Consumption Network, Fiscal Policy and Sectoral Dynamics

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Abstract

Using US household panel data, we uncover a rich heterogeneity across sectors in the fraction of workers that are hand-to-mouth (HTM), ranging from 30 to 70 percent. Moreover, using data from the 2008 tax rebate, we find substantial differences between the *marginal* and the *average* consumption baskets, and that households spend their marginal income disproportionately towards sectors with more HTM workers. That is, when a shock increases aggregate income, household expenditures are endogenously directed towards the pockets of HTM households, a mechanism that further amplifies the initial shock. To evaluate the relevance of these findings for fiscal policy, we construct a multi-sector, two-agent, new-Keynesian model. Like in the data, we allow the fraction of HTM workers to differ across sectors. We do not impose homothetic preferences, which enables us to match both the *average* and the *marginal* consumption baskets. At the fixed prices limit, we can analytically derive the fiscal multiplier and show that our findings increase its size by 10% on impact. In the dynamics, prices, and wages rise more strongly in sectors with more HTM workers, as households direct their *marginal* spending towards these sectors. This upward pressure on wages of HTM workers implies a large cumulative fiscal multiplier. [1]

[1]We are thankful for their continual support to Adrien Auclert, Eduardo Dávila, Patrick Kehoe, and Giuseppe Moscarini. We also thank Costas Arkolakis, Luigi Bocola, Zhen Huo, Elena Pastorino, Oliver Pfäuti, and seminar participants at Yale University and Stanford University for feedback and comments.

1 Introduction

In economies with heterogeneous agents, households differ in their marginal propensity to consume (MPC) out of transitory income changes. Understanding which households are exposed to a shock, therefore, becomes crucial to determine its propagation: when a shock redistributes toward high-MPC households, the resulting Keynesian multiplier is higher, and thus the effects of the shock on output are amplified. In this paper, we document a new channel of redistribution operating through a consumption network across sectors. Households' heterogeneity is relevant not only in terms of their MPC, but also because of their sector of employment, which might be more or less exposed to business cycle fluctuations. Empirically, we show that hand-to-mouth (HTM) households are distributed unevenly across sectors, ranging from 30 to 70 percent at the two-digits NAICS level. Furthermore, we show that the way households spend the average dollar across sectors, which we refer to as the *average consumption basket*, is different from the way they allocate the marginal dollar across sectors, which we refer to as the *marginal consumption basket*: households spend their marginal income disproportionately towards sectors with more HTM employees. Therefore, when a shock such as a fiscal transfer increases aggregate income, household expenditures are endogenously directed toward the pockets of HTM households, a mechanism that further amplifies the initial shock.

To fix ideas, it is helpful to consider the following illustrative example. At the two-digit level, we find that the sector with the largest share of HTM workers is the hotels and restaurants sector[2] (NAICS 72), where we classify over 70 percent of employees as HTM. Towards the opposite extreme of the spectrum, only 45 percent of workers in the utilities sector (NAICS 22) are HTM, the fifth-lowest fraction. When we look at average expenditures, households spend roughly the same amount on utilities as they do on hotels and restaurants. However, as common wisdom would suggest, the marginal consumption shares in these two sectors differ starkly. When households receive a fiscal transfer, they increase their hotels and restaurant expenditures by over 60% more than what is predicted by the average consumption share of that sector. On the contrary, household expenditures on utilities do not increase: if anything, they slightly decline. After a fiscal transfer, we thus expect little action in the utilities sector, but a boom in demand for hotels and restaurants, which raises labor demand in that sector. Since the fraction of hand-to-mouth workers employed in hotels and restaurants is much higher than the one in the utilities sector, the burst of first-round expenditures

[2]The NAICS 72 sector is typically classified as "Accomodation and food services", but for expositional purposes, we refer to it as "Hotels and restaurants" sector, which are its two major components.

resulting from the fiscal stimulus ends up disproportionately in the pockets of HTM workers, who spend a large fraction of this additional income. Second-round expenditures are thus magnified by this mechanism, which raises the Keynesian multiplier associated to the fiscal transfer, as we will formalize in equation (1).

The consumption pattern we highlight amplifies the output response to the initial shock by redistributing toward HTM households. We focus on fiscal policy as the most natural application to illustrate our findings, but the mechanism has broader implications for output volatility and sectoral fluctuations. To formalize the insight that the fiscal multiplier can depend on the complex structure of a consumption network, we build a multi-sector New Keynesian economy with sectoral and household heterogeneity. Each worker only works in a single sector but can consume goods produced in any sector. There are two key forces of our consumption network. The first force is the marginal propensity to consume *from* workers employed in different sectors, which captures the *intensity* of expenditure. The second force of the consumption network is captured by the consumption shares of households *towards* the various sectors in the economy, which captures the *direction* of expenditure.

