# Forward Guidance (Puzzle) with rule-of-thumb households*

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### Abstract

Forward guidance has become an important monetary policy tool. Incomplete markets can dampen the strong aggregate effects of forward guidance that are inherent in many (complete market) models. We introduce rule-of-thumb households into a medium-scale DSGE model as a simple approximation to a fully-fledged incomplete markets model. The mere introduction of such households actually amplifies the aggregate effects unless we allow for countercyclical transfers. We quantify the sufficient share of rule-of-thumb households and the degree of redistribution that is necessary to tame the power of forward guidance.

**Keywords:** Forward Guidance Puzzle, Rule-of-thumb households, Redistribution, Monetary policy, Bayesian Estimation

**JEL Classification:** E44, E52, E62

# 1  Introduction

Interest rate forward guidance has become an important tool for central banks to enhance the effectiveness of monetary policy at the zero lower bound (Fed, 2008; ECB, 2013). However, it is still little known about the macroeconomic effects and especially the quantitative implications of announced future interest rate paths. Even worse, many structural models suffer from the so-called forward guidance puzzle (Del Negro, Giannoni and Patterson, 2015): An unreasonably large response of inflation and output that rises exponentially if the horizon of interest rate guidance is extended. The reason is a strong (cumulative) intertemporal substitution that is inherent in the standard representative agent New Keynesian (RANK) model and which becomes magnified when the interest rate is pegged (Kiley, 2016).

One way to tame the power of forward guidance in such models is to lower the intertemporal substitution channel by incorporating some form of incomplete markets as in McKay, Nakamura and Steinsson (2016).[1] This reduces the responsiveness of present outcomes to changes in future interest rates and introduces some form of discounting into the Euler equation (McKay, Nakamura and Steinsson, 2017).

In this paper we study the quantitative implications of rule-of-thumb households to dampen the power of forward guidance in an estimated medium-scale New Keynesian model. Such Two-Agent New Keynesian (TANK) models serve as a simple approximation to a fully-fletched heterogeneous agent model (Debortoli and Galí, 2018; Bilbiie, 2018a). We show that the mere existence of rule-of-thumb households actually *amplifies* the forward guidance puzzle. The reason is

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[1]Another possibility is to allow the peg to be only imperfectly credible as in Haberis, Harrison and Waldron (2017) or Kulish and Pagan (2017) or to let monetary policy counteract these inflationary pressures in the future, see section 4 for a discussion.

that their income and thus demand moves more than one-to-one with aggregate income, raising the response of total consumption relative to a representative agent benchmark, see Bilbiie (2018b) or Acharya and Dogra (2018). If we allow for *countercyclical* transfers (similar to automatic stabilizers in McKay and Reis, 2016), the demand response is tamed as the income of rule-of-thumb households is now relatively lower/higher whenever the economy is in a boom/recession.[2] For realistic values of the share of rule-of-thumb households and countercyclical transfers forward guidance is attenuated.

# 2    Framework

We augment the model of Carlstrom, Fuerst and Paustian (2017) by rule-of-thumb consumers in the spirit of Galí, López-Salido and Vallés (2007) and a simple transfer rule. The economy consists of households, firms and a banking sector, which allows to analyze the effects of unconventional monetary policy measures. In a nutshell, real investment is ultimately financed by financial intermediaries, whose lending capacities are constrained by their net worth. We now focus on the two augmented elements.

A measure $1 - \lambda$ of households has complete access to financial markets and can smooth consumption through short-term deposits and the accumulation of real capital. The remaining fraction $\lambda$ has no access to financial markets (it can neither borrow nor save) and consumes its wage income and transfers. We refer to them as rule-of-thumb ('constrained' or 'hand-to-mouth') households. Firms do not differentiate between the types of households when hiring labor, so the supply of hours and the wage rate is the same across households. The budget

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[2]See also Werning (2015) for a related discussion in the context of an incomplete markets model.

constraint of hand-to-mouth agents is

$$C_t^h = w_t H_t - T_t^h - \tau \left( Y_t - Y \right),$$

where their consumption is $C_t^h$, labor income is $w_t H_t$, lump-sum taxes are $T_t^h$ and the degree of countercyclical transfers is governed by $\tau \geq 0$, which rebates income whenever aggregate output is different from steady state $(Y_t - Y)$.[3]

We estimate the model on eight euro area time series (real GDP, investment, hours worked, inflation, short-term interest rates, long-term interest rates, wages and net worth of banks) from 1998Q1 until 2014Q4. Table 1 shows the estimated posterior means that are used for the parameterization which are largely in line with similar estimates for the euro area (e.g. Smets and Wouters, 2003; Coenen, Karadi, Schmidt and Warne, 2018).[4]

# 3   Simulations

Now we quantify the importance of rule-of-thumb consumers and redistribution policy to tame the power of forward guidance. In principle, a positive share of rule-of-thumb households should lower the aggregate implications of forward guidance, since a smaller fraction responds directly to announcements of the central bank, i.e. in the aggregate, the strength of intertemporal substitution is

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[3]Alternatively, the transfer rule could rebate firm profits (Bilbiie, 2018a). In our model, a taming of forward guidance is only possible when intermediate good profits are used, as they are countercyclical (as are markups after demand-type driven shocks). However, bank profits (or even total profits) are strongly pro-cyclical and would thus amplify the aggregate effects.

