1 Y_{l,t}^{\frac{\sigma-1}{\sigma}} dl \right)^{\frac{\sigma}{\sigma-1}}$ and aggregate prices are given by $P_t = \left(\int_0^1 P_{l,t}^{1-\sigma} dl \right)^{1/(1-\sigma)}$. Each retailer faces a downward sloping demand curve for his variety, and he must choose the optimal nominal price, taking into consideration the Calvo probability θ_p that he may not be able to change his price. The pricing problem of retailers leads to a standard New Keynesian Phillips curve (Equation 2.11), which is shown in log deviation from steady state, where $\hat{\pi}_t = \ln P_t - \ln P_{t-1}$ is the inflation rate (steady state inflation is zero), and $\hat{X}_t = \ln X_t - \ln X$ is the deviation in the retailer's average markup from steady state (where $X = \frac{\sigma}{\sigma-1}$ and $\kappa = (1 - \theta_p)(1 - \beta\theta_p)/\theta_p$). The parameter κ is the slope of the Phillips curve — the higher κ , the more responsive inflation (and less responsive output) is to a given shift in demand. With flexible prices $\kappa \rightarrow \infty$, so shifts in demand affect prices and not output. With more sticky prices (higher θ_p) a larger share of firms are unable to change their prices to move markups towards their desired level, resulting in a muted response of inflation and a larger response of output to increases in demand (such as government purchases or transfers).

¹³In a related model, Galí *et al* (2007) assume that labour across household types as being perfectly substitutable (rather than Cobb-Douglas as in Equation 2.10). They also argue that imperfectly competitive labour markets are needed to fit the response of consumption to a government purchases shock with a reasonable share of HtM HHs. It turns out that their formulation generates *exactly* the same aggregate allocations and multipliers as the Cobb-Douglas specification used here in Equation 2.10 (including a generalization to sticky wages). In Online Appendix 2.1 we show the equivalence analytically between our simple model with a Cobb-Douglas specification, and a similar model with perfect substitutes and a union as in Galí *et al* (2007). We also verify the equivalence numerically for the full model with sticky wages.

$$(2.11) \quad \hat{\pi}_t = \beta E_t \hat{\pi}_{t+1} - \kappa \hat{X}_t$$

The price of intermediate output in terms of final output is the inverse of the retailer's average markup $\frac{P_t^{int}}{P_t} = \frac{1}{X_t}$. As such, the marginal product of labour or capital in terms of intermediate goods must be divided by the markup to generate the real marginal product. As in Galí (2008), deviations of Y_t^f from Y_t are second-order in the neighbourhood of the steady state, and so for our first-order approximation $\hat{Y}_t = \hat{Y}_t^f$. Aggregate real wages are given by:

$$(2.12) \quad w_{1,t} = \alpha(1 - \mu) \frac{1}{X_t} \frac{Y}{L_{1,t}}, \quad w_{2,t} = (1 - \alpha)(1 - \mu) \frac{1}{X_t} \frac{Y}{L_{2,t}}$$

2.4. Sticky wages. The government transfer multiplier depends crucially on the labour supply response of different types of households. Christiano *et al* (2005) argue that sticky wages are important for fitting the response of a monetary policy shock to the data. Because wage stickiness necessitates adding extra state variables (lagged real wages), we assume flexible wages in the simplified model (but include sticky wages in the full model in Section 4).

We model wage stickiness as in Erceg *et al* (2000) and Galí (2008). The labour supply of household type $\{\text{Ricardian}, \text{HtM}\}$, $L_{1,t}$ and $L_{2,t}$ respectively, are now CES composites of differentiated labour inputs (indexed by i): $L_{1,t} = [\int_0^1 L_{1,t}(i) di]$ and $L_{2,t} = [\int_0^1 L_{2,t}(i) di]$ where the demand for each variety i is given by Equation 2.4 and 2.9. Since households possess market power in their labour supply decisions, they are able to set their wage at a steady state markup above their marginal rate of substitution $\mu_w = \varepsilon_w / (\varepsilon_w - 1)$.

Each member i of the Ricardian and HtM households is allowed to reset his/her nominal wage with constant probability $1 - \theta_w$ in each period. As such, the wage decision of the Ricardian HH at time $t = 0$ is to choose $W_{1,0}^*(i)$, to maximize Equation 2.1 subject to Equation 2.4 and other constraints, where the discount rate $\beta_1 = \beta \theta_w$ is lower to reflect the fact that the further into the future, the less the chance that the fixed nominal wage $W_{1,0}^*(i)$

will apply. The HtM HH's problem is analogous. The optimal nominal wage of HHs of type i (who get to reset at time $t = 0$) can be expressed as a weighted average of the expected future wage level for other households and the log deviation of the wage mark-up from its steady state level $\hat{\mu}_{k,t}^w = \hat{w}_{k,t} - \varphi \hat{L}_{k,t} - \hat{c}_{k,t}$.

Aggregating over types that cannot reset wages, we get the New Keynesian wage Philips curve (Equation 2.13), where nominal wage inflation for each household $\hat{\pi}_{k,t}^w = \ln W_{k,t} - \ln W_{k,t-1}$, $k = 1, 2$ will be a function of expected wage inflation tomorrow and the deviations of each household's marginal rate of substitution from its steady state level $\hat{\mu}_{k,t}^w$ (variables with hats generally denote deviations from steady-state).

$$(2.13) \quad \hat{\pi}_{k,t}^w = \beta \mathbb{E}_t \hat{\pi}_{k,t+1}^w - \lambda \hat{\mu}_{k,t}^w$$

where $\lambda = \frac{(1-\theta_w)(1-\theta_w\beta)}{\theta_w(1+\varphi\epsilon)}$, and $\hat{w}_{k,t} = \hat{w}_{k,t-1} + \hat{\pi}_{k,t}^w - \hat{\pi}_t$, $k = 1, 2$ is the real wage.

2.5. Monetary and Fiscal Policy. During normal times, the central bank follows a Taylor Rule (in linearised form) with interest rate smoothing, where $\hat{R}_t = \ln R_t - \ln R_{SS}$ is the log deviation of the gross nominal interest rate from its steady state level. We allow for the possibility that the central bank is constrained by the ZLB and keeps the nominal rate fixed for a certain number of periods before resuming the Taylor rule (Equation 2.14). The degree of interest rate smoothing is governed by the parameter ϕ_R .

$$(2.14) \quad \hat{R}_t = \phi_R \hat{R}_{t-1} + (1 - \phi_R)(\phi_\pi \hat{\pi}_t + \phi_Y \hat{Y}_t)$$

Government expenditures consist of unproductive government purchases G_t , and targeted transfers to HtM households Tr_t . Government expenditure is financed by a lump sum tax on the Ricardian households Tax_t . Note here that throughout the paper, \hat{Tr}_t and \hat{G}_t are the deviation of transfers and government purchases from steady state as a share of GDP, i.e. $\hat{Tr}_t \equiv \frac{Tr_t - Tr_{SS}}{Y_{SS}}$, $\hat{Tax}_t \equiv \frac{Tax_t - Tax_{SS}}{Y_{SS}}$ and $\hat{G}_t \equiv \frac{G_t - G_{SS}}{Y_{SS}}$. This simplifies the expressions for multipliers and allows for the possibility that purchases are zero in steady state. The notation

only applies to transfers and purchases: other variables with “hats” are log deviations from their respective steady-states.

The government runs a balanced budget each period (Equation 2.15). Whether the government runs a balanced budget does not matter for the path of the economy as taxes are only levied on the unconstrained households, who are Ricardian — it is only the timing of the transfers and purchases that affect allocations.¹⁴

$$(2.15) \quad Tax_t = Tr_t + G_t$$

The paths of $\hat{T}r_t$ and \hat{G}_t are exogenous and are assumed to follow an AR(1) process.

$$(2.16) \quad \hat{T}r_{t+1} = \rho\hat{T}r_t + e_{Tr,t+1} \quad \text{and} \quad \hat{G}_{t+1} = \rho\hat{G}_t + e_{G,t+1}$$

where $\{e_{Tr,t+1}, e_{G,t+1}\}$ are zero-mean i.i.d shocks. The model is closed by the standard aggregate resource constraint:

$$(2.17) \quad Y_t = c_{1,t} + c_{2,t} + I_t + G_t$$

3. WHEN IS THE TRANSFER MULTIPLIER LARGER THAN THE PURCHASE MULTIPLIER?

ANALYTICAL RESULTS FROM A SIMPLIFIED MODEL

In this section we derive analytical expressions in a simplified model for the targeted transfer and purchases multipliers in “normal” times when the central bank follows a Taylor rule (Section 3.2) or when nominal interest rates are at the Zero Lower Bound (ZLB, Section 3.3). Given the analytical approach, we focus on the *relative* size of the targeted transfer and purchases multipliers which we can characterize exactly, rather than the numerical size of the transfer multiplier which requires a richer model (Section 4). The transfer multiplier is

¹⁴This is not the case if taxes are levied only on the HtM HHs or if taxes are distortionary. Equation 2.15 excludes steady state transfers across households to ensure consumption shares equal labour shares.

larger than the purchase multiplier when the economy’s aggregate demand curve is inverted (Section 3.4), which occurs occasionally when monetary policy follows a Taylor rule, but *always* when the ZLB binds. Because transfers lead to lower supply than purchases (but have the same effect on demand), they generate more inflation and so the transfer multiplier is more sensitive to the monetary policy response to inflation than the purchase multiplier (Section 3.5).

