Targeted vs. Timely Fiscal Stimulus Payments

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Abstract

This paper analyzes the tradeoff between targeted versus timely fiscal stimulus payments in a quantitative two-sector HANK model. In response to a negative sectoral shock, fiscal policy is specified as the total size of transfers, the degree of targeting towards households in the affected sector, and the length of periods until the policy can be implemented. The key trade-off in the model is that the degree of targeting is increasing in the delay until policy can be implemented. In the baseline calibration of symmetric equilibrium with one household wholly employed in each sector, the key result is that fully targeting the stimulus program to the household in the affected sector yields less total welfare than intermediate levels of targeting.

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1 Introduction

Fiscal stimulus payments are a crucial tool for governments to provide financial relief to households during times of economic downturn. The distribution of these payments requires a delicate balance between the need for timeliness and the importance of targeting. Targeted payments that reach those most in need limit the total fiscal cost and provide the highest marginal impact, but designing and implementing targeted programs can be a slow-moving process. The costs of waiting to distribute payments to those who most need them can be severe, especially in times of crisis when many are struggling to make ends meet. Timely stimulus payments that are distributed to all households, even those who may not necessarily need them, can avoid delays that further exacerbate financial hardship and increase the efficacy of payments by delivering them when they can have maximal impact.

In response to aggregate shocks that disproportionately affect certain households, common wisdom argues that targeted fiscal relief towards these households yields the most efficient use of public funds. However, discerning which households are affected and creating programs to target them is a difficult and time-consuming process, which can be limited by both technical and political factors.

For example, at the onset of the global COVID-19 pandemic in 2020, US congress quickly enacted the CARES Act, which included large payments that were directly distributed to many households. As Schild and Garner (2021) discuss, the speed with which payments could be disbursed was of first-order importance, including choosing to structure payments as tax rebate so as to utilize the IRS's existing infrastructure for making transfers directly into households' bank accounts. In the Congressional Record, Sen Mitch McConnell is quoted as stating that "the purpose of [the transfer] is to provide immediate relief to folks who are facing cash flow problems in their families as they stay home to stop the spread of this virus" (Congressional Record Vol. 166, No. 53), and Senator Cory Brooker agrees, adding that "we need to be doing it quickly, getting payments to people as soon as possible" (Congressional Record Vol. 166, No. 54).

Although the CARES Act (and the Economic Stimulus Act in 2008) included income thresholds at which transfers were decreased until zero for sufficiently high-income households, there was no explicit targeting to households directly impacted by macroeconomic conditions. In fact, the CARES Act also included targeted relief via expended unemployment benefits, but Congress still felt the need for speedier but less targeted direct fiscal transfers. Further, there was some sense that even those not directly facing unemployment would benefit from relief: Senator Brooker states that "economic relief packages coming from this body should be about offering everyone relief, including those who, through no fault of their own, now find themselves on that financial brink" (Congressional Record Vol. 166, No. 54).

This paper studies the trade-off between the targeting and timeliness of stimulus payment disbursement. The analysis is undertaken in a New Keynesian model with two sectors and two households subject to heterogeneous idiosyncratic income shocks. Each household supplies labor to two productive sectors in the economy that are subject to aggregate and sectoral productivity shocks. In response to a sectoral TFP shock, which affects both households employed by that sector directly via labor income and households in the other sector via general equilibrium, the fiscal authority announces and implements a fiscal transfer program.

The model highlights two key mechanisms that are important for studying the trade-off between targeting and timeliness. First, sectoral shocks have large impacts on households employed in that sector, but also have large impacts on households in the "unaffected" sector through general equilibrium. This is a strong case for why even "untargeted" transfers are still important for households indirectly affected by negative shocks. Second, fiscal transfers to one set of households also affect other households through general equilibrium. Distributing payments towards households that are not directly affected by a negative shock may still prop up the affected sector through the labor income effect of increased production to satisfy the new demand.

The main exercise in this paper is studying various fiscal policy responses to a negative productivity shock in one sector. Fiscal policy in the model is specified as the total size of transfers, the degree of targeting towards households in the affected sector, and the length of periods until the policy can be implemented. The key trade-off in the model is that the degree of targeting is increasing in the delay until policy can be implemented.

In the baseline calibration of symmetric equilibrium with one household wholly employed in each sector, the key result is that fully targeting the stimulus program to the household in the affected sector yields less total welfare than intermediate levels of targeting. This is because of the two forces described above and the fact that additional targeting comes at the expense of additional delays until the first dollar of stimulus is transferred to households.

The model's rich heterogeneity on the household side also allows for studying the distributional impact of policies. The main analysis focuses on households at the median level of liquidity, but the key results carry through for households at the lower and upper quartiles. Households in the lower quartile are generally made better off by any degree of targeting, while the opposite holds true for households in the upper quartile. This occurs because, mechanically, wealthier households pay more taxes and receive the same lump-sum transfer, but also because the marginal utility of less liquid households is much more sensitive to changes from both the initial productivity shock and the fiscal transfer.

Related Literature This paper contributes to a literature that focuses on the impact of fiscal transfers from governments to households on household welfare. Oh and Reis (2012) document a large share of fiscal support during the Great Recession was via direct transfers to households and build a model which demonstrates the positive impacts of targeted transfers from high- to low-wealth households. In this paper, I model two households employed in two sectors, and transfers funded by both households (via taxes) are targeted targeted towards households employed by the sector experiencing a negative sectoral productivity shock. This may include but not does necessarily imply directional transfers along the distribution of wealth. Bilbiie, Monacelli and Perotti (2013) and Mehrotra (2018) study the impact of fiscal transfers vs. fiscal spending in models that also break Ricardian equivalence, while di Giovanni, ebnem Kalemli-Özcan, Silva and Yildirim (2023) and Hale, Leer and Nechio (2023) focus on the inflationary aspect of stimulative fiscal policies. Relative to all of these papers, I focus on the trade-off between the targeting of fiscal transfers and the time it takes for the fiscal transfers to occur.