To study MPC *from* workers in different sectors, we use the Panel Study of Income Dynamics (PSID). We use the methodology in Kaplan, Violante, and Weidner (2014) to classify liquidity-constrained households as HTM and we uncover that sectors are highly heterogeneous in the fraction of HTM households they employ. This fraction ranges from 30 percent for low HTM sectors to 70 percent for high HTM sectors. As shown in Kaplan, Violante, and Weidner (2014), the HTM status is strongly predictive of MPC. Our results thus suggest that workers in some sectors have much higher MPC than others. Furthermore, we show analytically that in our setting, in response to an un-targeted fiscal shock, the MPC of workers in a sector can be mapped one-to-one with the fraction of HTM workers employed in that sector, justifying our empirical approach.

To study the second key element of our consumption network, consumption shares, we use data from the Consumer Expenditure Survey (CEX). When studying the direction of consumption, we distinguish between *average* consumption shares, which capture average household expenditures across sectors, and *marginal* consumption shares, which characterize how households spend across sectors the marginal dollar of income. Average consumption shares are straightforward to measure in CEX. Instead, marginal consumption shares must be estimated. We do so using CEX data on the tax-rebate episode of 2008-2009. We adopt the same identification strategy that Parker et al. (2013) use to estimate marginal propensity to consume, enriched to account for the direction of consumption across sectors.

There are many reasons to believe that *average* and *marginal* consumption shares might differ. For example, some expenditures, such as rent, might be hard to adjust in the short term. Another possibility is that consumers have non-homothetic preferences, which is the interpretation we will use throughout the paper. Some goods, such as utilities, have a strong subsistence demand: households will always consume a certain amount of these items, and this subsistence demand is not sensitive to fluctuations in their personal income. Other goods, such as food in restaurants or hotels, have a smaller subsistence demand but are heavily consumed at the margin if households receive an increase in their income. We refer to this type of goods as *discretionary* goods, as opposed to subsistence goods. By deviating from the standard assumption of homothetic preferences, we are able to define within the model both the *average* and the *marginal* consumption shares, and to match their empirical counterparts. The general approach we take encompasses the well-known difference between the consumption patterns of durables and non-durable goods, with the former being more sensitive to transitory income changes.

To provide an intuition for our mechanism we use a simplified framework in which we abstract from the input-output network, and we assume that wages, and thus prices, are fully rigid and that the elasticitiy of substitution for consumption goods across sectors is equal to one. This simplified framework helps in providing intuition at this stage, as we obtain an analytical expression for the fiscal multiplier of an untargeted fiscal transfer, proportional to household income[3], that illustrates the core mechanism of this paper:

$$dY = \frac{\overline{MPC}}{1 - \left[\overline{MPC} + S \times cov(MPC_s, MCS_s - ACS_s)\right]} > \frac{\overline{MPC}}{1 - \overline{MPC}} = dY^{symmetric} \tag{1}$$

[3]If one were to consider a generic fiscal transfer, the multiplier would be

$$dY = \frac{MPC^{TW}}{1 - \left[\overline{MPC} + S \times cov(MPC_s, MCS_s - ACS_s)\right]},$$

where at the numerator we have the *transfer-weighted* average of households' MPC. This term governs the first-round expenditures and is higher when the transfer is targeted toward high MPC households. The mechanism we propose works through second-round expenditures, irrespectively of how the transfer is targeted. However, we are only able to show that $MPC_s = H_s$ in the case of an untargeted transfer, so for a generic transfer, MPC_s are endogenous objects.

where MPC_s is the MPC *from* households employed in sector s (which is equivalent to the fraction of HTM workers in that sector); $\overline{MPC}$ is the average MPC in the economy; MCS_s is the marginal consumption share *towards* sector s; and ACS_s is the average consumption share *towards* sector s. Our main empirical finding shows that households' marginal expenditure is biased towards high MPC sectors, that is $cov(MPC_s, MCS_s - ACS_s) > 0$. Sectors whose workers have high MPC tend to be heavily consumed at the margin and thus have $MCS_s > ACS_s$ (think of the restaurant and hotel sectors). Instead, sectors whose workers have low MPC tend to have stronger subsistence demand and thus $MCS_s < ACS_s$ (think of the utilities sector). Therefore, the fiscal multiplier in an economy calibrated to the data is larger than that of an equivalent but *symmetric* economy, in which $cov(MPC_s, MCS_s - ACS_s) = 0$. Notice that perfect symmetry across sectors is sufficient but not necessary for the covariance term to disappear. The amplification mechanism we propose would disappear in three cases: (i) if sectors are homogeneous in the marginal propensity to consume of their workers (so that there is no variation in MPC_s across sectors); (ii) if households spend at the margin precisely in the same proportion of their average expenditure (so that there is no variation in $MCS_s - ACS_s = 0$ across sectors); (iii) or, finally, if there is variation in both MPC_s and $MCS_s - ACS_s$, but this variation is uncorrelated, that is, household marginal expenditure is different from average expenditure, but it is not directed disproportionately towards high-MPC sectors. Instead, we find in the data that sectors are heterogeneous and that households direct their marginal consumption disproportionately towards high-MPC sectors. Using (1) and our estimates for the elements of the consumption network suggests that our mechanism raises the fiscal multiplier by around 10%.