3.1. The importance of wealth effects on labour supply. The effect of targeted transfers on *aggregate demand* is identical to that of purchases — they are both spent — and the only difference depends on labour supply. When the HtM HH receives a transfer, it becomes better off and so “spends” some of the transfer on higher leisure/reduced work which *lowers* labour supply — the wealth/income effect on labour supply. In contrast, a government purchase has no effect on HtM HH labour supply (absent GE effects).¹⁵ All differences between transfer and purchase multipliers in this paper stem from the effects of this difference in general equilibrium. Without wealth effects – for example, with Greenwood–Hercowitz–Huffman (GHH) preferences – transfers have the same effect on aggregate supply as purchases, and hence the targeted transfer multiplier is *identical to* the purchases multiplier.¹⁶

The wealth effect enters the model through the household’s labour-leisure first order condition. With standard (separable) preferences as in Section 2, a transfer to the HtM HH increases consumption (as $c_2 = w_2 L_2 + Tr_2$), which increases the denominator of Equation 3.1, and therefore reduces labour supply L_2 . In contrast, with GHH preferences, consumption does not appear in the labour-leisure FOC (RHS of Equation 3.1), and so there is no effect of the transfers on labour supply of HtM HHs at constant wages.

¹⁵For either targeted transfers or purchases, lump sum taxes increase on the Ricardian HH, which makes it want to work more (also via the wealth effect). This means that in total, aggregate labour supply increases for a purchase, and is roughly unchanged for a transfer.

¹⁶If preferences are GHH, the targeted transfer and purchases multipliers are identical and in the simple model are given by $\frac{1}{\varphi} \left(\frac{\alpha\varphi\kappa}{\varphi+1} \frac{[\phi_\pi - \rho]}{(1-\rho)(1-\rho\beta)} - (1-\alpha) \right)^{-1}$. With either perfect inflation targeting ($\phi_\pi \rightarrow \infty$) or flexible prices ($\kappa \rightarrow \infty$), the GHH multiplier will go to zero.

$$(3.1) \quad \textit{Standard pref.} : \quad L_2 = [w_2/c_2]^{1/\varphi} = [w_2/(w_2L_2 + Tr_2)]^{1/\varphi} \quad \textit{GHH} : \quad L_2 = w_2^{1/\varphi}$$

The empirical literature (surveyed in Online Appendix 9) generally finds significant estimates of the wealth/income effect – albeit ones that vary across studies and are modest in size – and so are broadly supportive of the standard preferences used here. In our model, the size of wealth effects depends only on the size of the Frisch elasticity (φ^{-1}).¹⁷ Conditional on having standard preferences, the Frisch elasticity doesn't affect the relative sizes of purchase and transfer multipliers in the simple model due to offsetting general equilibrium effects.

3.2. The transfer multiplier when Monetary Policy follows a Taylor rule. In order to get analytical results, we need to simplify the model by assuming flexible wages, no capital or steady state government spending, and a simplified Taylor rule where nominal interest rates only respond to contemporaneous inflation.¹⁸ The list of log-linearised equations (A1-A9) is shown in Box 1 where a hat ($\hat{\cdot}$) denotes percentage deviation from steady state (except for transfers and purchases, where it represents the change in fiscal policy as a share of GDP).

¹⁷Specifically, the size of the income effect with our preferences is $-(\varphi + 1)^{-1} < 0$, which is increasing in absolute magnitude with the Frisch (φ^{-1}). See Keene (2011). The wealth/income effect is also known in the labour literature as the marginal propensity to earn (MPE) out of unearned income. With GHH preferences the MPE is zero.

¹⁸The first group of assumptions make sure the multiplier is constant over time — that is, output is a constant multiple of \hat{G}_t or \hat{Tr}_t — by removing endogenous state variables such as capital (by setting the capital share $\mu \rightarrow 0$), lagged wages (by making nominal wages flexible $\lambda \rightarrow \infty$) or the lagged interest rate (by setting interest rate smoothing $\phi_R = 0$). The second group of assumptions simplify the expressions by assuming (i) the central bank does not respond to output ($\phi_Y = 0$) and (ii) ensuring that the steady state consumption share of each household is equal to their share of wage income. We achieve the latter by setting steady state government purchases to zero ($G_{ss} = 0$), and assume a wage subsidy equal to $s_{ss} = X_{ss} - 1$ (where X_{ss} is the steady state gross markup), funded by a lump sum tax of $(X_{ss} - 1)Y_{SS}$ on Ricardian HHs such that consumption and wage income of each HH is a share α or $1 - \alpha$ of total GDP. A similar approach used by Bilbiie (2008) is to assume a fixed cost of operating each firm that exactly offsets profits in steady state.

Box 1: Simplified New Keynesian model**Model Equations (A1-A9)**

[A1 Production Function] $\hat{Y}_t = \alpha \hat{L}_{1t} + (1 - \alpha) \hat{L}_{2t}$

[A2 Resource Constraint] $\hat{Y}_t = \alpha \hat{c}_{1,t} + (1 - \alpha) \hat{c}_{2,t} + \hat{G}_t$

[A3 HtM Budget Constraint] $(1 - \alpha) \hat{c}_{2,t} = \hat{T}r_t + (1 - \alpha)(\hat{w}_{2,t} + \hat{L}_{2,t})$

[A4 Ricardian Euler Equation] $\hat{c}_{1,t} = - \left(\hat{R}_t - E_t \hat{\pi}_{t+1} \right) + E_t \hat{c}_{1,t+1}$

[A5 Taylor Rule] $\hat{R}_t = \phi_\pi \hat{\pi}_t$

[A6 Phillips Curve] $\hat{\pi}_t = \beta E_t \hat{\pi}_{t+1} - \kappa \hat{X}_t$

[A7 Fiscal policy (exogenous)] $\hat{T}r_{t+1} = \rho \hat{T}r_t + \hat{e}_{Tr,t+1}$ or $\hat{G}_{t+1} = \rho \hat{G}_t + \hat{e}_{G,t+1}$

[A8 Labour-Leisure FOC] $\hat{w}_{kt} = \hat{c}_{kt} + \varphi \hat{L}_{kt}, \forall k = 1, 2$

[A9 MPL=wage] $\hat{w}_{k,t} = \hat{Y}_t - \hat{L}_{k,t} - \hat{X}_t, \forall k = 1, 2$

Proposition 1. Flexible price multiplier. *In the limit of the simple model when prices are flexible ($\kappa \rightarrow \infty$), the transfer multiplier is zero and the government purchase multiplier is $1/(\varphi + 1)$ (where φ^{-1} is the Frisch elasticity of substitution).*

Proof. Combine Equations A8, A9, A1, A2 to form Equation 3.2. When prices are flexible ($\kappa \rightarrow \infty$), retailers keep their markups constant at the profit-maximising optimum, so $\hat{X}_t = 0$ and hence $\hat{Y}_t = \frac{1}{\varphi+1} \hat{G}_t$. \square

$$(3.2) \quad \hat{Y}_t = \frac{1}{\varphi + 1} \hat{G}_t - \frac{1}{\varphi + 1} \hat{X}_t$$

The flexible price multiplier is driven entirely by wealth effects on labour supply. Both targeted transfers and purchases are funded by a lump-sum tax on the Ricardian household which cause it to increase labour supply (a negative wealth effect) when its consumption falls to pay the tax. For purchases this is the end of the story: higher labour supply boosts output leading to a positive multiplier of $(1 + \varphi)^{-1}$ (the neoclassical wealth effect). For transfers, this negative wealth effect for the Ricardian household is exactly offset by the positive wealth

effect on the HtM HH who receives the transfer, leaving output unchanged. An implication of Equation 3.2 is that transfers affect output only through variation in markups \hat{X}_t .¹⁹

Solving the analytical model with sticky prices

Box 2: Dynamic two-equation system:

Modified New Keynesian IS Curve (with a fraction $1 - \alpha$ of HtM HHs):

$$(3.3) \quad \hat{Y}_t = E_t \hat{Y}_{t+1} - \frac{(\phi_\pi \hat{\pi}_t - E_t \hat{\pi}_{t+1}) + [E_t \hat{G}_{t+1} - \hat{G}_t] + \alpha^{-1} [E_t \hat{T}r_{t+1} - \hat{T}r_t]}{1 - \alpha^{-1}(1 - \alpha)(\varphi + 1)}$$

Standard New Keynesian Phillips Curve

$$(3.4) \quad \hat{\pi}_t = \beta E_t \hat{\pi}_{t+1} - \kappa [\hat{G}_t - (\varphi + 1)\hat{Y}_t]$$

We solve the analytical model — and show how it works — in five steps. In the first step we rearrange the Equations A1-A9 into a modified New Keynesian IS Curve (Equation 3.3) and a standard New Keynesian Phillips curve (Equation 3.4, which does not depend on the HtM share) as shown in Box 2. In the case that there are no HtM HHs ($\alpha = 1$) (transfers are not defined in this case), the modified NK IS curve collapses to its standard version: $\hat{Y}_t = E_t \hat{Y}_{t+1} - (\phi_\pi \hat{\pi}_t - E_t \hat{\pi}_{t+1}) + (\hat{G}_t - E_t \hat{G}_{t+1})$. The Philips curve is the same as it would be in a standard NK model without HtM HHs.