On the empirical side, the analysis in this paper builds on empirical estimates of the marginal propensity to consume out of fiscal transfers. Overall, both revealed-preference and reported-preference estimates of the marginal propensity to consume out of these transfers are largely in agreement (Parker and Souleles, 2019). A litany of papers estimate the consumption response out of transfers in the Great Recession (Shapiro and Slemrod, 2009; Sahm, Shapiro and Slemrod, 2010; Parker, Souleles, Johnson and McClelland, 2013; Broda and Parker, 2014), COVID-19 pandemic (Parker, Schild, Erhard and Johnson, Forthcoming; Dunn, Hood and Driessen, 2020; Chen, Qian and Wen, 2020; Andersen, Hansen, Johannesen and Sheridan, 2020; Baker, Farrokhnia, Meyer, Pagel and Yannelis, 2020; Karger and Rajan, 2020; Coibion, Gorodnichenko and Weber, 2020), and other fiscal transfer programs (Johnson, Parker and Souleles, 2006, 2009). Orchard, Ramey and Wieland (2023) study the 2008 fiscal stimulus program in a New Keynesian model and show that general equilibrium forces generate a smaller aggregate fiscal multiplier, which reconciles the large household-level consumption response to the relatively muted aggregate consumption response. Similarly, the model in this paper studies stimulative fiscal policy in general equilibrium, but with two households and two sectors in order to study the trade-off between targeting and timeliness when only one sector is directly affected by a negative shock.

The heterogeneous agent New Keynesian (HANK) model developed in this paper builds on seminal work in Kaplan and Violante (2014) and Kaplan, Moll and Violante (2018). The model is coded and solved using the toolkit developed in Auclert, Bardóczy, Rognlie and Straub (2021). The production sector of the economy is expanded to contain two production sectors, closely following Cantelmo and Melina (2023), while the household sectors features two households and the rest of the model closely follows Auclert et al. (2021). The presence of non-Ricardian households and fiscal stimulus transfers, both immediate and in the future, connect closely to the relevance of intertemporal MPCs studied in Auclert, Rognlie and Straub (2018). In this setting, however, fiscal stimulus transfers occur at the same time as a negative sectoral shock, and may even be delayed until later in the future. As such, marginal utility is higher in earlier periods when the shock hits, and so the cumulative multiplier out of the transfer is more front-loaded than for a fiscal transfer during regular times.

Outline Section 2 develops a standard HANK model extended to incorporate two households and two sectors which are connected via labor markets and a final goods producer. Section 3 specifies the baseline symmetric calibration and presents impulse response functions for aggregate and sectoral shocks, as well as fiscal transfer shocks. Section 4 discusses the trade-off between targeting and timeliness in the model, and Section 5 illustrates this trade-off in the benchmark model. Section 6 concludes.

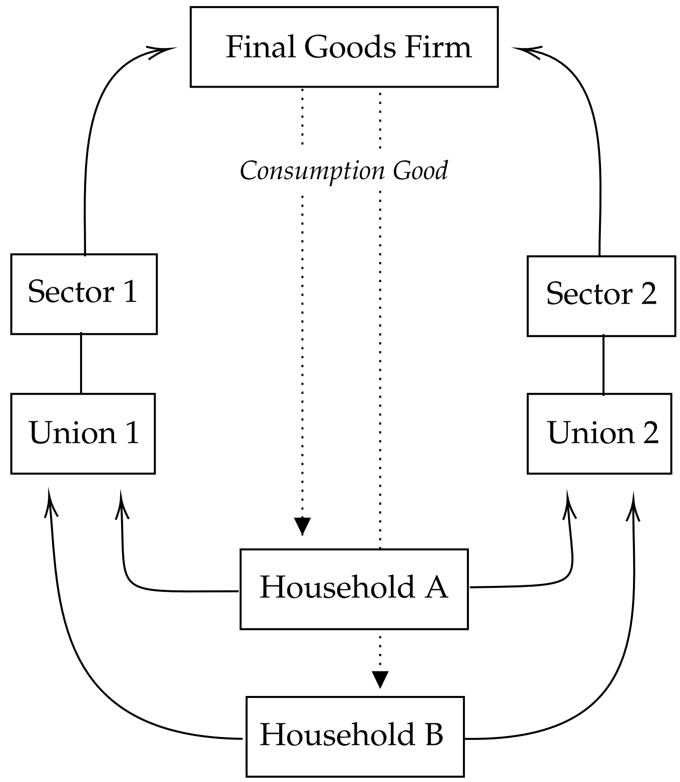
2 Model

I construct a medium-scale HANK model with two sectors and two households. The model extends the two-sector structure of Cantelmo and Melina (2023) to feature two households that allocate labor across sectors. Households have access to two different assets, and the rich production and household sectors are embedded into a canonical HANK model, e.g., the one studied in Auclert et al. (2021).

The structure of the economy is depicted in Figure 1. Similar to standard models, the numeraire in the economy is a final output good produced by the Final Goods Firm. The final output good is an aggregate of the final intermediate good from each of two sectors. Each sector contains one sectoral aggregator firm and a continuum of monopolistcally competitive producers. The producers face aggregate and sectoral producitivty shocks, and use sectoral capital and labor. Given demand for labor by each sectoral firm, labor is inelastically supplied by a sectoral labor union. Each union sets wages on behalf of all of its members.

There are two households in the economy, each of which supplies labor to both sec-

Figure 1: Partial Illustration of Production Structure in Model



toral unions. While the fraction of each household is fixed, each household's labor is (partially) substituable between each of the labor unions. Total labor demand is dictated by the sectoral production firms to the unions, and then wages are determined such that total supply from both households clear the market. Each household consumes the final output good, which, completing the cycle, aggregates each sectoral good.

Omitted from the figure but described below are the fiscal and monetary policy rules, the capital and investment decisions, and the financial intermediaries. In what follows, index j refers to the firm (1 or 2), index h to the household type (A or B), and index i to individual firms and/or households.

2.1 Households

A continuum $i \in [0, 1]$ of infinitely lived households consuming final good and supplying labour. The household inelastically supplies labor to the union in each sector. There are two types of households, indexed by $h \in \{A, B\}$, with a fraction $\chi_A \in [0, 1]$ of type A and $\chi_B = 1 - \chi_A$ of type B. Labour is supplied by each household of each type to the labor union in each sector of the economy, with substitutablity between sectors to degree λ:

$$N_{i,h,t} \equiv \mathcal{N}(N_{1,i,h,t}, N_{2,i,h,t}) = \left[\chi_{1,h}^{-\frac{1}{\lambda}} \left(N_{1,i,h,t}\right)^{\frac{1+\lambda}{\lambda}} + \chi_{2,h}^{-\frac{1}{\lambda}} \left(N_{2,i,h,t}\right)^{\frac{1+\lambda}{\lambda}}\right]^{\frac{\lambda}{1+\lambda}}.$$

The parameter $\chi_{j,h} \equiv \frac{N_{1,h}}{N_h} \in [0,1]$ is the steady-state aggregate share of labour of household h in sector j, with $\chi_{j,A} + \chi_{j,B} = 1$. Note that we will utilize the extreme case of no labor mobility, i.e., $\lambda = 0$, in which the CES aggregator becomes a Cobb-Douglas function, in the calibration.