In the quantitative section of the paper, we relax the assumption of perfect price rigidity, which leads to new insights on the dynamic response to a fiscal shock. As aggregate income increases after the fiscal shock, demand is endogenously directed towards sectors producing *discretionary* goods, while sectors with a relatively high *subsistence* component do not benefit as much. Since prices and wages respond to sectoral labor tightness, our model predicts a relative surge in wages and prices in *discretionary* sectors. To formalize this concept, we define two price indexes. The *marginal price index*, which is measured using as weights the *marginal* consumption shares, and the *average price index*, which uses as weights *average* consumption shares, similarly to the CPI. After a fiscal transfer, the inflation rate is higher when measured using the *marginal price index*. Since HTM households are disproportionately employed in *discretionary* sectors, this redistribution through prices and wages benefits more HTM households, further enhancing the mechanism described in equation (1) with rigid prices, which only operated through the quantity of labor. The cumulative output response to a fiscal shock is around 15% higher than in a comparable homothetic economy.

Related Literature. Households differ in their marginal propensity to consume (MPC) out of transitory income changes and the importance of redistribution between low and high-MPC households has been highlighted in several papers. Auclert (2019) and Bilbiie (2020) study its role for the transmission of monetary policy. Patterson (2019) finds that high MPC households are more exposed to the business cycle, and derives a reduced form *Matching Multiplier* which is similar in spirit to our equation 1. Patterson (2019) builds on a sufficient statistic approach, thus it does not provide an explanation for the greater exposure of high MPC households to the business cycle. We show that high MPC households tend to work in sectors that benefit from increased spending during expansions, as households spend their marginal income disproportionately towards these sectors. This mechanism can explain over half of the 20 percent amplification found in Patterson (2019).
Flynn, Patterson, and Sturm (2021) and Andersen and Straub (2022) use micro-data and disaggregated economic account to study the propagation of shocks in an economy with rich production and consumption networks. Within this line of research different households purchase different consumption baskets, meaning that they spend their income differently across sectors. However, the allocation of an extra unit of income across sectors does not depend on the nature of the shock, that is whether it is a transitory or a permanent income change. In this sense we see our work to be complementary to theirs, as we document sharp differences between the average consumption basket and the marginal consumption basket, and we study the effect of this heterogeneity for the transmission of shocks in a networked economy, while we abstract from the way consumption baskets differ across households. Our approach also leads to different quantitative results. While Flynn, Patterson, and Sturm (2021) finds a negative results, meaning that households' patterns of directed consumption across sectors (and regions) do not contribute meaningfully to multipliers, we find that households' consumption patterns across sectors can have sizable effects on the fiscal multiplier.

Another paper along this line is Almgren et al. (Forthcoming), finding that countries in the Euro-Area are heterogeneous in the fraction of HTM among their residents, and showing that the fraction of HTM is positively related to the output elasticity of that country to ECB's monetary policy.

Our paper is also related to a large literature on the importance of input-output networks in the propagation of shocks. For instance, Bouakez, Rachedi, and Santoro (2020) study the spending multiplier in a multi-sector economy, finding that input-output linkages strongly amplify the effectiveness of fiscal policy. Bouakez, Rachedi, and Santoro (2020) studies an economy with symmetric sectors and uses as a benchmark a one-sector economy, instead, we study the role of heterogeneity across sectors and use as a benchmark a multi-sector economy with symmetric sectors. Our work is also related to Baqaee and Farhi (2018) and Baqaee and Farhi (2022), who study the propagation of shocks through input-output and consumption networks. While their contributions are mostly on the theory side, where the main role is played by production rather than consumption networks, we emphasize the propagation of shocks through households' consumption behavior, providing new empirical evidence and assessing their quantitative implications for aggregate output.
The rest of the paper is organized as follows. Section 2 illustrates our empirical findings. Section 3 describes the model setup. Section 4 studies the amplification of fiscal policy deriving from our mechanism. Section 5 concludes.

2 Data

2.1 Heterogeneity in marginal propensity to consume

To study the heterogeneity of workers' propensity to consume across sectors, we need data on both household balance sheets and the sector in which household members work. The PSID (Panel Study of Income Dynamics) provides all such data, allowing us to compute the fraction of Hand-to-Mouth households among workers in each sector. We collect data from 2003 to 2019, corresponding to 9 survey waves. We obtain a panel with 16,685 households and 81,545 household-year observations.