In the second step, we restrict the parameter space to where Assumption A1 holds ($\phi_\pi > 1$ and $1 - \alpha < (2 + \varphi)^{-1}$), which we show in Lemma 1 is a sufficient condition for determinacy.²⁰ All our results with a Taylor rule — even when the transfer multiplier is larger than the purchase multiplier — are in this region of the parameter space. This is distinct from

¹⁹If we assumed that the share of labour income of each household was *not* same as their share of aggregate consumption, then the wealth effects of the two households would not exactly cancel in response to a targeted transfer. This means that the aggregate supply curve would shift in response to a targeted transfer and the flex-price transfer multiplier would be positive (negative) if the HtM HH's consumption labour share is larger (smaller) than his labour share. Nonetheless, transfers will still increase supply by less than same-sized government purchase, so much of the intuition is unchanged. See Online Appendix 4.

²⁰In a related model, Galí *et al* (2004) find that only the Taylor principle is required for determinacy so long as the HtM share is below a certain cut-off (around 0.57 in their Figure 2), which is consistent with the finding here. Bilbiie (2008) also finds that when the HtM share is reasonably low the Taylor Principle is sufficient for determinacy (his Proposition 7).

Bilbiie’s (2008) IADL region (where $\phi_\pi < 1$ and $1 - \alpha > (2 + \varphi)^{-1}$), which can be seen in the different white determinacy regions in Online Appendix Figure 4 (Panel A) — see Online Appendix 5.1 for a discussion.

Assumption A1: The Taylor Principle holds ($\phi_\pi > 1$) and the HtM share is not too high ($1 - \alpha < (2 + \varphi)^{-1}$).

Lemma 1. *Assumption A1 is a sufficient condition for a determinant equilibrium in the simple model (Equation 3.3-3.4).*

Proof. Rearrange Equation 3.3-3.4) in state-space form, and use Woodford (2003) Proposition C1 (p670). □

In the third step, we use Lemma 2 to solve for expectations of future variables in terms of current variables, which removes all dynamics from the model.²¹ Because all variables follow an AR(1) process with the same persistence ρ , the static solution of the model at $t+1$ is just a shrunk-down version of the static solution of model at t .

Lemma 2. *Following an unanticipated transfers or purchases shock with persistence ρ , all model variables follow an AR(1) process with persistence ρ along the adjustment path. That is, for any variable \hat{Z}_t then $E_t \hat{Z}_{t+1} = \rho \hat{Z}_t$*

Proof. Follows from the linearity of the model and lack of endogenous state variables. Can be shown by guess and verify. □

Aggregate supply and demand

The fourth step is to show the equilibrium can be characterized by an aggregate supply and aggregate demand relationship linking current output \hat{Y}_t and current inflation $\hat{\pi}_t$. This is similar to the “Old Keynesian” aggregate demand and aggregate supply relationships in undergraduate textbooks, but with rational expectations micro-foundations.²²

²¹When prices are flexible, the model is essentially static because real interest rate adjusts to make the Euler equation hold.

²²Conditional on P_{t-1} , solving for the inflation rate is the same as solving for the price level in “Old Keynesian” models.

The supply curve (Definition 1) is unchanged from the standard NK model.²³

The slope of the aggregate demand curve (Definition 2) is key in determining the relative size of transfers and purchases multipliers, so we provide a further decomposition of the opposing forces driving its slope: the Taylor Principle (TP) effect (Definition 3) and the Disposable Income (DI) Effect (Definition 4). The two factors correspond (respectively) to the determinants of the two endogenous components of aggregate demand (Equation A2): consumption by the Ricardian household as a share of GDP $\alpha\hat{c}_{1,t}$, and consumption by the HtM HH as a share of GDP $(1-\alpha)\hat{c}_{2,t}$. Normally the AD curve is downward sloping as higher inflation leads to higher real interest rates and lower consumption demand of the Ricardian HH. An increase in inflation is associated with *higher* aggregate demand (an inverted AD curve) when (i) the boost to the consumption of the HtM HHs (via lower markups, higher wages and hence incomes) outweighs any reduction in consumption demand of the Ricardian HH through higher real interest rates or (ii) the ZLB binds so that higher inflation reduces real interest rates and so increases Ricardian HH consumption.

In the final step, we identify the multiplier by intersecting the aggregate demand and supply curves (substituting out for inflation). Transfers and purchases both increase demand by the same amount (Remark 2), but only government purchases expand supply (Remark 1). This means that the targeted transfer multiplier will be larger than the purchases multiplier *iff* the aggregate demand equation inverts (slopes upwards). Proposition 2 presents the transfer and purchase multipliers and Proposition 3 lists some implications.

Away from the ZLB, the transfer multiplier will be larger than the purchase multiplier when: (i) the share of HtM households is larger, $\uparrow (1-\alpha)$, as this increases the share of aggregate consumption that is sensitive to wages and markups and reduces the share sensitive to the interest rate, and (ii) fiscal policy is not too persistent, $\downarrow \rho$, as this makes retailers more reluctant to increase prices (in case they cannot change prices back in the future) and instead reduce markups/increase wages, which increases HtM HH disposable income. For example, with our default parameters (Table 1) and $\rho = 0$, the transfer multiplier is larger

²³Labour supply decisions of households (which affect firms' marginal costs) affect the supply curve but not the demand curve (note the inverse of Frisch elasticity substitution φ in Equation 3.5).

so long as the HtM share $(1 - \alpha)$ is greater than around 10% (but less than $1/3$ to satisfy Assumption A1). With the default HtM share $(1 - \alpha = 0.3)$ the transfer multiplier is larger so long as $\rho < 0.6$ — see the white region of Online Appendix Figure 4 (Panel B).

Definition 1. *Aggregate Supply Curve.* The aggregate supply curve is given by Equation 3.5, and reflects the desired output of firms \hat{Y}_t^{AS} at a given level of inflation $\hat{\pi}_t^{AS}$. The curve is the generalization of the Phillips curve (Equation A6), solving out for expectations (using Lemma 2) and markups \hat{X}_t (using Equation 3.2).

$$(3.5) \quad \hat{\pi}_t^{AS} = \frac{\kappa(\varphi + 1)}{(1 - \rho\beta)} \hat{Y}_t^{AS} + \frac{-\kappa}{(1 - \rho\beta)} \hat{G}_t$$

Remark 1. Purchases increase aggregate supply, but transfers do not (i.e. only purchases appear in Equation 3.5).

Definition 2. *Aggregate Demand Curve.* The aggregate demand curve is given by Equation 3.6, and represents the level of output \hat{Y}_t^{AD} demanded for private and government consumption for a given level of inflation $\hat{\pi}_t^{AD}$.²⁴

$$(3.6) \quad \hat{\pi}_t^{AD} = -\frac{\alpha \hat{Y}_t^{AD}}{\Gamma} + \frac{\hat{T}r_t + \hat{G}_t}{\Gamma}$$

$$\text{where } \Gamma = \underbrace{[\alpha(\phi_\pi - \rho)/(1 - \rho)]}_{TP \text{ Effect}} - \underbrace{[(1 - \alpha)(1 - \rho\beta)/\kappa]}_{DI \text{ Effect}}$$

Remark 2. Purchases and targeted transfers have the same effect on aggregate demand.

Definition 3. *Taylor Principle (TP) Effect.* The *fall* in aggregate demand from the Ricardian household from an increase in inflation is given by $\alpha(\phi_\pi - \rho)/(1 - \rho)$.²⁵ As its name

²⁴The AD curve is derived by combining the aggregate resource constraint (Equation A2) and Equations 3.7 and 3.8. The aggregate demand curve is the generalisation of the standard New Keynesian IS curve in terms of current inflation, solving out for expectations using Lemma 2, and solving for consumption demand of the HtM household.