Each household of type h solves:

$$V_{h,t}(e, b_-, a_-) = \max_{c,b,a} u(c) - \nu(N_{h,t}) + \beta E_t[V_{t+1}(e', b, a)]$$
$$\text{s.t. } c + b + a = z_{h,t}(e) + T_{h,t} + (1 + r_t^a)a_- + (1 + r_t^b)b_- - \Psi(a, a_-).$$

Note that labour supply is determined by the union and does not enter the household's optimization problem directly. Labour income, $z_{h,t}(e)$, is given by:

$$z_{h,t}(e) = (1 - \tau_t)(w_{1,t}N_{1,h,t} + w_{2,t}N_{2,h,t})e,$$

with tax-free transfer to each household $T_{h,t}$. The illiquid asset adjustment cost is:

$$\Psi(a, a_-) = \frac{\chi_1}{\chi_2} \left| \frac{a - (1 + r_t^a)a_-}{(1 + r_t^a)a_- + \chi_0} \right|^{\chi_2} \left[(1 + r_t^a)a_- + \chi_0\right].$$

The union determines the total amount of labor demanded from each household, $N_{h,t}$, and then labor for each sector is given by:

$$N_{j,h,t} = \chi_{j,h} \left(\frac{w_{j,t}}{w_{h,t}}\right)^{\lambda} N_{h,t},$$

with $w_{h,t}$ the wage index for each household (which depends on their steady state shares):

$$w_{h,t} = \left[\chi_{1,h} w_{1,t}^{1+\lambda} + \chi_{2,h} w_{2,t}^{1+\lambda}\right]^{\frac{1}{1+\lambda}}.$$

2.2 Firms

2.2.1 Final Goods Firm

A final goods firm combines the two sectoral goods using a Cobb-Douglas aggregator:

$$Y_t \equiv \left[\chi_{Y_1}^{\frac{1}{\eta}} (Y_{1,t})^{\frac{\eta-1}{\eta}} + (1 - \chi_{Y_1})^{\frac{1}{\eta}} (Y_{2,t})^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}$$

As is standard, demand for each sectoral good depends on relative prices, defined in A.1.1. The aggregate price index and aggregate inflation are defined as:

$$P_t = \left[\chi_{Y_1} P_{1,t}^{1-\eta} + (1 - \chi_{Y_1}) P_{2,t}^{1-\eta} \right]^{\frac{1}{1-\eta}},$$
$$\pi_t = \frac{P_t - P_{t-1}}{P_{t-1}}.$$

2.2.2 Sectoral Goods Firms

Each sector $j \in \{1, 2\}$ consists of a sectoral aggregator and a continuum of intermediate goods firms. The sectoral aggregator combines the intermediate goods into the sectoral good, C_j, with a constant elasticity of substitution, $\frac{\mu}{\mu-1}$. Each intermediate goods firm k in sector j has a Cobb-Douglas production function over capital and labour, subject to an aggregate and sectoral shock:

$$y_{k,j,t} = F(k_{j,k,t-1}, n_{k,j,t}) = Z_t Z_{j,t} k_{j,k,t-1}^{\alpha} n_{k,j,t}^{1-\alpha}.$$

Each firm sets its price subject to quadratic adjustment costs and chooses capital subject to quadratic adjustment costs. Aggregating across the sector produces a sectoral Phillips curve and sectoral Tobin's Q. Appendix A.1.2 details the derivation of these objects.

2.3 Labour Unions

In each sector, a labour packer purchases employment services from a continuum of labour unions and packs them into a composite labour good, $N_{j,t}$, with a constant elasticity of substitution, $\frac{\mu_w}{\mu_w-1}$. The composite labour good is then leased to the continuum of intermediate goods in that sector for wage $W_{j,t}$.

Households provide differentiated labour input to each sector's unions, which gives them some pricing power in setting their own wage. Each differentiated labour input's wage is set by a corresponding union, and under the assumption that every household provides every labour type, then all unions represent all households. Therefore, unions set wages to maximize utility of all households of each type, taking as given their consumption and savings decisions. Unions face quadratic wage adjustment costs which they pass on to households. This generates a sectoral wage Phillips curve in each sector, derived in Appendix A.2. As such, sectoral wage is inflation given by:

$$1+\pi^w_{j,t} = \frac{w_{j,t}}{w_{j,t-1}}(1+\pi_t).$$

The joint decision of the labor union in deciding total labor supplied to each firm and the household's individual decision of how to allocate labor between each sector ensures that the sectoral labor markets clear in each period:

$$\begin{aligned} N_{1,t} &= N_{1,A,t} + N_{1,B,t} \\ N_{2,t} &= N_{2,A,t} + N_{2,B,t} \end{aligned}$$

2.4 Financial Intermediary

A representative financial intermediary takes deposits from households. Illiquid assets and liquid assets, transformed at proportional cost ω, are invested into government bonds, $B^g_{G,t}$, and firm equity in each sector, $p_{j,t}$ (see Appendix A.3 for details).

By assuming that capital gains accrue to the illiquid asset held by the household, ex-post returns are equal to:

$$1+r_t = \frac{1+i_{t-1}}{1+\pi_t} = 1 + r^b_t + \omega,$$

and:

$$1+r^a_t = \Theta_{1,t}\left(\frac{d_{1,t}+p_{1,t}}{p_{1,t-1}}\right) + \Theta_{2,t}\left(\frac{d_{2,t}+p_{2,t}}{p_{2,t-1}}\right) + (1-\Theta_{1,t}-\Theta_{2,t})(1+r_t),$$

where $\Theta_{j,t}$ is the share of firm j equity in the illiquid portfolio.