The PSID reports, for both the reference person and the spouse, whether the person is working and, if so, in which sector. Sectors are classified with Census codes. To match these with NAICS industry codes, we use the Census-NAICS crosswalk from the U.S. Census Bureau. This procedure matches over 99.8 percent of reported sectors in PSID. Since we aggregate balance sheet information at the household level, we also need to assign households to different sectors. To do so, we use the NAICS code of the reference person. This is motivated by the observation that the fraction of reference persons out of employment is only 19.6 percent, while the same figure stands at 61.7 percent for spouses. Using the sector of employment of the reference person thus seems like a natural choice.

Once we have assigned each household to a sector, we proceed to classify them as HTM or non-HTM (Permanent income households in the terminology of the model). Following a methodology proposed in Kaplan, Violante, and Weidner (2014), we classify households as HTM if their liquid assets fall below half of their bi-weekly income. The intuition is that such low levels of assets suggest the presence of a binding borrowing constraint, with the household exhausting all the sources of liquidity in proximity to the arrival of the subsequent paycheck. Since these households are close to their borrowing constraint, we expect them to behave as hand-to-mouth, with the constraint breaking the equality of their Euler equation. We refer to KVW for a detailed description of the methodology and theoretical background.

KMV find that the HTM status is a strong predictor of the consumption response to transitory shocks. This provides support for the choice of using the fraction of HTM by sector as a proxy for the MPC, rather than directly estimating the MPC in each sector, a choice that we make because of two advantages. Firstly, it directly maps to our model environment with hand-to-mouth and permanent-income households. Secondly, estimating the fraction of HTM is feasible at essentially any level of disaggregation in the PSID, while estimating MPCs might quickly run into sample size issues as we move to disaggregated levels.
Using the illiquid wealth, we are also able to distinguish between poor and rich HTM, depending on whether they hold positive illiquid assets. However, for the purpose of our sectoral analysis, we focus only on the distinction between HTM and non-HTM. As shown in KVM, overall net worth is a poor predictor of the propensity to consume, contrarily to the HTM status.

Following KVW, we classify as liquid assets the sum of checking and savings accounts, plus financial assets other than retirement accounts (money market funds, certificates of deposit, savings bonds, and Treasury bills plus directly held shares of stock in publicly held corporations, mutual funds, or investment trusts), to which we subtract liquid debt. Before 2011, liquid debt is categorized as Debt other than mortgages, while after 2011 it only includes credit card debt. Household income is computed as the sum of the labor income of both partners, government transfers, and income from own business. By classifying households as HTM if liquid assets are above half of households' biweekly income, we are essentially imposing a zero borrowing constraint. Our results on the heterogeneity of HTM across sectors are essentially unchanged if we instead impose one month of income as the borrowing constraint, an arbitrary threshold often used in the literature (KMV, Almgren et al. (Forthcoming)).

We find that 53 percent of households are classified as HTM, roughly in line with the 46 percent found in KMV using PSID data.

The procedures outlined above allow us to compute the fraction of HTM households depending on their sector of employment. The main result we find is that sectors are strikingly heterogeneous in the fraction of HTM households they employ, ranging from 30 to 70 percent. This is our main motivating finding. Furthermore, these differences seem to be persistent throughout the two decades we study.

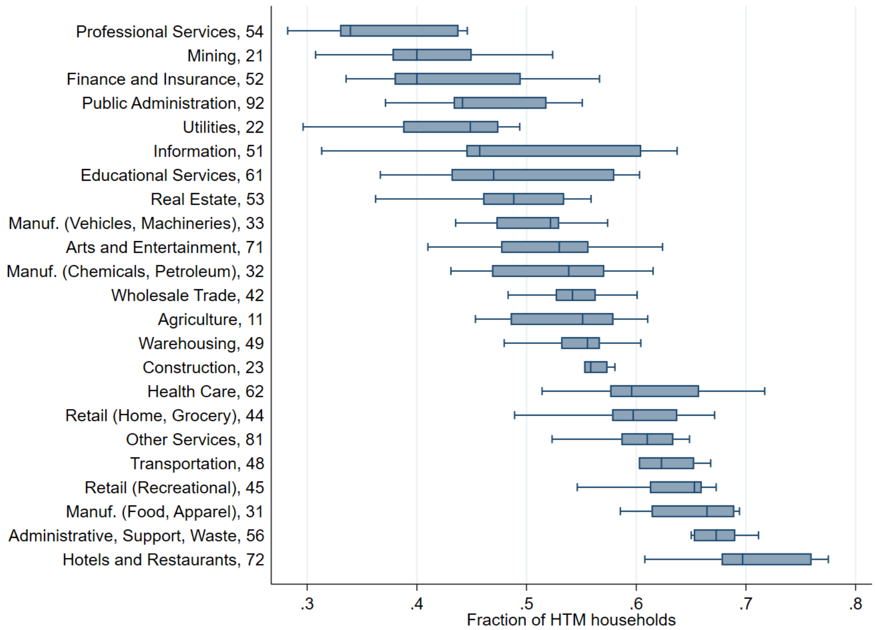

Figure 1: Fraction of Hand-to-Mouth households by industry of employment (two-digits NAICS code).