²⁵Consumption of the Ricardian household is driven by the Euler equation (Equation A4), and so the Taylor Principle effect comes from substituting the Taylor rule (Equation A5) into the Euler Equation, and using Lemma 2 to solve for the expectations of future consumption and inflation (Equation 3.7).

suggests, $\alpha(\phi_\pi - \rho)/(1 - \rho) > 0$ whenever the Taylor principle holds (i.e. $\phi_\pi > 1$), which ensures that an increase in inflation raises real interest rates and lowers the consumption of the Ricardian household. When the ZLB binds, the Taylor Principle Effect reverses its sign because a rise in inflation *lowers* real interest rates, which increases consumption demand from Ricardian HHs (Section 3.3 — effectively $\phi_\pi = 0$).

$$(3.7) \quad \alpha \hat{c}_{1,t} = - \underbrace{[\alpha(\phi_\pi - \rho)/(1 - \rho)]}_{TP\ Effect} \hat{\pi}_t$$

Definition 4. *Disposable Income (DI) Effect.* The *boost* to aggregate demand by the HtM household from an increase in inflation is given by $(1 - \alpha)(1 - \beta\rho)/\kappa$, other things (transfers and aggregate output) equal. Consumption of the HtM household is driven by its disposable income each period, and along the adjustment path higher inflation increases wages (by reducing markups), thereby boosting labour income of the HtM HH.²⁶

$$(3.8) \quad (1 - \alpha) \hat{c}_{2,t} = \hat{T}r_t + (1 - \alpha) \hat{Y}_t + \underbrace{[(1 - \alpha)(1 - \beta\rho)/\kappa]}_{DI\ Effect} \hat{\pi}_t$$

Proposition 2. *Sticky price multiplier.* *In the simple model when prices are sticky, monetary policy follows a Taylor rule and Assumption A1 holds, the targeted transfer and purchases multipliers are given by Equation 3.9.*

$$(3.9) \quad \hat{Y}_t = \left[\alpha + \Gamma \frac{\kappa(\varphi + 1)}{(1 - \rho\beta)} \right]^{-1} \left[\hat{T}r_t + \hat{G}_t + \frac{\kappa}{(1 - \rho\beta)} \Gamma \hat{G}_t \right]$$

where:

- $M_{Tr} = \left[\alpha + \Gamma \frac{\kappa(\varphi + 1)}{(1 - \rho\beta)} \right]^{-1} > 0$ is the transfer multiplier,

²⁶The disposable income effect is derived from the HtM HH's budget constraint (Equation A3), substituting the firm's FOC (Equation A9), and using the Phillips curve (Equation A6) plus Lemma 2 to substitute out variation in markups \hat{X}_t to yield Equation 3.8.

- $M_G = \left[\alpha + \Gamma \frac{\kappa(\varphi + 1)}{(1 - \rho\beta)} \right]^{-1} \left(1 + \frac{\kappa}{1 - \beta\rho} \Gamma \right) > 0$ is the purchases multiplier,
- $\Gamma = \underbrace{[\alpha(\phi_\pi - \rho)/(1 - \rho)]}_{TP\ Effect} - \underbrace{[(1 - \alpha)(1 - \rho\beta)/\kappa]}_{DI\ Effect}$

Proof. Use the aggregate demand (Equation 3.6) and aggregate supply (Equation 3.5) relations to eliminate $\hat{\pi}_t$, and solve for \hat{Y}_t . \square

Proposition 3. *Transfer and Purchase Multipliers and Inverted Aggregate Demand Curve.* *In the simple model when assumption A1 holds, the targeted transfer multiplier is larger than the purchase multiplier whenever:*

- a) *the Disposable Income effect dominates the Taylor Principle effect, i.e.*

$$\Gamma = \underbrace{[\alpha(\phi_\pi - \rho)/(1 - \rho)]}_{TP\ Effect} - \underbrace{[(1 - \alpha)(1 - \rho\beta)/\kappa]}_{DI\ Effect} < 0$$

or equivalently:

- b) *the demand curve is inverted (slopes upward in $(\hat{Y}, \hat{\pi})$ -space).*

Proof. Follows from Proposition 2 and Definition 2. \square

3.3. The transfer multiplier when the ZLB binds. It is well documented that government purchases are much more potent when monetary policy is at the ZLB (Eggertsson 2010b, Christiano *et al* 2011, Woodford 2011). We show analytically that the targeted transfer multiplier is larger than the (already large) purchases multiplier at the ZLB (Proposition 4). In Section 4, we get similar numerical results in medium-scale DSGE model.

We show the transfer multiplier is larger than the purchases multiplier at the ZLB using a tractable two-state setup similar to that in Eggertsson (2010b) and Woodford (2011), where the ZLB and contemporaneous fiscal expansion persist with probability ξ each period. In this set-up, the *reason* the ZLB is binding does not matter (Christiano *et al* 2011): the multiplier is determined by the fact that nominal interest rates do not respond to fiscal policy. For

simplicity, we abstract from the reason the ZLB binds, and model “the ZLB binding” as a constant nominal interest rate policy of the central bank while this regime lasts.²⁷

The key reason that targeted transfers are more stimulatory than purchases at the ZLB is that they generate more inflation: transfers and purchases provide the same boost to demand, but transfers do not boost supply. When monetary policy follows a Taylor rule, the extra increase in inflation will increase wages, and hence the disposable income of the HtM HH, which will boost demand (the DI effect). But it will also *raise* real interest rates, which will *reduce* demand of the Ricardian HH (the TP Effect). At the ZLB there is no tension between the TP effect and the DI effect: higher inflation *lowers* the real interest rate, and hence *increases* consumption by the Ricardian household. Hence, the aggregate demand curve is always inverted at the ZLB, and the transfers multiplier is always larger than the purchases multiplier.

Assumption A2: (i) The ZLB regime is not too persistent (Markov probability $\xi < 0.35$ with our default parameters), (ii) the non-ZLB regime is an absorbing state and (iii) the Taylor principle ($\phi_\pi > 1$) holds in the non-ZLB regime.

Lemma 3. *Consider a fiscal shock of size $\hat{T}r_t$ or \hat{G}_t and a constant nominal interest rate at time t (the “Zero Lower Bound regime”). With probability ξ , the fiscal shock and constant nominal rate policy continues at $t + 1$. With probability $1 - \xi$, $\hat{T}r_{t+1} = \hat{G}_{t+1} = 0$ and the central bank resumes a Taylor rule (the non-ZLB regime). Assume assumption A2 holds. Then while the ZLB binds, the equilibrium is characterized by the same equations as before (3.2-3.9), but with $\phi_\pi = 0$ and $\rho = \xi$.*

Proof. Can be shown by guess and verify. □

Proposition 4. *Assume A2. When the ZLB binds (as described in Lemma 3),*

- a) the transfer multiplier will be greater than the purchases multiplier*
- b) the economy’s aggregate demand curve will be inverted*

²⁷A caveat is that the fiscal expansion does not affect the number of periods that the ZLB is binding. Mathematically, the size of the shock that causes the ZLB to bind in our two state example would appear as a constant in Equation 3.10, and so does not affect the multiplier.

c) the transfer and purchases multipliers are given by Equation 3.10.

$$(3.10) \quad \hat{Y}_t = \left[\alpha + \Gamma_{ZLB} \frac{\kappa(\varphi + 1)}{(1 - \xi\beta)} \right]^{-1} \left[\hat{T}r_t + \hat{G}_t + \frac{\kappa}{(1 - \xi\beta)} \Gamma_{ZLB} \hat{G}_t \right]$$

where:

- $M_{Tr}^{ZLB} = \left[\alpha + \Gamma_{ZLB} \frac{\kappa(\varphi + 1)}{(1 - \xi\beta)} \right]^{-1}$ is the transfer multiplier
- $M_G^{ZLB} = \left[\alpha + \Gamma_{ZLB} \frac{\kappa(\varphi + 1)}{(1 - \xi\beta)} \right]^{-1} \left(1 + \frac{\kappa}{1 - \beta\xi} \Gamma_{ZLB} \right)$ is the purchases multiplier.
- $\Gamma_{ZLB} = \underbrace{[\alpha(-\xi)/(1 - \xi)]}_{TPEffect} - \underbrace{[(1 - \alpha)(1 - \xi\beta)/\kappa]}_{DIEffect}$

Proof. Follows from Lemma 3. □

Determinacy at the ZLB. The determinacy of the ZLB equilibrium depends on the persistence of the ZLB and non-ZLB regimes and other model parameters. In the Online Appendix 5.2, we follow Davig and Leeper (2007) and model the ZLB as a two-regime Markov process, which allows for transitions between the ZLB and non-ZLB regimes in both directions. We show numerically that with other default parameters (Table 1), so long as the non-ZLB state is absorbing and the expected persistence of ZLB regime is expected to be relatively short, then the Taylor principle ($\phi_\pi > 1$) in the non-ZLB regime is a sufficient condition for determinacy, as in Assumption A2.²⁸

3.4. Aggregate Supply and Aggregate Demand Diagram. The effect of a transfer or purchases shock can be seen in shifts in the aggregate demand and aggregate supply curves in Figure 3.1.²⁹ Because all transfers are targeted at the HtM HH who will consume them (we relax this assumption below in Section 5.1), transfers and purchases shift the demand curve

²⁸Analytically, we can also assume $[1 - (1 - \alpha)(2 + \varphi)](1 - \xi)(1 - \beta\xi) - \alpha\xi\kappa(1 + \varphi) > 0$, which ensures a positive multiplier, which has the same form (with $\alpha = 1$) as in Eggertsson (2012).