2.5 Fiscal Policy

The fiscal authority uses a proportional labor income tax, τ_t, and one-period nominal debt, B_t, to finance its spending, G_t. The budget constraint is given by:

$$B_{G,t} + \tau_t \sum_{h\in\{A,B\}} \sum_{j\in\{1,2\}} w_{j,t} N_{j,h,t} = (1+r_t) B_{G,t-1} + G_t + T_A + T_B$$

The fiscal authority maintains a degree of deficit financing, ρ_B, where ρ_B implies a budget that balances period-by-period, and adjusts labor taxes to finance the remainder of its budget. Government borrowing in each period is therefore the sum of new financing of government spending in that period and refinancing debt from previous periods:

$$B_{G,t} = \rho_B (G_t + B_{G,t-1}).$$

In steady state, government bonds equal:

$$B_G = \frac{\rho_B}{1-\rho_B} G.$$

2.6 Monetary Policy

The monetary authority uses a Taylor rule to set the nominal rate on bonds:

$$i_t = r^* + \phi_\pi \pi_t + \phi_y (Y_t - Y_{SS})$$

3 Benchmark Calibration and Impulse Responses

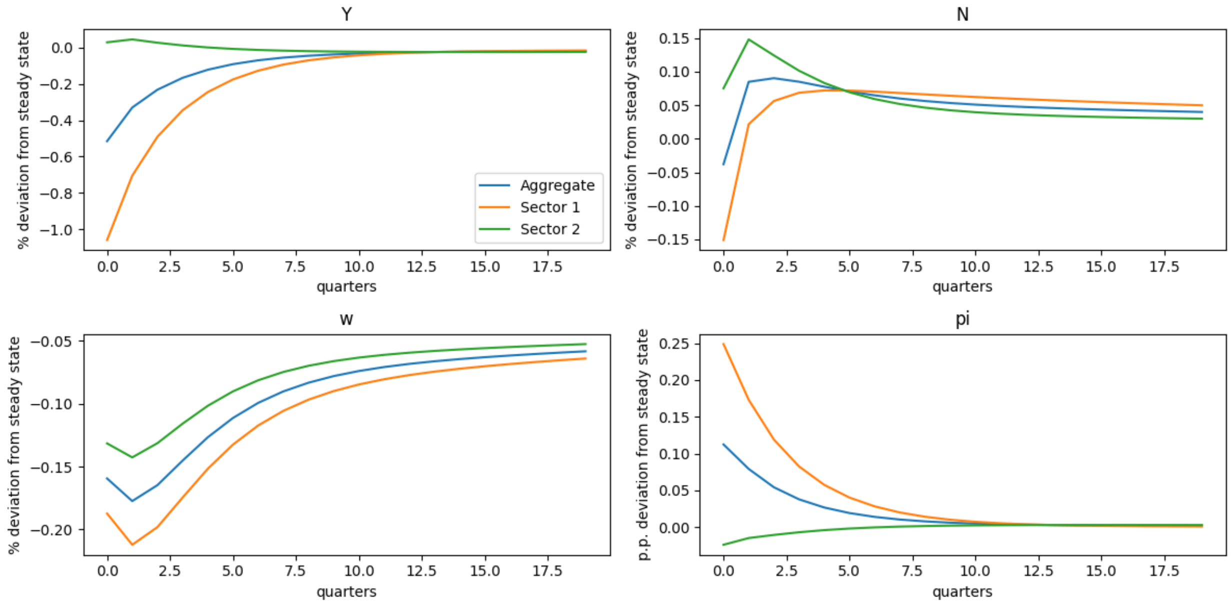
3.1 Benchmark Calibration with Symmetric Households and Firms

In the benchmark calibration, Household A exclusively supplies labor to the union for Sector 1, $\chi_{A,1} = 1$, and Household B exclusively supplies labor to the union for Sector 2, $\chi_{B,1} = 0$. Labor for each household and sector is given by:

$$\begin{aligned} N_{A,1,t} &= N_{A,t} = N_{1,t}, \\ N_{A,2,t} &= 0, \\ N_{B,1,t} &= 0, \\ N_{B,2,t} &= N_{B,t} = N_{2,t}. \end{aligned}$$

In this extreme case, there is never labor substitution between sectors (and the parameter governing the degree of such substitution, λ, is left unspecified). The remaining parameters are calibrated exactly as in Auclert et al. (2021).

Figure 2: Aggregate Responses to Aggregate & Sectoral Productivity Shocks



Notes: Impulse responses of aggregate and sectoral variables to a Sector 1 TFP shock (Z_1).

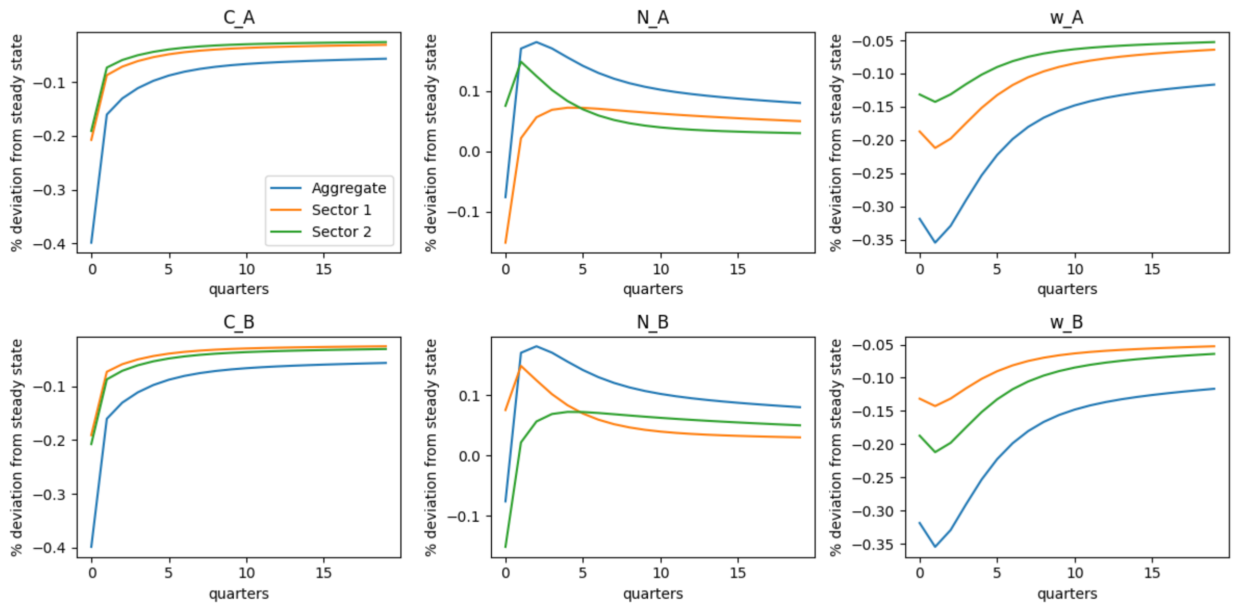
3.2 Response to Aggregate and Sectoral TFP Shocks

3.2.1 Aggregate Response to Productivity Shocks

Figure 2 plots the impulse responses to a TFP shock in Sector 1. Again, due to the symmetry in the benchmark calibration, the response to a TFP shock in Sector 2 would yield an identical aggregate impact and the labels for the sectoral lines would switch. Three IRFs are plotted in the panel for each variable: the aggregate quantity and the two sectoral quantities.