Given the striking magnitude of this sectoral heterogeneity, it is natural to wonder what drives the fraction of HTM households at the sector level. As one might expect, our results suggest that it is not the sector to make households hand-to-mouth, but rather it is households with a high propensity to be HTM that disproportionately sort into some sectors. When predicting the HTM status at the household level using a Probit regression, sectoral dummies have essentially no explanatory power once we include demographics and income. On the contrary, both demographics and income explain a substantial fraction of HTM status at the household level.

	(1)	(2)	(3)	(4)
Demographics*	✓	✓		
Income	✓		✓	
Precision	0.380	0.358	0.260	-
Adding sector dummy	0.382	0.367	0.276	0.167

* Years of education, age, white dummy, number of kids

Table 1: The precision is computed as the correlation between the HTM status predicted using observables and the actual HTM status.

Descriptive statistics at the sector level confirm this intuition by showing that high HTM sectors disproportionately employ workers with low education and low income. High HTM sectors also employ a substantially larger fraction of black workers. These sectoral statistics resonate with the finding in Patterson (2019) that low-income and black households have high MPC. What we are highlighting here is that these distinct demographic groups also tend to sort into different industries, effectively making some sectors high-MPC and others low-MPCs, which can have important consequences for the propagation of shocks, as we highlight in subsequent sections.

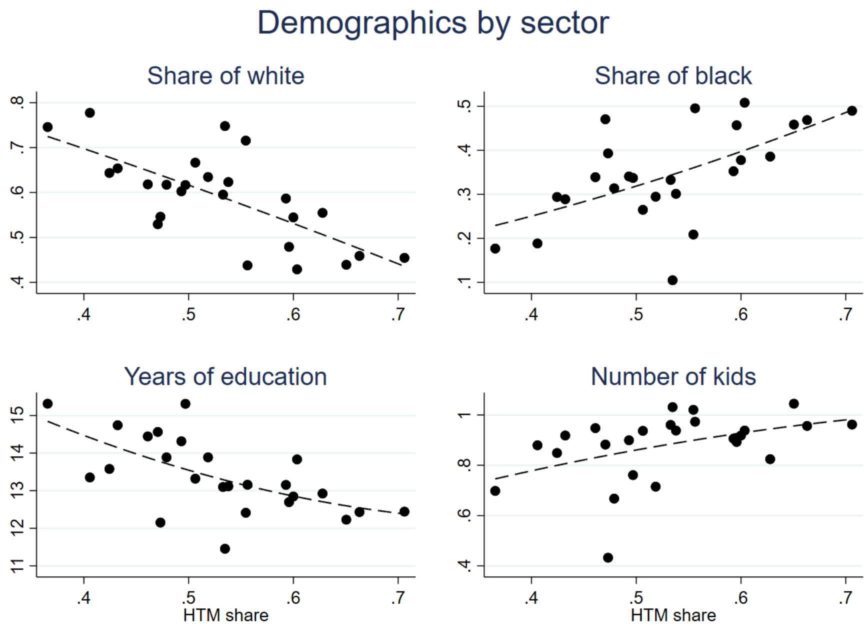

Figure 2: Households characteristics by 2-digits industries. Race and years of education are those of the reference person in the household.

2.2 The marginal consumption basket

We use data from the Consumer Expenditure Survey data to construct an estimate of the marginal consumption basket and the average consumption basket. To do so, we first use data from the 2008 Economic Stimulus Payments to estimate the marginal propensity to consume across goods produced in different sectors. The US government passed the Economic Stimulus Act of 2008 in February 2008 in response to the recession that started in December 2007. The main part of the Act was a $100-billion program of Economic Stimulus Payments (ESPs) designed to raise consumer demand. The ESPs averaged approximately $900 and were disbursed to US taxpayers in the spring and summer of 2008. The advantages of using the (ESPs) to estimate marginal propensity to consume have been widely discussed in the literature (Parker et al. (2013)), Broda and Parker (2014)), and we refer to those for a broader discussion of the ESPs. Let us just emphasize how the crucial aspect of our estimation strategy is that the timing of ESP disbursement was effectively randomized across households. Indeed, within each disbursement method (mostly bank account or mail), the timing of the payment was determined by the last two digits of the recipients' Social Security numbers, which are effectively randomly assigned.