[4]It was not possible to identify the share of hand-to-mouth households $\lambda$ and the redistribution coefficient $\tau$ simultaneously in the data. We calibrate the share of constrained households to 30% (e.g. Dolls, Fuest and Peichl, 2012) since there is various empirical evidence on such a share. We estimate $\tau \sim 0.5$. Leeper, Plante and Traum (2010) find $\tau$ in the range 0.05 to 0.25 in a similar transfer rule for RANK. However, this should be interpreted as a lower bound since we estimate the model on euro area data (typically more redistribution) and target the transfers to the constrained households only.

Table 1: Parameterization

| Parameter | Value |
|---|---|
| *Households* | |
| Discount rate* | 0.99 |
| Habit | 0.76 |
| Inverse Frisch-elasticity | 1.89 |
| Share hand-to-mouth* | 0.30 |
| | |
| *Labor unions* | |
| Wage indexation | 0.33 |
| Calvo wages | 0.86 |
| Wage markup* | 0.20 |
| | |
| *Firms* | |
| Capital share* | 0.33 |
| Depreciation rate* | 0.025 |
| Price indexation | 0.53 |
| Calvo prices | 0.81 |
| Price markup* | 0.20 |
| Inv. adjustment costs | 14.19 |
| Networth adjustment costs | 6.20 |
| | |
| *Government* | |
| Maturity gov. debt* | 10y |
| Degree of redistribution | 0.49 |
| Smoothing mp | 0.73 |
| Taylor-coef inflation | 1.59 |
| Taylor-coef output | 0.58 |

*Note*: Parameters with an asterisk * are calibrated, the remaining ones are set to their estimated posterior means. The complete table of prior and posterior values can be found in Gerke, Giesen and Scheer (2019).

smaller. However, it is well known that constrained households react stronger to (even smaller) changes in aggregate income than optimizing ones (Galí et al., 2007). We refer to this latter effect as an H2M-amplifier, which strengthens the forward guidance puzzle. Taken together, the overall effect is not clear ex-ante.

In order to assess the quantitative implications of the introduction of hand-to-mouth consumers we run several forward guidance simulations by following the anticipated news approach of Laséen and Svensson (2011). In particular, we consider an interest rate peg of annualized 25bp below steady state for three different horizons: 1/2 year, 1 year and 2 years (similar as in Sahuc, 2016).

Figure 1 depicts the impact of forward guidance on the annualized interest rate (first column), annualized real GDP growth (second column) and annualized inflation (third column) for three different horizons (in each row respectively). To put the TANK-responses into perspective we first assess the RANK benchmark without hand-to-mouth agents (black solid line). Start with an interest rate peg of 2 quarters (upper row): this leads to an expansion in output and inflation in both periods. If the horizon is doubled to 4 quarters, the peak response of both variables roughly doubles as well (see the middle row). However, if the horizon doubles again from 1 to 2 years, the peak response of inflation and output rise exponentially (8 and 7 times, respectively) and display very large effects, i.e. the forward guidance puzzle is present.[5]

Now contrast these responses to the estimated TANK and TANK without transfers, both depicted in figure 1. As one can see, the mere introduction of hand-to-mouth households with no transfers (blue dotted line) *amplifies* the power of forward guidance relative to RANK. This difference increases the longer monetary policy implements forward guidance (see the bottom row). In contrast,