For example, the first panel plots the IRF for aggregate output, Y, Sector 1 output, Y_1, and Sector 2 output, Y_2, to a TFP shock in Sector 1, Z_1. Aggregate output decreases by 0.4% of steady-state output due to the sectoral TFP shock, driven by a 1.0% decrease in Sector 1 output and an essentially flat response in the unaffected sector. Labor decreases in the affected sector but increases in the unaffected sector, leading to a small aggregate increase in total labor. On the other hand, wages fall in both sectors, and the aggregate wage response is also negative. Inflation increases in the affected sector and remains largely unchanged in the unaffected sector.

Figure 3: Household Responses to Aggregate & Sectoral Productivity Shocks



Notes: Impulse responses of households to aggregate and sectoral productivity shocks.

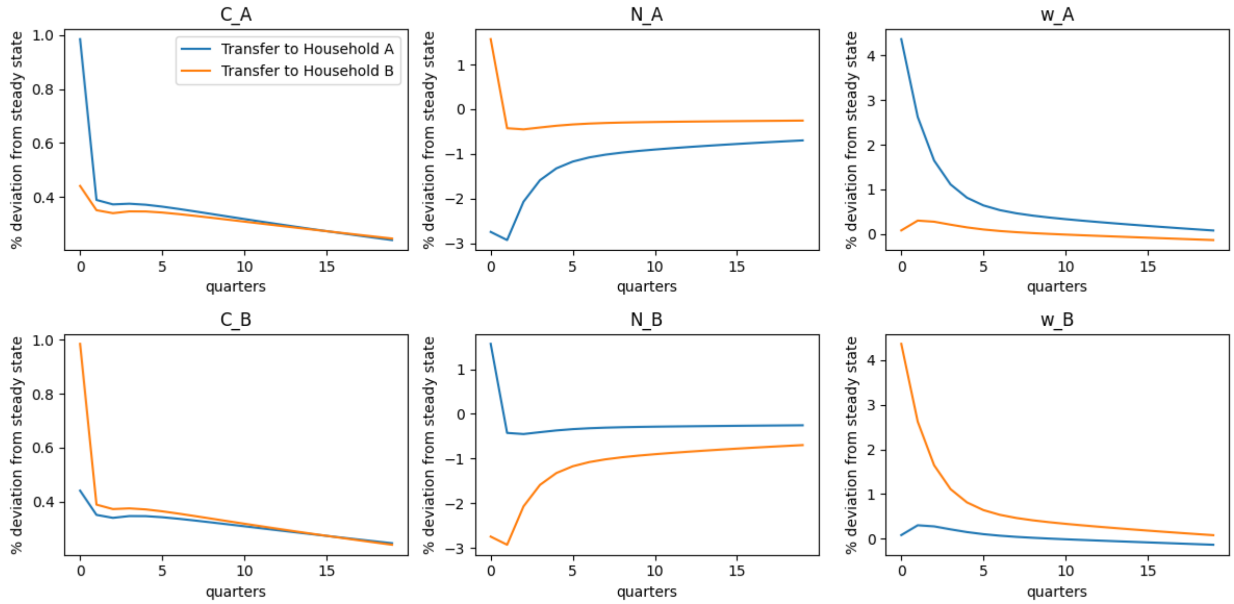
3.2.2 Household Responses to Productivity Shocks

Figure 3 plots how each Household's variables respond to aggregate and sectoral shocks. Each panel plots the response of a variable to aggregate and sectoral TFP shocks. For Household A, Sector 1 shocks have a much larger impact since Household A is wholly employed in that sector; a similar logic applies to Household B for Sector 2. Further, the IRFs are identical across the first and second rows, other than labels, since sectoral and household allocations are symmetric but completely partitioned.

In response to a negative own-sector TFP shock, consumption decreases -0.2%, which is almost identical to the consumption response of an other-sector TFP shock. However, labor and wage move very differently if the shock is own-sector or other-sector, with larger responses coming from the own-sector shock but the other-sector shock generating a meaningful impact.

The key insight from this analysis is that even with this completely partitioned labor market, shocks in one sector have large effects on households employed in the other sector due to general equilibrium. This will be an important justification for why even "untargeted" fiscal stimulus will improve welfare; despite not being directly impacted by the negative shock, "untargeted" households will indirectly feel the impact, and therefore benefit from stimulus.

Figure 4: Household Responses to Fiscal Transfer Shocks



Notes: Impulse responses of household variables to transfers to each household.

3.2.3 Household Responses to Fiscal Transfer Shocks

I model the fiscal response as one-time transfers to households in the form of shocks to the household-specific lump-sum transfers, T_A and T_B. These shocks also appear on the government's budget constraint and must be accounted for by increasing taxes or government borrowing. Figure 4 plots how each household's variables respond to transfer shocks. Again, since this benchmark calibration is symmetric, the figures in each row are relabelled copies of one another.

Unsurprisingly, transfers to Household A increase consumption for Household A. The transfer decreases the supply of labor and increases wages. At the same time, consumption for Household B increases meaningfully with transfers to the other household. This is because in general equilibrium, since Household A's final consumption good uses output from both sectors, labor and wages must increase in Sector 2. Household B is the sole employee in Sector 2, and therefore the increased production increases labor and wages for Household B, which then increases consumption. This analysis reveals that stimulus transfers to either households will eventually fund the consumption of both households, which will be an important dimension in understanding the tradeoff between targeting fiscal transfers and increasing overall welfare.

4 The Trade-Off Between Targeting and Timeliness

The fiscal stimulus programs studied in this paper are modelled as unexpected shocks to lump-sum transfers that are zero in steady-state. A stimulus program consists of three elements: the size of the stimulus package, S, the degree of targeting toward Household A (the sole employee in Sector 1), θ, and the number of periods before which fiscal transfers are disbursed, t_D. In what follows, the size of the stimulus program is taken as given, although later extensions analyze also the impact of stimulus size on total welfare.

4.1 Targeting

To parameterize the degree of targeting, I denote $\theta \in [0, 1]$ as the precision of fiscal stimulus and define stimulus to each household as:

$$\frac{S_A}{S} = \theta + (1-\theta)\chi_A$$
$$\frac{S_B}{S} = (1-\theta)\chi_B$$

Figure 5 illustrates how stimulus is allocated between Households A and B as precision, θ, varies. This specification is chosen based to deliver intuitive values of total transfers for the polar opposite cases of targeting. When $\theta = 0$, stimulus is not targeted specifically towards either household, but instead evenly distributed across the population: $S_A = \chi_A S$ and $S_B = \chi_B S$. At the other extreme, when $\theta = 1$, stimulus is directed completely towards the affected household, Household A, and Household B receives no transfer: $S_A = S$ and $S_B = 0$.