²⁹In Figure 3.1 O_x , ($x = 1, 2$) represents the steady state equilibrium ($\hat{Y}, \hat{\pi}$) with the original (solid) Aggregate Supply (AS) and Aggregate Demand (AD) curves. A_x represents the new equilibrium with a 0.2% GDP transfer shock contemporaneously, which shifts the AD curve to the right, but doesn't affect AS. B_x reflects the new equilibrium with a 0.2% of GDP government purchases shock in the first period, which shifts both AD and AS curves to the right. At any period t in the future the figure looks identical except that all points are scaled by ρ^t .

out by the same amount (Equation 3.6) but only government purchases shift the aggregate supply curve (via the neoclassical wealth effect).³⁰ As in Proposition 1, government purchases increase the desired labour supply of the Ricardian household (because they are worse off due to higher taxes), but transfers have no effect on aggregate supply, because the extra labour supply of Ricardian households (who are worse off) exactly offsets the reduced labour supply of the HtM HH (who are better off). When the aggregate demand curve is downward sloping (for example with a high persistence shock, with $\rho = 0.9$ and a Taylor Rule in the left-hand panel of Figure 3.1), the increase in aggregate supply from a government purchases shock increases the purchases multiplier above the transfer multiplier.

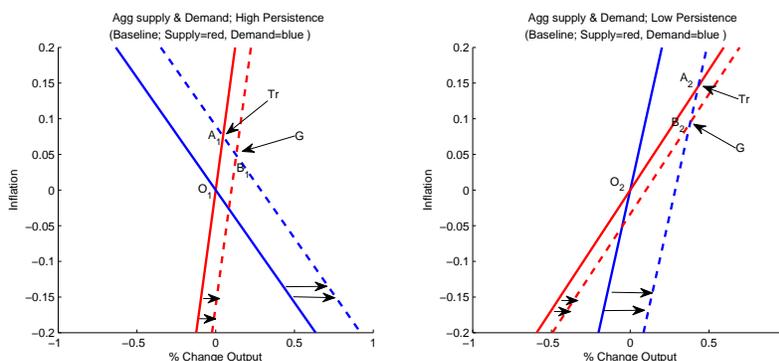


FIGURE 3.1. Aggregate demand and supply when the purchases multiplier is larger (LHS: high persistence of fiscal policy ($\rho = 0.9$) and when the transfer multiplier is larger (RHS: low persistence of fiscal policy ($\rho = 0.5$)). See footnote 29 for details.

However, when the Disposable Income effect dominates the Taylor Principle effect, the aggregate demand curve inverts and the transfer multiplier will be larger than the purchase multiplier (Proposition 3b).³¹ This always happens when monetary policy is constrained by

³⁰In Online Appendix 2.1, we show that the simple model A1-A9 in Box 1 is *equivalent* to assuming perfect substitutes across labour types with a union as in Galí *et al* (2007). In Online Appendix 2.2 we assume instead that the labour of the two households are imperfect substitutes (with elasticity of substitution ϑ), *without* a union. This reduces the transfer multiplier, and substantially complicates the analysis, though doesn't change the results much so long as the elasticity of substitution between labour inputs is not too high. Imperfect substitutes means that the aggregate demand curve shifts by *less* for a transfer than for a government purchase, because some of the income from the transfer is spent on leisure instead of consumption (this doesn't happen in the Cobb-Douglas model because lower labour supply for a household is offset by higher wages, keeping labour income constant). As a result, the AD curve has to be even more inverted for the transfer multiplier to be greater than the purchase multiplier.

³¹The slope of the supply curve is always positive. It increases with $(1 + \varphi)$ and decreases with κ — this means that the supply curve is flatter (more Keynesian) with a higher Frisch elasticity or more sticky prices.

the Zero Lower Bound, but can also happen when the fiscal shock is not very persistent (if monetary policy follows a Taylor rule). From the RHS of Figure 3.1 one can see that when the demand curve inverts, higher inflation *boosts* aggregate demand by increasing the disposable income of the HtM HH by more than it reduces the consumption of the Ricardian HH via higher real interest rates. This means that the increase in supply from a government purchases shock actually reduces the multiplier relative to a comparable targeted transfer.³²

3.5. The sensitivity of the transfer multiplier to the central bank’s response to inflation and alternative monetary policy rules. The larger size of the transfer multiplier at ZLB is because the transfer multiplier is generally more sensitive than the purchase multiplier to the monetary policy response to inflation (Proposition 5). Under a Taylor rule, ϕ_π appears in the numerator and denominator of the expression for the purchases multiplier, but only in the denominator of the expression for the transfer multiplier. As discussed above, transfers tend to produce more inflation than purchases, and so an increase in ϕ_π will lead to a larger increase in real rates for transfers than purchases (as $\phi_\pi > 1$), leading to a greater fall in the multiplier.³³

Proposition 5. *Assume A1. A more aggressive monetary policy response to inflation leads to a larger proportional fall in the transfer multiplier than the purchasers multiplier, i.e. $\partial \ln M_{Tr} / \partial \phi_\pi < \partial \ln M_G / \partial \phi_\pi$ where $\partial \ln M_{Tr} / \partial \phi_\pi < 0$ and $\partial \ln M_G / \partial \phi_\pi < 0$.*

Proof. Differentiating the expressions for the multipliers in Proposition 2 with respect to ϕ_π yields:

$$(3.11) \quad \frac{\partial \ln M_{Tr}}{\partial \phi_\pi} = -M_{Tr} \frac{\kappa(\varphi + 1)}{(1 - \rho\beta)} \frac{\alpha}{1 - \rho} < 0$$

³²This result is related to Eggertsson and Krugman (2012) and Eggertsson (2010a, 2012), who argue that the “paradox of toil” means that increase in aggregate supply can reduce actual output. However in those papers this only occurs at the ZLB, whereas here it can also occur with a Taylor rule (due to the presence of HtM HHs). In the latter case, a *reduction* in price flexibility ($\downarrow \kappa$) increases transfer multiplier relative to the purchase multiplier here, whereas *increased* flexibility makes restrictive labour market practices more stimulatory in Eggertsson (2012).

³³If the central bank responds to output in the Taylor rule, Equation 3.9 becomes $\hat{Y}_t = \left[\alpha + \frac{\alpha\phi_Y}{(1 - \rho)} + \Gamma \frac{\kappa(1 + \varphi)}{1 - \rho\beta} \right]^{-1} \left[\hat{G}_t + \hat{T}r_t + \Gamma \frac{\kappa\hat{G}_t}{1 - \rho\beta} \right]$, which does not affect the relative size of the transfer and purchase multipliers (though it reduces their absolute size).

$$(3.12) \quad \frac{\partial \ln M_G}{\partial \phi_\pi} = \frac{\partial \ln M_{Tr}}{\partial \phi_\pi} - \left[\frac{1}{M_G(\varphi + 1)} \right] \frac{\partial \ln M_{Tr}}{\partial \phi_\pi}$$

where M_{Tr} and M_G are the transfer and purchase multipliers (from Proposition 2) respectively. As $\partial \ln M_{Tr} / \partial \phi_\pi < 0$ and $-[M_G(\varphi + 1)]^{-1} < 0$ the second term in Equation 3.12 is positive and so, then $\partial \ln M_G / \partial \phi_\pi > \partial \ln M_{Tr} / \partial \phi_\pi$. \square

3.5.1. *Two alternative monetary policy rules during normal times.* This subsection investigates the size of multipliers with two alternative monetary policy rules, which are the least and most accommodating of inflation (respectively) in normal times. In the framework above, the effect of monetary policy on demand is governed by the strength of the Taylor Principle effect (the fall in consumption demand from unconstrained HHs when inflation rises). In normal times, the Taylor Principle effect is at its strongest when any rise in inflation cuts off *all* consumption demand from unconstrained HHs. It is at its weakest when inflation has no effect on the consumption of the Ricardian household (i.e consumption of the Ricardian HH is constant). These rules are captured by perfect inflation targeting, and a constant real interest rate policy, respectively.

Perfect inflation targeting (a strict form of price-level targeting)

A number of papers have examined the effect of transfers in heterogeneous agent models, but have assumed a strict form of price-level targeting to keep the model tractable. For example, Oh and Reis (2012) assume monetary policy is such that the price level is constant, and Athreya *et al* (2016) assume that the price level returns to its original pre-shock level after one period.

Introducing a strict form of price-level targeting into our analytical model is straightforward. If the monetary authority enforces a constant price level, then inflation is zero in all periods $\hat{\pi}_t = 0 \forall t$. From the Phillips curve (Equation A6), this implies that markups will be constant ($\hat{X}_t = 0$), and so one gets the *flex-price multipliers from Proposition 1*. An alternative way to see this is to assume that the central bank implements a constant price level by following the Taylor rule (Equation A5), but by responding infinitely strongly to inflation deviations. That is, $\phi_\pi \rightarrow \infty$, implying $\Gamma \rightarrow \infty$ for the multipliers in Proposition

2. As Γ is only in the denominator of M_{Tr} , $M_{Tr} \rightarrow 0$ as $\phi_\pi \rightarrow \infty$, whereas $M_G \rightarrow (\varphi + 1)^{-1}$ as $\phi_\pi \rightarrow \infty$. Given these results, it is not surprising that papers which assume a strict form of price-level targeting also find a transfer multiplier close to zero (though this does not guarantee larger multipliers with alternative rules).