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[5]For longer pegs (several years) it is also prone to the so-called 'reversal' puzzle, see Carlstrom, Fuerst and Paustian (2015) or Gerke, Giesen, Kienzler and Tenhofen (2018).
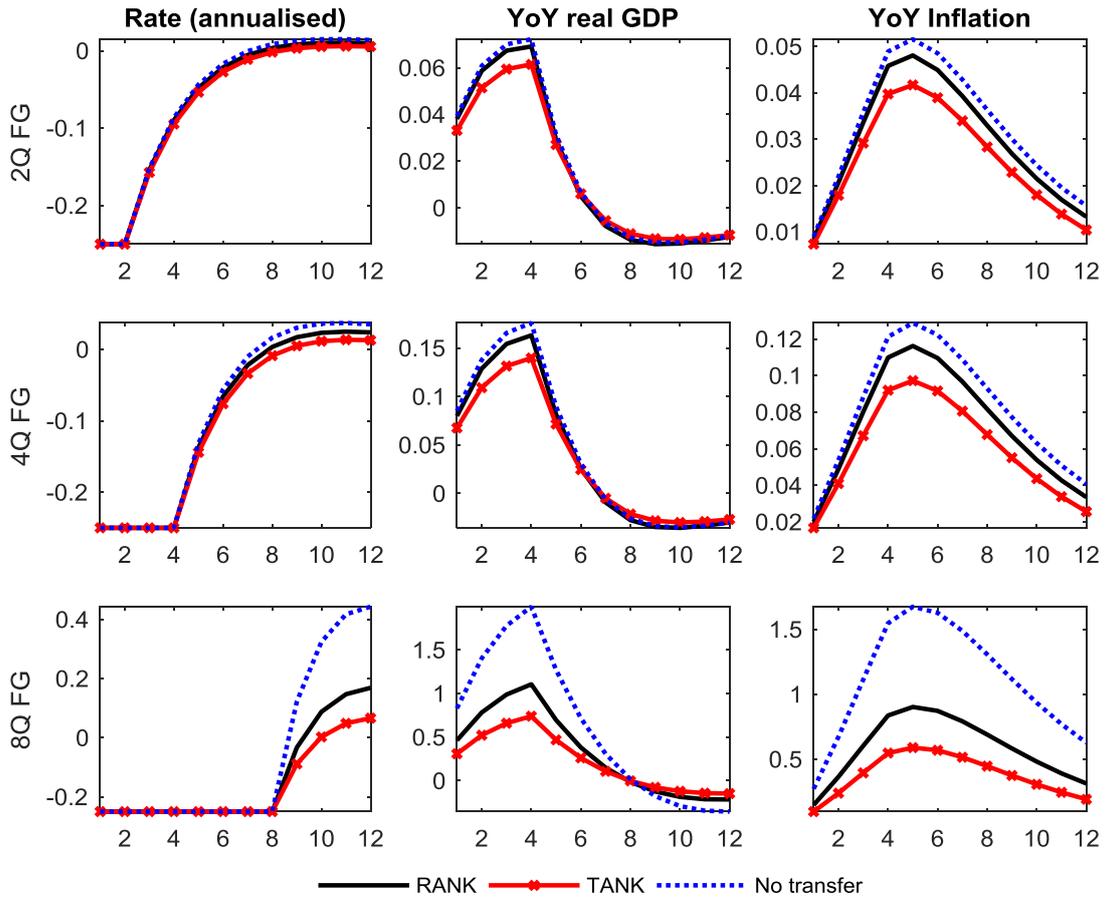
Figure 1: Simulated quarterly responses for 3 different horizons of forward guidance (in each row). The first column depicts the interest rate (pp), the middle column the year-over-year real growth rate (%) and the last column the year-over-year inflation rate (pp), all relative to steady state. The black solid line corresponds to the representative agent model. The red solid-dotted line represents the estimated TANK and the blue dotted line the TANK model with no transfers.

when we allow for countercyclical transfers (red solid-dotted line) the strength of forward guidance is substantially reduced. As above, the reduction is stronger for longer pegs.

The reason behind the smaller (stronger) aggregate effect in the estimated TANK with transfers (without transfers) is the different response of total income for constrained households and thus their consumption demand. This is illustrated in figure 2 which illustrates the response of three more variables for hand-to-
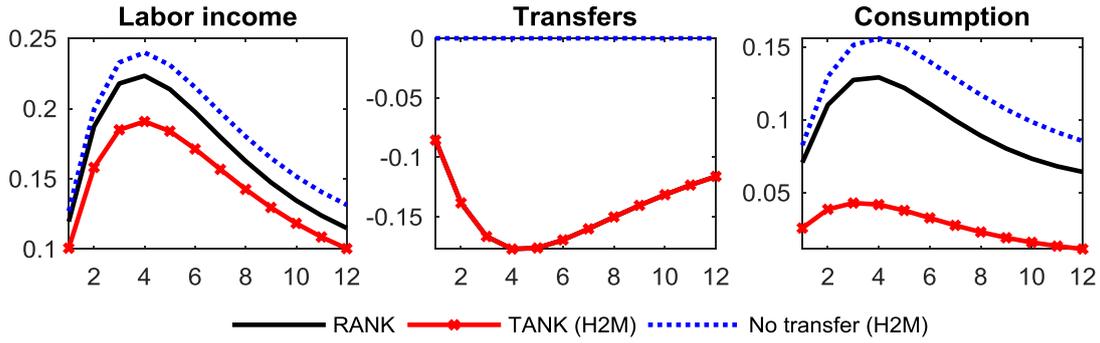
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Figure 2: Simulated quarterly responses for an interest rate peg of 25bp below steady state for 4 quarters in %-deviation from steady state. The red solid-dotted line represents the response of hand-to-mouth (H2M) households in the estimated TANK model, the blue dotted line in the TANK model without transfers. The black solid line represents RANK (aggregate response).