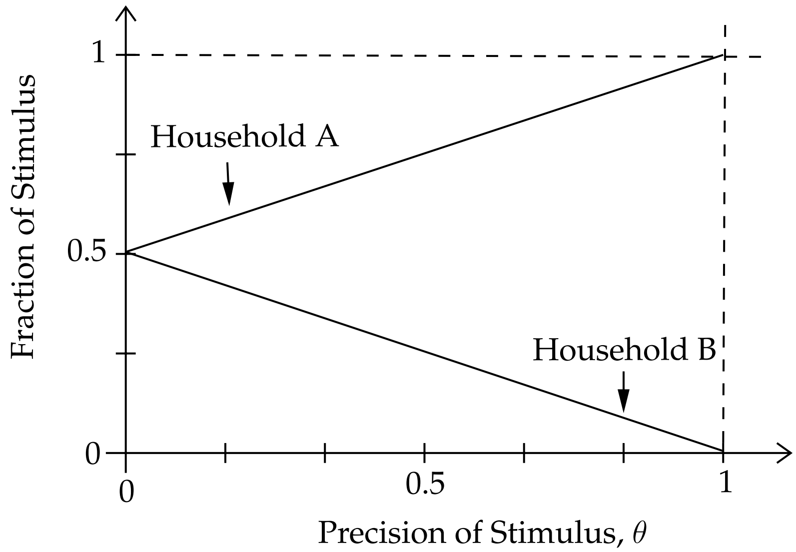
4.2 Timeliness

Fiscal transfers are disbursed to each household as one-time payments. The timing and amount of the transfer shocks are announced simultaneously with the negative TFP shock. The total stimulus to each household, S_A and S_B, are disbursed as one lump-sum transfer in period t_D:

$$dT_{A,t} = \begin{cases} S_A & \text{if } t = t_D, \\ 0 & \text{otherwise} \end{cases}, \quad dT_{B,t} = \begin{cases} S_B & \text{if } t = t_D, \\ 0 & \text{otherwise} \end{cases}.$$

In periods before t_D, transfers are zero; in period t_D, the transfer is made; and in all periods after, transfers are again zero. When $t_D = 0$, the transfer is disbursed in the same

Figure 5: Relation Between Stimulus Precision and Distribution to Each Household



Notes: Illustration of the relationship between the precision of stimulus, θ, and the fraction of stimulus allocated to each household.

period as the negative productivity shock. When $t_D > 0$, the transfer is disbursed with some delay, but the exact size and scope of the stimulus is announced at the same time as the negative productivity shock is realized.

4.3 Modeling the Trade-Off Between Targeting and Timeliness

To capture the trade-off between targeting and timeliness, the length of delay until the fiscal transfer occurs is defined as a function of the precision of transfers:

$$D(\theta) : [0, 1] \to \mathbb{Z}_{\geq 0}.$$

This function maps the degree of targeting, θ, to the set of nonnegative integers. Given the total stimulus package and desired level of targeting, the delay function, $D(\theta)$, closes the specification of fiscal policy:

$$t_D = D(\theta).$$

5 Welfare Analysis of Fiscal Stimulus Programs

From now on, focus on the benchmark symmetric calibration and a TFP shock to Sector 1. Call Sector 1 the affected sector and Household A the affected household. At time t, the economy is subject to an unanticipated TFP shock to Sector 1. In response, the government announces an unanticipated and one-time fiscal stimulus program that is a fraction $\omega \in [0, 1]$ of steady-state output, $S = \omega Y_{SS}$. For a given level of targeting, θ, and the corresponding delay, $D(\theta)$, the shocks to Sector 1 TFP, Household A's transfer, and Household B's transfer are given by:

$$
\begin{aligned}
dZ_{1,t} &= \rho_{Z_1} dZ_{1,t-1} + \epsilon_{Z_1,t}, \\
dT_{A,t} &= S_A \cdot \mathbb{1}[t = D(\theta)], \\
dT_{B,t} &= S_B \cdot \mathbb{1}[t = D(\theta)].
\end{aligned}
$$

5.1 Trade-Off Between Targeting and Timeliness

To illustrate the model's main mechanism, the delay function is specified as a simple linear function in which every two quarters of delay allows the government to allocate an additional 25 percentage points of stimulus towards the affected sector's households:

$$D(\theta) = 8\theta.$$

If there is no targeting, $\theta = 0$, then there is no delay in disbursing stimulus evenly across the population of households. It takes six months to design a program that increases the targeting of households in the affected sector to 25 percentage points, and a full two years to completely target affected households.

5.2 Welfare Measurement

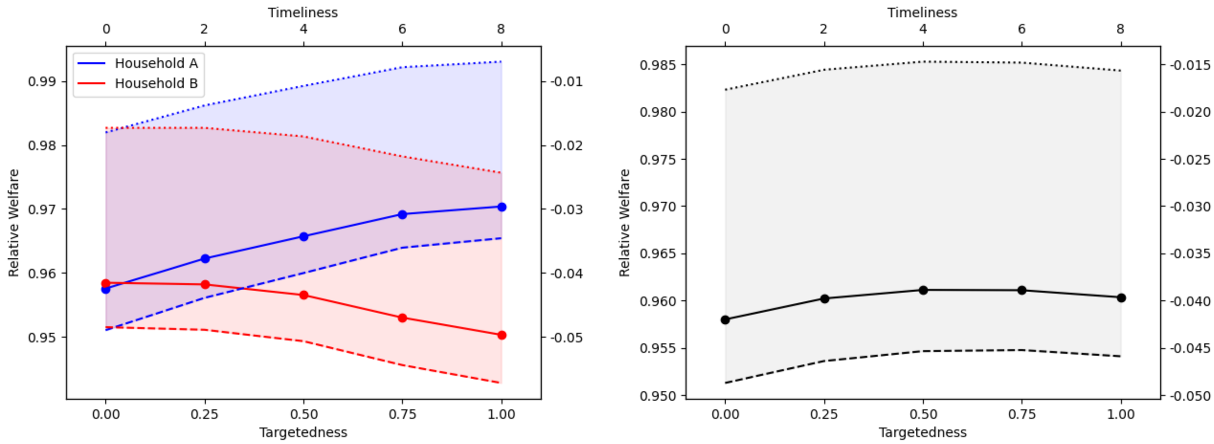
To measure welfare, I construct the household's constant consumption equivalent (CEE): given a sequence of shocks and corresponding sequence of consumption and labor, $\{C_t, N_t\}$, the CEE is the level of consumption that would make the household equally well off in terms of lifetime utility if labor was at its steady-state level:

$$\sum_{t=0}^{\infty} \beta^t U(C_{CEE}, N_{SS}) = \sum_{t=0}^{\infty} \beta^t U(C_t, N_t).$$

5.3 Analysis

Panel (a) of Figure 6 plots the tradeoff between timeliness and targetedness for Households A and B at the 25^{th}, 50^{th}, and 75^{th} percentiles of liquidity. In this section, I focus on the median effect, marked by the solid line and markers.