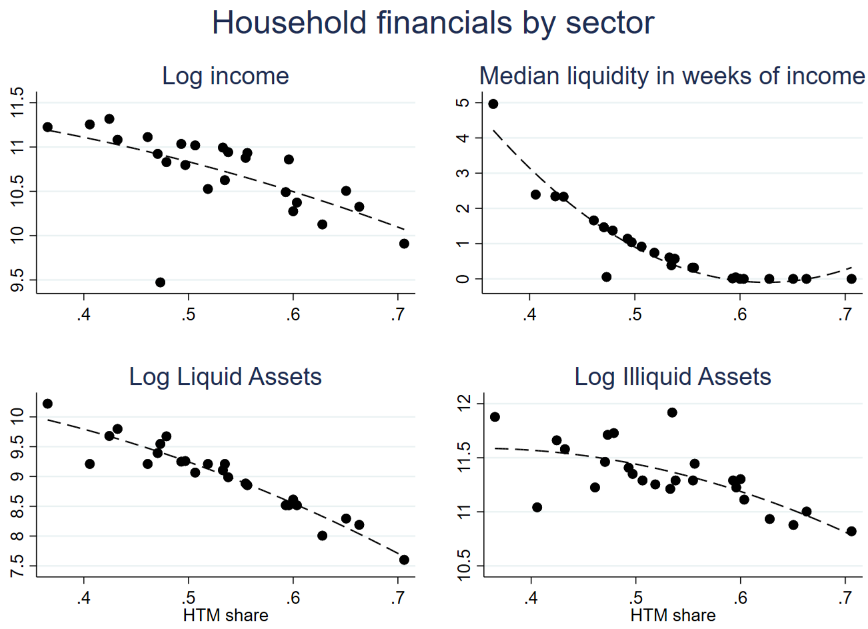

Figure 3: Households balance sheets by 2-digits industries. For the top right figure, we have computed in each sector the median across workers of the ratio between liquid assets and weekly income.

2.2.1 The Consumer Expenditure Survey

The Consumer Expenditure (CE) interview survey contains data on income, demographic variables, and detailed expenditures of a stratified random sample of US households. Approximately 10,000 addresses are contacted each calendar quarter which yields approximately 6,000 useable interviews. Households are interviewed four times, at three-month intervals, about their spending over the previous three months. Particularly relevant for our analysis are data on monthly expenditure for each good category, where each good category coincides with a UCC code. In our data, there are 588 different UCC codes. Then, we follow Hubmer (2022) and use a mapping constructed in Levinson and O'Brien (2019) to map each UCC code into a NAICS industry code. This way we construct a measure of monthly expenditure by NAICS code for each household in our sample. In practice, we aggregate monthly expenditures by industry at 2-digits and 3-digits NAICS level: we think that this level of aggregation is granular enough to study heterogeneity, but it is not too granular so that we can preserve some statistical power. Finally, we aggregate all expenditure data at the quarterly level to reduce the amount of noise for good categories associated with low-frequency purchases.

We use data from interview surveys for the period 1997:2013. Questions about the 2008 ESPs were added to the Consumer Expenditure survey in interviews conducted between June 2008 and March 2009, which coincides with the time during which the payments were disbursed to households. Households were asked if they received any "economic stimulus payments...also called a tax rebate" and, if so, the amount of each payment they received and the date the payment was received. We split the data into two samples: the main sample, including all the data 1997:2013, and a sub-sample with data 2007:2009. We use the entire sample to estimate the average consumption basket, and we use the sub-sample to estimate the marginal consumption basket. In Table 2 we report a few summary statistics as well as average expenditure by industry for the 2007:2009 sub-sample. The average amount received by households from ESP, conditional on receiving something, is $942 in our data, according to the last column of the first panel of Table 2. From Panel B one can see that households concentrate their expenditure in some industries: Utilities (22), Manufacturing (31-33), Finance and Insurance (52), Real Estate (53), Accommodation and Food Services (72), and Other Services (81).

Panel A: **Summary statistics**					
	Income	Expenditure	Age	Family size	ESP
Average	52,714	30,493	52	2.5	942
p25	14,010	14,887	40	1	600
p50	36,628	23,310	51	2	900
p75	73,243	36,417	64	3	1,200

Panel B: **Households' average expenditure and estimates of β_s**			
2-digits industry	Quarterly average expenditure	$100 \times \hat{\beta}_s$	$100 \times \mathrm{SE}(\hat{\beta}_s)$
Agriculture, 11	14.29	0.6**	(0.2)
Mining, 21	24.44	-0.4	(0.4)
Utilities, 22	564.50	-4.1**	(0.7)
Construction, 23	410.14	18.6	(16.1)
Manuf. (Food, Apparel), 31	1,637.38	4.5*	(2.2)
Manuf. (Chemicals, Petroleum), 32	769.64	5.8**	(1.9)
Manuf. (Vehicles, Machineries), 33	926.57	25.8*	(12.8)
Transportation, 48	148.70	2.5	(1.7)
Warehousing, 49	2.74	0.1	(0.1)
Information, 51	513.39	0.9	(0.6)
Finance and Insurance, 52	1,975.90	1.7	(2.5)
Real Estate, 53	856.37	1.8	(2.7)
Professional Services, 54	141.13	-0.4	(1.9)
Administrative, Support, Waste, 56	79.77	-0.2	(0.5)
Educational Services, 61	265.17	-9.8**	(3.5)
Health Care, 62	295.50	1.9	(2.1)
Arts and Entertainment, 71	60.47	1.1	(0.7)
Hotels and Restaurants, 72	710.52	6.1**	(2.2)
Other Services, 81	739.25	4.8	(4.0)

Table 2: Panel A displays some summary statistics for the sample 2007:2009. The second column of Panel B shows households' quarterly average expenditure by industry -aggregation is performed here at a two-digits level to make results easy to read- for the sample 2007:2009. The third and fourth columns of Panel B report point estimates and standard errors for β_s.