mouth households (H2M) when the interest rate is pegged for 4 quarters. Focus on the case with no transfers (blue dotted line) first. The left panel reveals that labor (and thus total) income increases more compared to RANK (black solid line), which raises consumption demand of hand-to-mouth households (right panel) as well as aggregate consumption (not shown) and income (middle row and middle panel in figure 1). Therefore, the H2M-amplifier outweighs the smaller intertemporal channel. Now contrast the dynamics with countercyclical transfers (red solid-dotted line). As transfers are *reduced* during the boom (middle panel) so is total income and thus consumption demand (right panel). Hence, the H2M-amplifier becomes sufficiently weak such that the power of forward guidance is attenuated.

In order to quantify the share of hand-to-mouth households $\lambda$ and the associated degree of countercyclical redistribution $\tau$ that is necessary to tame the power of forward guidance, figure 3 compares the relative peak response of inflation (left panel) and output (right panel) after 8 quarters of forward guidance for different combinations of $\lambda$ and $\tau$. A value above 1 indicates an amplification and a value below 1 a dampening relative to RANK. All combinations that
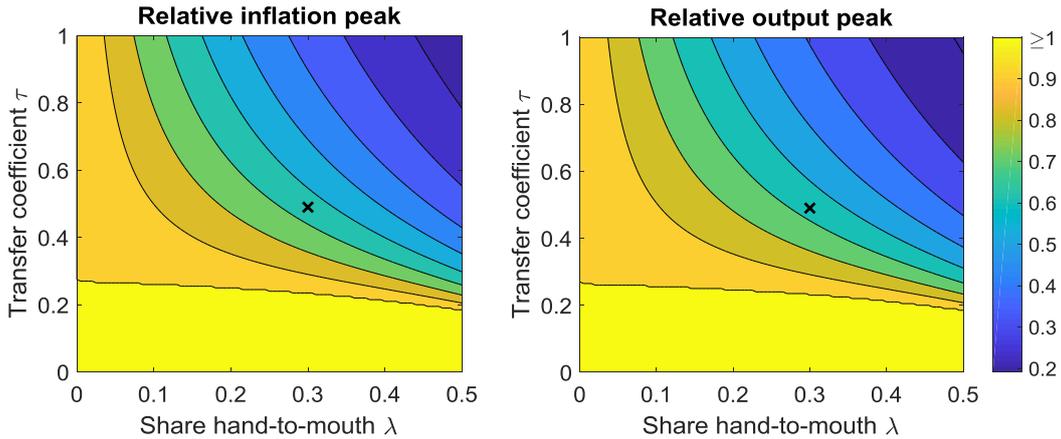
Figure 3: Peak response of inflation (left panel) and output (right panel) for different parameterized TANK models relative to RANK for 8 quarters of forward guidance. Values above 1 indicate an amplification (all in bright yellow), values below 1 a dampening. The cross denotes estimated values.

result in amplification (i.e. values $> 1$) are depicted in bright yellow. There are two takeaways: First, there is a non-negligible region where rule-of-thumb households lead to stronger aggregate effects of forward guidance, especially when redistribution is negligible. Second, the combination of a high share of hand-to-mouth households *and* significant redistribution leads to the strongest reduction of the power of forward guidance. The cross in the figure highlights the values that were used for the above simulations. At this point, compared to RANK, the power of forward guidance is reduced by roughly 40%.[6]

# 4 Discussion

The parameterizations of the share of hand-to-mouth households and, more importantly, the amount of countercyclical redistribution are crucial to assess whether the power of forward guidance is attenuated. A further taming is possible if monetary policy is strongly history dependent, since an inertial reaction

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[6]In McKay et al. (2016) the incomplete markets model reduces the initial impact of their forward guidance experiment by 60% compared to a complete markets benchmark.

of the central bank will carry its endogenous feedback of interest rates into the future (after the peg), see for instance Bilbiie (2018a). As many central banks indeed emphasize a medium term goal of their inflation targets, we estimated a version of the above model with a Taylor rule that reacts to a 4-quarter average of the past inflation rates (e.g. Justiniano, Primiceri and Tambalotti, 2013). First results indeed indicate a further taming. We leave a thorough analysis of the quantitative implications of different monetary policy rules and strategies for future work.

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