Figure 6: Timeliness vs. Targeting Tradeoff in Baseline Symmetric Model



(a) Welfare of Households A and B

(b) Weighted Welfare

The vertical axis plots the ratio of the CEE to steady-state consumption. As discussed above, because of general equilibrium effects, the sectoral shock in Sector 1 almost equally affects Households A and B. It follows that when stimulus is evenly distributed between the two households, welfare decreases almost identically by approximately 4 pp. As targeting increases, there is a clear divergence between the impact of welfare for each household. If stimulus is delayed by two periods but more directed towards Household A, the tradeoff is positive for Household A since welfare increases by 0.5 pp. On the other hand, welfare for Household B decreases by 0.4 pp. This pattern continues as more stimulus is targeted towards Household A, even though the stimulus is delayed for up to eight quarters in the fully-targeted case.

The total welfare effect of each policy depends on how each household is weighed. Panel (b) of Figure 6 presents a utilitarian welfare measure in which each household is weighed by its relative size, which, in the benchmark symmetric calibration, is 0.5. This panel combines the two lines in panel (a) and illustrates that the relationship between targeting and total welfare is not monotonic: as targeting increases, the delay increases, which leads to less total welfare than intermediate levels of targeting. Of course, this result obtains in the benchmark symmetric calibration under a simple functional form for the delay function. In the next section, the model is enriched quantitatively and calibrated to various recessions in US history.

5.4 Distributional Considerations of Trade-Off

The heterogeneous underpinning of the household blocks in the model allows for a distributional analysis of welfare gains. In panels (a) and (b) of Figure 6, the dashed lines depict the 75^{th} percentile household and the dotted lines depict the 25^{th} percentile household, both measured according to liquidity within household type (A and B). Under any fiscal stimulus plan, the 25^{th} percentile household is made more whole than the median household, while the 75^{th} percentile household is made less whole.

On a mechanical level, this reflects the fact that transfer policies are redistributive in this model since the fiscal stimulus is a lump-sum but labor income taxes are proportional. More importantly, however, poorer households are much more sensitive to small changes in liquidity, and therefore their response to both the negative TFP shock and positive fiscal transfer are heightened. The overall shape of the lower and upper quartiles' welfare is similar to that of the median, and therefore the weighted welfares also display the same pattern: there is an intermediate level of targeting which yields more total welfare than the full-targeting case.

5.5 Inflation Considerations of Trade-Off

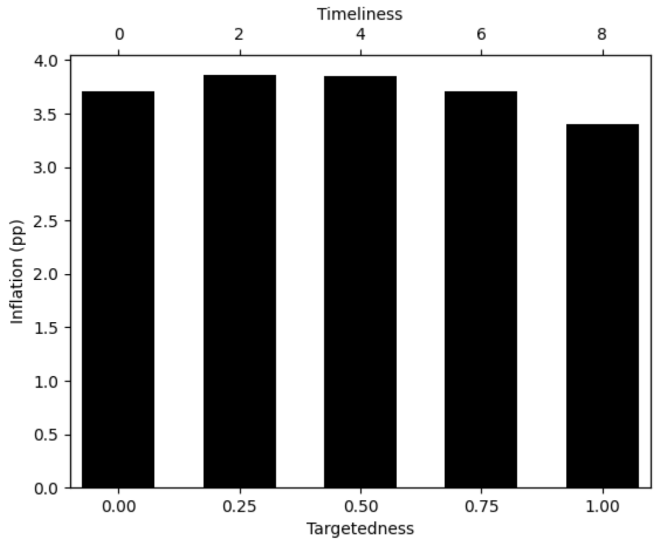
Figure 7 plots inflation for five fiscal policy scenarios ranging from no delay and no targeting to an eight-quarter delay and complete targeting. As with with welfare, inflation is not monotonic in targeting nor timeliness, with the highest level of inflation occurring for an intermediate value of timeliness and targeting. The impact of inflation on welfare is captured in the metric above, and this figure demonstrates that high inflation does not necessarily imply low welfare, since the benefit of high inflation may be more consumption.

6 Conclusion

In a model with two households and two sectors, this paper studies fiscal policy in response to sectoral productivity shocks. Targeting fiscal transfers towards households affected directly by the negative shock increases welfare, but the delay involved in designing and implementing such targeted programs can decrease welfare. This tradeoff is the key focus of analysis in this paper.

The main finding is that intermediate levels of targeting and timeliness can maximize household welfare; untargeted transfers with no delay distributes too much stimulus to households unaffected by the shock, while complete targeting to households affected by

Figure 7: Inflation in Baseline Symmetric Model



Notes: Inflation in period of negative TFP shock for different combinations of timeliness and targetedness.

the shock is delayed to the point where affected households would prefer smaller transfers if it meant a shorter delay.

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A Model

A.1 Firms

A.1.1 Final Goods Firm

Demand for each sectoral good is given by:

$$Y_{1,t} = \chi_{Y_1} \left(\frac{P_{1,t}}{P_t}\right)^{-\eta} Y_t,$$
$$Y_{2,t} = (1-\chi_{Y_1}) \left(\frac{P_{2,t}}{P_t}\right)^{-\eta} Y_t,$$

A.1.2 Sectoral Goods Firms

Each firm sets its price subject to quadratic adjustment costs relative to the aggregate price index in the previous period:

$$\psi_{k,j,t} = \frac{\mu}{\mu-1}\frac{1}{2\kappa}\left[\log\left(\frac{P_{k,j,t}}{P_{t-1}}\right)\right]^2 Y_{j,t}.$$

This yields a Phillips curve in each sector:

$$\log(1+\pi_{j,t}) = \kappa\left(mc_{j,t} - \frac{1}{\mu}\right) + \frac{1}{1+r_{t+1}}\frac{Y_{j,t+1}}{Y_{j,t}}\log(1+\pi_{j,t+1}),$$

with:

$$mc_{j,t} = \frac{w_{j,t}}{F_N(K_{j,t-1}, N_{j,t})}, \quad 1+\pi_{j,t} \equiv \frac{P_{j,t}}{P_t}(1+\pi_t).$$