Constant real interest rate targeting

At the more accommodative end of the monetary policy spectrum (in normal times) is a constant real interest rate rule (Woodford 2011). If real interest rates are constant, then so is consumption of unconstrained HHs — the Taylor Principle effect will be zero. This is similar to setting $\phi_\pi \rightarrow 1^+$, though to implement constant real interest rates we also need make the Taylor rule forward looking: replace Equation A5 with $\hat{R}_t = \phi_\pi^{FL} E_t \hat{\pi}_{t+1}$ and take $\phi_\pi^{FL} \rightarrow 1^+$.³⁴ Solving using the same solution procedure as above, the transfer multiplier approaches $[\alpha - (1 + \varphi)(1 - \alpha)]^{-1}$ and the purchase multiplier approaches $\alpha \times [\alpha - (1 + \varphi)(1 - \alpha)]^{-1}$. As such, the transfer multiplier is *always* larger than the purchase multiplier with a constant real interest rate rule so long as the share of HtM HHs is positive ($\alpha < 1$).³⁵

4. THE TRANSFER MULTIPLIER IN A MEDIUM-SCALE DSGE MODEL

By including realistic features such as sticky wages, capital, and a more flexible parametrisation, the full model allows us to show (i) that the transfer multiplier is often large in a quantitative sense (i.e. greater than one) — especially when the ZLB binds — and (ii) that the analytical results of Section 3 hold qualitatively in a richer model. See Table 1 for parameters, and Section 2 for a statement of the full model.

In this section we analyse once-off fiscal shocks (persistence $\rho = 0$), and persistent fiscal shocks ($\rho = 0.9$). The once-off shock is designed to capture once-off transfer payments, like the 2001 and 2008 Bush stimulus payments. The more persistent shock closely aligns with the transfer component of the 2009 ARRA (see Online Appendix 8).

³⁴In our model, if $\phi_\pi^{FL} = 1$ the model is indeterminate, though we can get arbitrarily close from above with a determinant solution (we also verified this numerically). It is also important not to assume ϕ_π^{FL} is too large (Galí *et al* 2004 Fig. 5, Bilbiie 2008 Prop. 1). With a contemporaneous Taylor rule (and a low share of HtM HHs), large values of $\phi_\pi \gg 1$ (for price level targeting) are determinant (by Lemma 1).

³⁵As $\alpha \rightarrow 1$, transfers and purchases multipliers approach unity. Woodford (2011) also found a purchase multiplier of unity with a constant real interest rate rule in a model without HtM HHs.

In the full model, output will not be a constant multiple of the fiscal stimulus (as there are additional state variables), and so we report the *present value multiplier* (Uhlig 2010). This is the discounted sum of increases to output, relative to the discounted sum of fiscal expenditure, where the discounting is at the HH's discount rate β :

$$(4.1) \quad PV \text{ Multiplier} \equiv \frac{\sum_{i=0}^{\infty} \beta^i \hat{Y}_{t+i}}{\sum_{i=0}^{\infty} \beta^i \hat{T}r_{t+i}} \text{ or } \frac{\sum_{i=0}^{\infty} \beta^i \hat{Y}_{t+i}}{\sum_{i=0}^{\infty} \beta^i \hat{G}_{t+i}}$$

Determinacy The full model is much less susceptible to indeterminacy than the simple model, possibly because sticky wages limit the extent that demand shocks increase inflation. If the central bank follows a Taylor rule (with the Taylor principle in effect $\phi_\pi > 1$), there are no values of the HtM HH share (away from corners) where the model is indeterminate.³⁶ When the ZLB binds for a fixed non-stochastic number of periods (we have checked up to 7 years), we get similar results.

4.1. Sticky Wages. The most important difference between the simple and full models is the presence of sticky wages in the full model, which weakens wealth effects on labour supply and hence reduces the difference between transfer and purchase multipliers.³⁷ When wages are sticky, an increase in HtM consumption due to a transfer is partially absorbed by a fall in the labour markup $\hat{\mu}_{2,t}^w = \hat{w}_{2,t} - \varphi \hat{L}_{2,t} - \hat{c}_{2,t}$, rather than a fall in the HtM HH's labour supply. This means a smaller fall in aggregate supply for a transfer, and hence a smaller increase in inflation, which moves the transfer multiplier towards the purchase multiplier. To see this, Figure 4.1 shows the effect of varying the Calvo probability of unchanged nominal wages (θ_w) on the multipliers in the full model. With $\theta_w = 0$, nominal wages are flexible and multipliers are similar to those in the simple model (and the purchase multiplier is very

³⁶In the full model we check determinacy numerically by making sure that the Blanchard-Kahn and rank conditions are satisfied in Dynare.

³⁷Recall that when wages are sticky, last period's real wage is a state variable and hence output will no longer be a constant multiple of the exogenous fiscal shock, ruling out an analytical solution for the multiplier.

TABLE 1. Full Model Parametrisation and Steady State

Parameter	Value	Parameter	Value
Discount Rate (β)	0.995*	Investment adj. cost (S'')	1.5
Frisch Labour Elasticity (φ^{-1})	1* or 0.2	Capital Depreciation Rate (δ_k)	0.03
Labour share HtM HH ($1 - \alpha$)	0.3*	Calvo Prob. Constant Wage (θ_w)	0.75
Calvo Prob. Constant Price (θ_p)	0.75*	Sticky Wage Elasticity (ε)	20.5 or 4.5
Taylor Rule Inflation (ϕ_π)	1.27*	Capital Share (μ)	0.25
SS Markup ($X = \sigma/(\sigma - 1)$)	1.05*	Taylor Rule Smoothing (ϕ_R)	0.73
SS Govt Purchases Share (G_{SS})	0.2	Taylor Rule Output (ϕ_Y)	0.13

* Indicates parameter is also in simple model (others are zero in the simple model).

different from the transfer multiplier). But with $\theta_w = 1$, nominal wages are perfectly sticky and the purchases and transfer multipliers are identical.³⁸

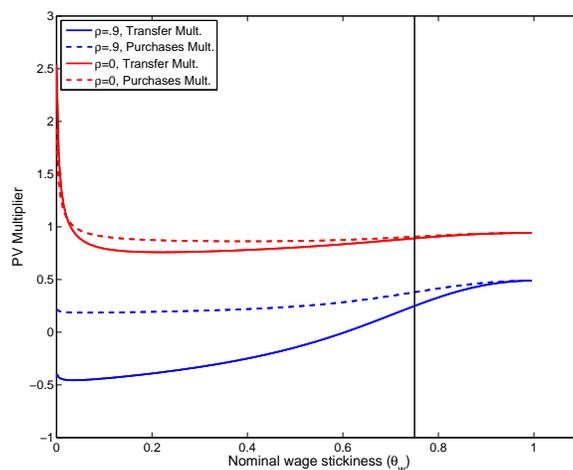


FIGURE 4.1. Wage stickiness and the PV multiplier (full model). The vertical line indicates default parametrization

4.2. Parameters and related empirical evidence. Parameters are listed in Table 1 and are taken from the literature, but are also chosen to be consistent with empirical evidence

³⁸The extent to which nominal wages or the wage markup changes also depends on the persistence of the shock. For once-off shocks, HHs are reluctant to change nominal wages (and they will have to be readjusted in the future), leading to larger movements in wage markups.

on the response of consumption for different groups to a transfer shock. Online Appendix Figure 3 shows the MPC estimated by Johnson *et al* (2006) in response to the 2001 Bush Tax rebates and compares them to the MPC of an analogous group from the full model.³⁹ In both the model and data, the lowest third of consumers by liquid assets tend to spend all their income, whereas the top two thirds of consumers, defined by their holdings of liquid assets, do not. The model’s estimates are well within one standard error of the empirical estimates (not reported). The MPC profile is the most sensitive to the share of HtM in the model, $1 - \alpha = 0.3$. Kaplan *et al* (2014) present a range of microeconomic evidence that a third of households are hand-to-mouth in the US, UK and Germany. A calibration of 0.3 is in the middle of the range of macroeconomic estimates of the share of constrained HHs, such as 0.36 from Iacoviello (2005), 0.5 from Campbell and Mankiw (1989) and Galí *et al* (2007) and 0.26 from Cogan *et al* (2010).

A voluminous literature finds macro-empirical estimates of the Frisch elasticity (usually > 1) are larger than the micro-empirical estimates (usually < 1) — due to frictions, indivisibilities and other factors (see Online Appendix 9 for a survey). Our default Frisch elasticity of $\varphi^{-1} = 1$ is the largest Frisch elasticity that is consistent with the microeconomic evidence.⁴⁰ Our results are also robust to an alternative calibration of $\varphi^{-1} = 0.2$ (see Online Appendix Table 1), which is in line with microeconomic estimates and also with modest wealth effects on labour supply (recall that the absolute size of wealth effects increases with the Frisch elasticity).

Other parameters are fairly common in the literature. We assume that wages change on average once a year, in line with evidence from Barattieri *et al* (2014). Investment adjustment costs are taken from Altig *et al* (2014), and the capital share (μ) chosen to match a steady state I/Y of around 20%, the average 2001-15 (WDI: NE.GDI.FTOT.ZS).

³⁹In the full model, this is the response to an untargeted once-off transfer. Specifically, HtM HHs are compared to those with less than US\$1000 in liquid assets, and Ricardian households are compared to those with more than US\$8000 in liquid assets, and those with US\$1000-US\$7000 in liquid assets. The data are from the bottom of Table 5 in Johnson *et al* (2006), and refer to MPC for non-durables.