2.2.2 Estimate MPCs

We estimate MPCs using the same specification of Parker et al. (2013) that relies on two-way fixed effects. The novelty of our results with respect to the literature lies in the consumption measures we use on the left-hand side of (2). Indeed, while there are already estimates of MPCs by good categories (eg. food at home, apparels, housing services, etc.), we are the first to estimate marginal propensity to consume by industry, both at two-digits and three-digits levels. Note that because of the timing of interviews in the CEX, we have time fixed effects at monthly frequencies even if we aggregated expenditure data at quarterly frequencies. Indeed, we may have quarterly-level observations -for different households- for the quarters January-March and for the quarter February-April. The variable $ESP_{i,t}$ measures the ESP amount received by the household in that period, and $\boldsymbol{X}_{i,t}$ is a vector of controls, that includes the age of the reference person and changes in the size of the family.

$$C_{i,s,t+1} - C_{i,s,t} = \sum_j \beta_{0j} \times \text{ month }_{j,i} + \beta_s ESP_{i,t+1} + \boldsymbol{\beta}'_{X,s}\mathbf{X}_{i,t} + u_{i,t+1} \tag{2}$$

We estimate (2) for each industry s. The estimated coefficients β_s measure how much households spend in industry s when they face an unexpected increase in their income of 1\$. We report in Table 2 the estimates of β_s using expenditure data aggregated by two-digits industry. In some cases, the magnitude of the estimated coefficients β_s is aligned with the average expenditures reported in Table 2. However, for some industries, there are large differences. For instance, the values of β_s are particularly large for Construction (23), and for industry 33, which is the "branch" of Manufacturing (31-33) that produces more durable goods. Also, we obtain some negative values of β_s for some industries: Utilities (22) and Educational Services (61). Moreover, those negative values of β_s are statistically significant at the 10% level. The estimate of the marginal propensity to consume that we obtained using total expenditure on the left-hand side of (2) is 0.61.

2.2.3 Marginal and average consumption shares

The next step is to use our estimates of β_s to construct the marginal consumption basket. Let denote by β the value we obtain by estimating (2) using total expenditure on the left-hand side (i.e. the marginal propensity to consume). Then, we define the marginal consumption share of industry s as

$$MCS_s = \frac{\beta_s}{\beta}$$

Then, we estimate the average consumption shares by industries using our entire sample for the period 1997:2013. Similarly, to our previous analysis, we first aggregate expenditure at quarterly frequencies. To clean the data from heterogeneous trends in inflation across industries, we deflate expenditure by industry using five different price indexes: CPI core, CPI food and beverages, CPI fuel, CPI electricity, and CPI gasoline. Then, for each household and for each quarter, we divide consumption by industry by total consumption to construct a measure of relative consumption by industry. Finally, we average relative consumption across households and time to obtain our measure of average consumption share. We denote by ACS_s the average consumption share of industry s. In Figure 4 we plot the average consumption shares (red) and the marginal consumption shares (blue) for each 2-digits industry. One contribution of this section is to clearly establish, from our results in Figure 4, that the marginal consumption shares differ substantially from the average consumption shares. This result is not completely new. For instance, it is well known that the marginal consumption basket is biased towards durable goods. Our finding incorporates this result and makes it more general, as the heterogeneity that we find between the average and the marginal consumption shares goes way beyond the simple distinction between durable and non-durable goods.