Firms choose capital subject to quadratic adjustment costs:

$$\varsigma\left(\frac{k_{k,j,t}}{k_{k,j,t-1}}\right) k_{k,j,t-1}, \quad \varsigma(x) = x - (1-\delta) + \frac{1}{2\delta\epsilon_I}(x-1)^2,$$

with depreciation $\delta \in (0,1)$. Dividends equal output net of labour costs, investment, and price adjustment costs:

$$d_{j,t} = Y_{j,t} - w_{j,t}N_{j,t} - I_{j,t} - \psi_{j,t},$$

with investment defined as:

$$I_{j,t} = K_{j,t} - (1-\delta)K_{j,t-1} + \varsigma\left(\frac{K_{j,t}}{K_{j,t-1}}\right) K_{j,t-1}.$$

Then, capital evolves according to:

$$(1+r_{t+1})Q_{j,t} = \alpha\frac{Y_{j,t+1}}{K_{j,t}}mc_{j,t+1} - \left[\frac{K_{j,t+1}}{K_{j,t}} - (1-\delta) + \frac{1}{2\delta\epsilon_I}\left(\frac{K_{j,t+1}-K_{j,t}}{K_{j,t}}\right)^2\right] + \frac{K_{j,t+1}}{K_{j,t}}Q_{j,t+1},$$

with Tobin's Q in each sector given by:

$$Q_{j,t} = 1 + \frac{1}{\delta \epsilon_I} \frac{K_{j,t} - K_{j,t-1}}{K_{j,t-1}}.$$

A.2 Labour Unions

Unions impose a quadratic wage adjustment cost on households:

$$\varrho(W_{k,j,t}, W_{k,j,t-1}) = \frac{\mu_w}{\mu_w - 1} \frac{1}{2\kappa_w} \left[\log \left(\frac{W_{k,j,t}}{W_{k,j,t-1}} \right) \right]^2.$$

In the symmetric equilibrium, the wage Phillips curve in each sector is given by:

$$\log(1+\pi^w_{j,t}) = \kappa_w \sum_{h \in \{A,B\}} \chi_h \left(\nu'(N_{h,t}) \frac{\partial \mathcal{N}_{h,t}}{\partial N_{j,h,t}} - \frac{(1-\tau_t) w_{j,t} N_{j,h,t}}{\mu_w} \int e_i U'(C_{h,i}) di \right) + \beta \log(1+\pi^w_{j,t+1}),$$

A.3 Financial Intermediary

In expectation, the return on nominal government bonds, the return on equity for each firm, and the economy-wide return, $E_t[1 + r_{t+1}]$, are all equal due to the absence of arbitrage:

$$\frac{1 + i_t}{E_t[\pi_{t+1}]} = \frac{E_t[d_{1,t+1} + p_{1,t+1}]}{p_{1,t}} = \frac{E_t[d_{2,t+1} + p_{2,t+1}]}{p_{2,t}} = E_t[1 + r_{t+1}].$$

The financial intermediary passes these returns on to households net of intermediation costs:

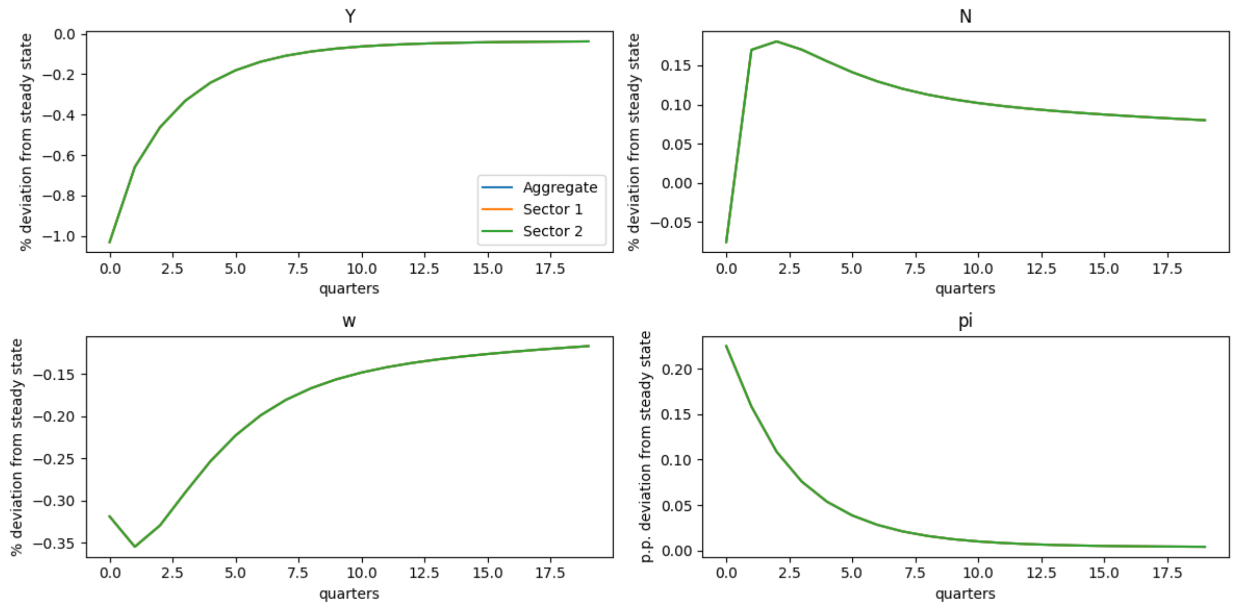
$$E_t[1 + r^a_{t+1}] = E_t[1 + r^b_{t+1}] + \omega = E_t[1 + r_{t+1}].$$

B Additional Results on Benchmark Calibration

B.0.1 Aggregate Response to Aggregate Productivity Shocks

Figure A.1 plots the impulse response of output, labor, wages, and inflation to an aggregate TFP shock. Each panel contains three lines: one for the aggregate response and one for each sectoral response. Under the benchmark calibration where sectoral and household allocations are symmetric, the three lines lay exactly on top of each other because the aggregate shock has an identical impact on both sectors. As in a typical New Keynesian model, a negative productivity shock decreases output, increases labor (after a small, initial decrease), decreases wages, and increase inflation.

Figure A.1: Aggregate & Sectoral Responses to Aggregate Productivity Shock



Notes: Impulse responses of aggregate variables to aggregate and sectoral productivity shocks.