⁴⁰Chetty *et al* (2011) argue that: “Even accounting for indivisible labour, micro studies do not support representative-agent macro models that generate Frisch elasticities above one” (p4). A Frisch of 1 is also common in the macroeconomic literature (eg Christiano *et al* (2005) and Nakamura and Steinsson (2014)).

Taylor rule coefficients, price stickiness and depreciation rates are estimated by Iacoviello (2005). In the full model, steady state government purchases are set at 20 per cent of GDP ($G_{SS} = 0.2$) as is common in the literature, funded by a lump sum tax on each household in proportion to labour income (though any new fiscal stimulus is still funded by taxes on Ricardian HHs). Government transfers as part of fiscal stimulus (Tr_t) are zero in steady state, though the HtM HH does receive steady state transfers equal to a share $(1 - \alpha)$ of total firm profits and capital income (after depreciation), such that the two households consume a fractions α and $1 - \alpha$ of total consumption. We solve the full model numerically using Dynare.

4.3. Quantitative Results when the central bank follows a Taylor rule. In this section we calculate the targeted transfer and purchase multipliers in normal times when the central bank follows a Taylor rule. The white region of Figure 4.2 Panel B shows that the transfer multiplier in the full model (when policy follows a Taylor rule) is larger than one when fiscal policy is not very persistent or the share of HtM HH is not too small, which is consistent with the results in the simple model. The transfer multiplier is rarely larger than the purchase multiplier — except for once-off stimulus with very high shares of HtM HHs (Figure 4.2 Panel A). In part, this reflects the fact that the purchase multiplier itself is large for temporary stimulus and moderate shares of HtM HHs.

The first row of Table 2 (Columns A and B) presents the targeted transfer and purchase multipliers (respectively) when the central bank follows a Taylor Rule. When fiscal policy is once-off — like the Bush 2001 tax rebates — both transfer and purchase multipliers are slightly below 1. With persistence $\rho = 0.9$ (similar to the ARRA) the transfer multiplier is around 0.25 and the purchase multiplier around 0.4. Impulse response functions with a Taylor rule or 2 years ZLB are presented in Online Appendix 10.

4.4. Zero Lower Bound (ZLB) in the full model. The Federal Reserve maintained nominal interest rates at 0-0.25 per cent from December 2008 to December 2015, a period of

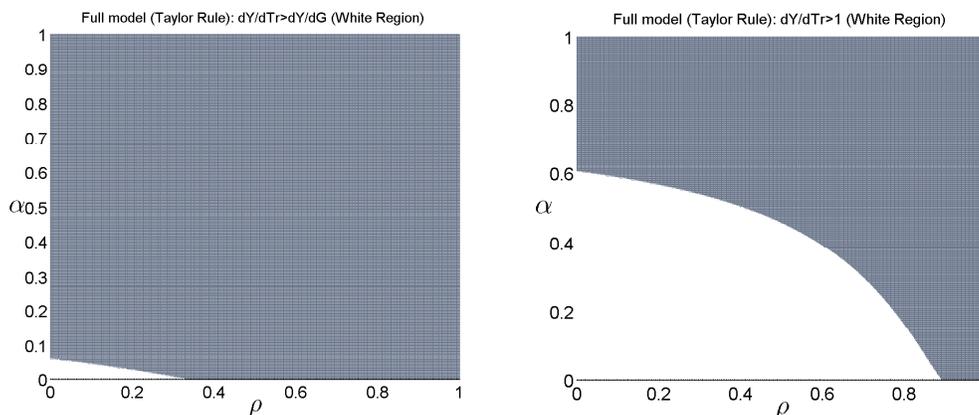


FIGURE 4.2. Regions of parameter space where the transfer multiplier is large (white) when monetary policy follows a Taylor rule (**Panel A** (LHS): transfer multiplier $>$ purchases multiplier, **Panel B** (RHS): transfer multiplier $>$ 1).

TABLE 2. Full Model — Present Value Multipliers

	A. Targeted Transfers		B. Purchases		Untargeted Transfers			
Default Frisch $\varphi^{-1} = 1$					C. Default Calib.		D. 50% HtM Share	
Fiscal persistence:	$\rho = 0$	$\rho = 0.9$	$\rho = 0$	$\rho = 0.9$	$\rho = 0$	$\rho = 0.9$	$\rho = 0$	$\rho = 0.9$
Taylor Rule	0.89	0.25	0.91	0.38	0.27	0.07	0.58	0.15
2 years ZLB	1.32	1.04	1.30	0.91	0.40	0.31	0.87	0.71
5 years ZLB	1.33	1.67	1.32	1.32	0.40	0.50	0.90	1.07
7 years ZLB	1.34	1.77	1.32	1.42	0.40	0.53	0.90	1.12

around 7 years. It is well documented in the literature that government purchases are much more stimulatory of economic activity when monetary policy is at the ZLB; for example, Christiano *et al* (2011) find a purchase multiplier above two in the case that the ZLB binds. Given that the conditions under which the ZLB binds have been modelled elsewhere, we follow Christiano *et al* (2011) and Cogan *et al* (2010) and assume the central bank commits to keeping the nominal interest rate constant for a certain number of periods known to agents (and then returns to a Taylor rule).⁴¹

As shown in Proposition 4, the targeted transfer multiplier tends to be larger than the purchase multiplier at the ZLB. Figure 4.3 (Panel A) shows (in white) the regions of the

⁴¹In a linear model with perfect foresight, it is the path of nominal rates that determines the multiplier, rather than the *reason* nominal rates take that path (Christiano *et al* 2011).

(ρ, α) -space where the transfer multiplier is greater than the purchase multiplier if the ZLB binds for two years. One can see that ZLB dramatically increases the area where the targeted transfer multiplier is larger than the purchase multiplier — which is now almost the whole parameter space. Moreover, the transfer multiplier is greater than one almost everywhere — except for very persistent transfers with a small share of HtM (Figure 4.3 Panel B).⁴²

Table 2 shows that with constant nominal interest rates for two years (as considered by Cogan *et al* 2010), all transfer multipliers are greater than one, and purchase multipliers are usually close to or above one.⁴³ With five years of constant rates, the multipliers are now quite large for $\rho = 0.9$ (a similar persistence as the ARRA), specifically 1.7 for targeted transfers and 1.3 for purchases. Multipliers are around 0.1 higher with 7 years at the ZLB. Particularly striking are the increases in multipliers at the ZLB for persistent transfer-based stimulus: the targeted transfer multiplier for $\rho = 0.9$ increases by 1.4 going from a Taylor rule to five years of the ZLB, whereas the purchase multiplier only increases by 0.9 — verifying Proposition 5 in the full model (transfer multipliers more sensitive to monetary policy than purchase multipliers).⁴⁴

5. EXTENSIONS: UNTARGETED TRANSFERS AND FINANCING FISCAL POLICY

5.1. Imperfect targeting of transfers. In the real world, it is unlikely that a government could *perfectly* target transfers to HtM households, and so the targeted transfer multipliers reported in Section 4 are an upper bound. Adjusting for imperfect targeting of transfers in the model is straightforward: if only a fraction χ_{Tr}^{HtM} of transfers are targeted at the HtM HH (i.e a fraction $1 - \chi_{Tr}^{HtM}$ “leak” out to Ricardian HHs; in the baseline model $\chi_{Tr}^{HtM} = 1$), then the standard transfer multiplier above will be simply scaled down by a factor of χ_{Tr}^{HtM} .

⁴²As shown by Woodford (2011), the multiplier is very sensitive to fiscal policy that occurs after the ZLB stops binding. Hence, longer periods at the ZLB have a larger effect on the multipliers for very persistent fiscal policy.

⁴³While short term rates have been constant for much longer than two years ex-post, it is not clear that markets fully anticipated this at the time (Swanson and Williams 2014).

⁴⁴A reduction in the Frisch elasticity to $\varphi^{-1} = 0.2$ (Online Appendix Table 1) reduces transfer and purchase multipliers in normal times, but increases them at the ZLB. This is because a lower Frisch elasticity means a large increase in real wages (and hence inflation) is required to meet a given increase in demand, which raises real interest rates under a Taylor Rule, but reduces them at the ZLB. A change in the Frisch elasticity can also change wage stickiness, though we change sticky wage CES elasticity (ε) which is largely offsetting.

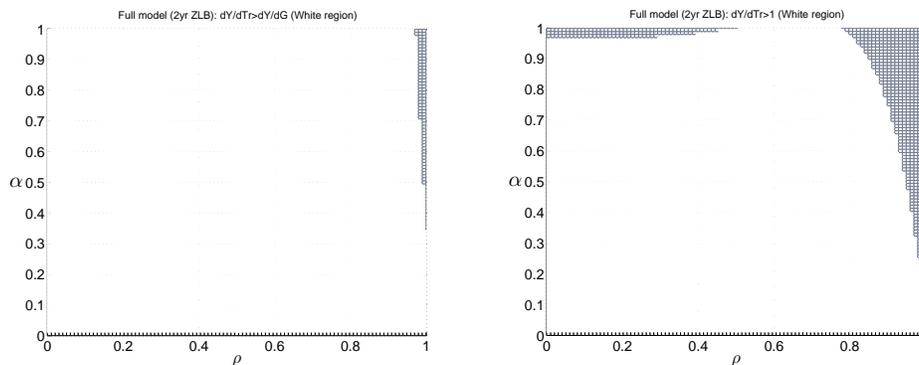


FIGURE 4.3. Regions where the targeted transfer multiplier is larger with 2yrs ZLB. **Panel A** (LHS): transfer multiplier $>$ purchases multiplier. **Panel B** (RHS): transfer multiplier > 1 .

To see this, note that the rest of the transfer (a fraction $1 - \chi_{Tr}^{HtM}$) flows from the Ricardian household to itself and hence has no effect on the economy.

This can be incorporated in the analytical model by replacing Equation A3 with $(1 - \alpha)\hat{c}_{2,t} = \chi_{Tr}^{HtM}\hat{T}r_t + (1 - \alpha)(\hat{w}_{2,t} + \hat{L}_{2,t})$ (scaling down the transfer by a factor χ_{Tr}^{HtM}). The expression for the multiplier becomes Equation 5.1, where Γ is defined as in Equation 3.9 and $0 \leq \chi_{Tr}^{HtM} \leq 1$ (and $\chi_{Tax}^{HtM} = 0$ for now). A stronger DI effect/weaker TP effect $\Gamma < -(1 - \chi_{Tr}^{HtM})(1 - \beta\rho)/\kappa \leq 0$ is required for the transfer multiplier to be greater than the purchases multiplier.

$$(5.1) \quad \hat{Y}_t = \left[\alpha + \Gamma \frac{\kappa(\varphi + 1)}{(1 - \rho\beta)} \right]^{-1} \left[(\chi_{Tr}^{HtM} - \chi_{Tax}^{HtM})\hat{T}r_t + \left\{ 1 - \chi_{Tax}^{HtM} + \frac{\kappa}{1 - \beta\rho} \Gamma \right\} \hat{G}_t \right]$$

An alternative assumption — which could be considered a lower bound — is that transfers are completely untargeted where $1 - \chi_{Tr}^{HtM} = 1 - \alpha = 0.7$ (with our default calibration). In the full model, Table 2 Column C shows that the untargeted transfer multiplier is around 0.25 for once-off transfers and 0.1 for persistent transfers if monetary policy follows a Taylor rule, and is usually around 0.5 for persistent transfers when the ZLB binds for an extended period.

The size of the *untargeted* transfer multiplier is much more sensitive to the fraction of HtM HHs than the targeted transfer multiplier (as it increases both the size of the targeted

transfer multiplier and the scaling factor). We also might expect that share of HtM HHs to be higher during a recession when fiscal stimulus actually takes place. Table 2 Column D shows that with a 50% HtM share (as in Campbell and Mankiw 1989, Mankiw 2000, Galí *et al* (2007)) the *untargeted* transfer multiplier is above one with persistent fiscal policy and 5 or more years of ZLB, and fairly close to one for less persistent fiscal policy. Online Appendix Figure 1 shows that when the ZLB binds for 2 years, the *untargeted* transfer multiplier is greater than one so long as the HtM share is greater than around 0.5 ($\alpha < 0.5$) and fiscal policy is not too persistent.

5.2. The funding of purchases and transfers: when the HtM HH pays taxes.

In the baseline analysis, only Ricardian HHs pay (lump-sum) taxes.⁴⁵ The targeted transfer or government purchase multiplier when a fraction χ_{Tax}^{HtM} of lump sum taxes fall on the HtM HH (the baseline is where $\chi_{Tax}^{HtM} = 0$) can be represented by a combination of the standard purchase/targeted transfer as presented in Sections 3/4 and a *negative* imperfectly targeted transfer (as in Section 5.1 with targeting χ). As the model is linear and fiscal variables are exogenous, the multiplier is simply the standard purchase/targeted transfer multiplier *less* the imperfect targeted transfer multiplier. That is, output is given by Equation 5.1 with $0 \leq \chi_{Tax}^{HtM} \leq 1$ (and $\chi_{Tr}^{HtM} = 1$ for now).⁴⁶ Assuming that transfers and purchases are financed in the same way, the difference between (and ranking of) transfer and purchase multipliers is unaffected by the fraction χ_{Tax}^{HtM} of taxes that fall on the HtM HH. In the full

⁴⁵Multipliers can also be substantially lower when fiscal stimulus is financed by distortionary taxation (Drautzburg and Uhlig (2015), Uhlig (2010) Leeper *et al* (2010a)). In Online Appendix 7 we add distortionary payroll taxes to the full model, which affect the absolute size of transfer and purchase multipliers, but do not affect their relative size. With a Taylor rule, multipliers fall enough to become negative with persistent stimulus. However, as in Eggertsson (2010b), we also find that distortionary taxation is much more benign at the ZLB, as extra inflation generated by a reduction in supply reduces real interest rates. As such, when the ZLB binds for 5 years, PV multipliers on persistent targeted transfers are still above one. See Online Appendix 7 for details.

⁴⁶These results are derived when lump sum taxes levied on the HtM are contemporaneous (the timing of taxes on the Ricardian HH does not matter due to Ricardian equivalence). If fiscal policy is instead debt funded by issuing perpetuities, then *regardless* of the allocation of the perpetual lump-sum taxes (to service the perpetuities) across the two households, multipliers are the same as the baseline when taxes fall on Ricardian HHs. The reason is that the transfer multiplier goes to zero as the persistence of the transfer goes to zero. See Online Appendix 3.

model, Panel A of Figures 4.2 and 4.3 are unchanged— but the absolute size of multipliers will be lower.⁴⁷

If taxation is completely untargeted — that is, the HtM HHs pay 30% of total tax bill in the full model — then multipliers are generally less than one, though the multiplier on persistent transfers when ZLB binds for 5 years or more is greater than one. These multipliers are calculated in Online Appendix Table 2, as the multipliers in Table 2 (Columns A and B), *less* the untargeted transfer multipliers in Table 2 Column C.

As the share of taxes that fall on HtM HHs increases to one ($\chi_{Tax}^{HtM} \rightarrow 1$, see Online Appendix Figure 2), the targeted transfer multiplier goes to zero and purchase multipliers will be equal to the difference between the baseline purchase and targeted transfer multiplier. As the transfer multiplier is positive, this will generally reduce the size of the HtM-financed purchase multiplier (as Monacelli and Perotti 2011), which becomes negative at the ZLB when the transfer multiplier is larger than the purchases multiplier.

6. CONCLUSION

Government transfers to individuals were a larger share of the 2009 US stimulus package than government purchases. At the same time, with depressed growth prospects in the United States and other economies, there has been a debate about the efficacy of fiscal policy. We have demonstrated that, in a New Keynesian model modified to have two types of agents that differ in their access to financial markets, the transfer multiplier is more sensitive than the purchase multiplier to the degree of accommodation of inflation of the central bank. When the ZLB is binding, the targeted transfer multiplier is larger than the purchases multiplier, and usually larger than one.

Using a simplified model that we can solve analytically, we show that while purchases and transfers both increase aggregate demand, only purchases increase aggregate supply (as wealth effects cancel across households for transfers). This means that transfer-based stimulus is more inflationary than purchase-based stimulus. In normal times, when the

⁴⁷When transfers are untargeted ($0 \leq \chi_{Tr}^{HtM} \leq 1$) and the HtM pay some fraction of taxes ($0 \leq \chi_{Tax}^{HtM} \leq 1$), then the transfer multiplier is only positive if the HtM HHs receive a greater fraction of transfers than they pay in taxes ($\chi_{Tr}^{HtM} > \chi_{Tax}^{HtM}$).

central bank follows a Taylor rule, the aggregate demand curve is usually downward sloping, so that higher rates of inflation lead to an increase in real interest rates and a lower multiplier. However, when the ZLB is binding, the economy's aggregate demand curve inverts, so that higher levels of inflation lower real interest rates and increase the multiplier. These results are quantitatively robust in a medium-scale DSGE model with capital and sticky wages.

The potential for a large targeted transfer multiplier (under certain circumstances) raises the policy question: should transfers be a larger part of future stimulus packages? A complete answer involves a full welfare calculation, which is sensitive to how individuals value government spending and is beyond the scope of this paper. An argument in favour of targeted transfers (versus purchases) in this context is that the people receiving the transfers choose what to spend them on, and so transfers might be more highly valued relative to purchases. Moreover, if transfers are targeted at constrained households who are also poorer, they may have higher marginal utility, leading to an increase in social welfare from a utilitarian perspective. Transfers might also be able to provide some insurance against steep reductions in consumption for those who become unemployed. Practicalities are also important. Expedient implementation of a temporary stimulus package — which has the highest multiplier under a Taylor rule — is much easier for a transfer than a government purchase. Public investment, which is a popular alternative form of fiscal stimulus, can have long implementation lags such that much of the investment occurs after the worst of a recession is over (Leeper *et al* 2010b). On the other hand, transfers cannot be perfectly targeted at constrained households and so the multipliers on real-world transfer packages are lower than the perfect-targeting benchmark.

An online appendix is available at:

<https://sites.google.com/site/stevenpennings/GP2017appendix.pdf>

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