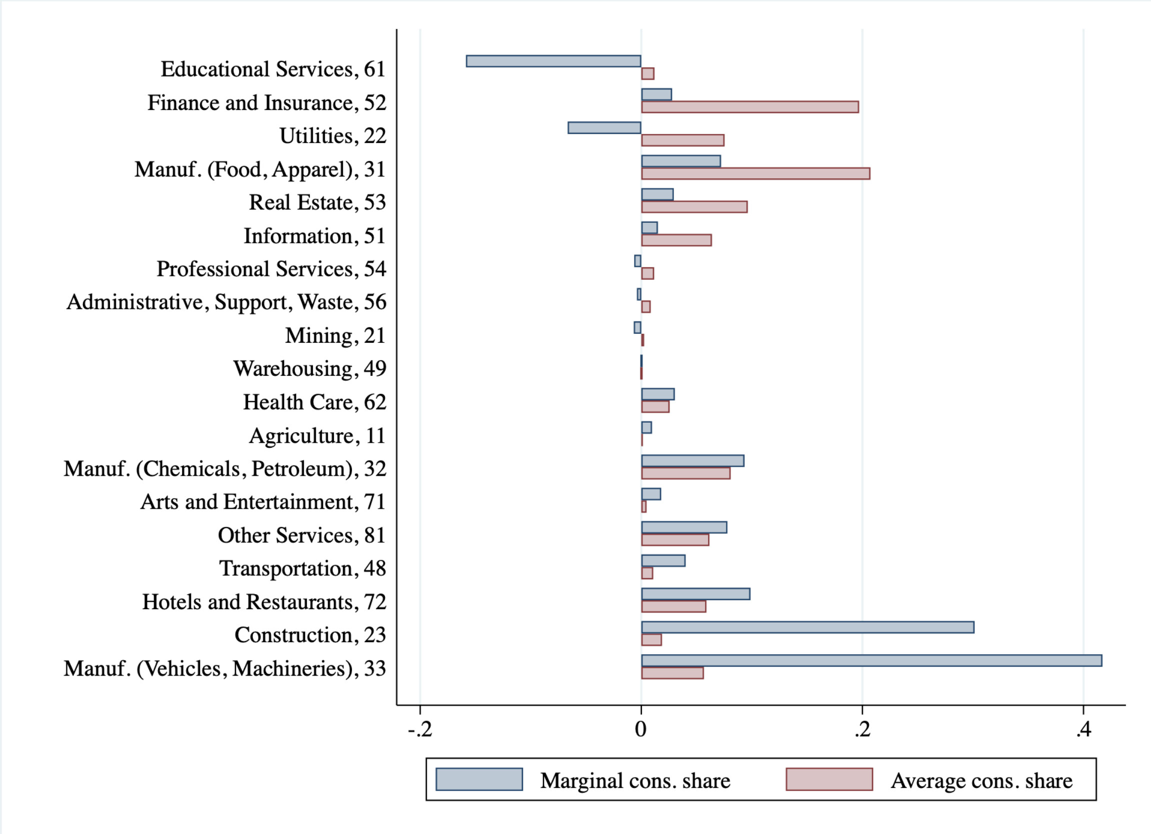

Figure 4: Estimates of marginal consumption shares (MCS) and average consumption shares (ACS) by 2-digits industries.

2.2.4 The average consumption basket and sectoral MPCs

The last empirical result of this paper is to show how the marginal consumption basket is biased toward industries whose employees have a high marginal propensity to consume. In other words, we find that on the margin households spend disproportionately more in sectors whose employees have a high marginal propensity to consume. This finding is particularly informative if one wants to evaluate the aggregate effect of fiscal policy: for the same aggregate average MPC, when households buy the marginal consumption basket instead of the average consumption basket, the fiscal multiplier will be larger. In Figure 5 we plot the difference between marginal consumption shares and average consumption shares on the y-axis, and the share of hand-to-mouth households employed in that industry on the x-axis: there is a positive correlation. To make this point clearer, we adopt the following strategy. We define $C_{i,HTM,t}$ as "expenditure towards hand-to-mouth households" and $C_{i,PIH,t}$ as "expenditure towards permanent-income households". Let H^s be the share of hand-to-mouth households employed in sector s, estimated in the previous section. Then, we have

$$C_{i,HTM,t} = \sum_s H^s \times C_{i,s,t}$$
$$C_{i,PIH,t} = \sum_s (1 - H^s) \times C_{i,s,t}$$

The idea is to use those measures of consumption to show in a clear way how the marginal consumption basket is biased towards sectors whose employees have higher MPC. In order to do so, we estimate (2) using $C_{i,HTM,t}$ and $C_{i,PIH,t}$ on the left-hand side. There are two advantages of this approach with respect to the results in Figure 5. First, there are two simple statistics to compare -that is β_{PIH}, β_{HTM}- rather than as many statistics as the number of industries we have. Second, we take advantage of the higher level of aggregation of expenditure data we use here to reduce noise and increase power. To be more clear, we estimate (3) and (4).

$$C_{i,PIH,t+1} - C_{i,PIH,t} = \sum_j \beta_{0j} \times \text{ month }_{j,i} + \beta_{PIH} ESP_{i,t+1} + \boldsymbol{\beta}'_{X,PIH} \mathbf{X}_{i,t} + u_{i,t+1} \quad (3)$$

$$C_{i,HTM,t+1} - C_{i,HTM,t} = \sum_j \beta_{0j} \times \text{ month }_{j,i} + \beta_{HTM} ESP_{i,t+1} + \boldsymbol{\beta}'_{X,HTM} \mathbf{X}_{i,t} + u_{i,t+1} \quad (4)$$

We report the estimates of β_{PIH}, β_{HTM} in Table 3. As one can see from the first row, out of a marginal expenditure of 61$, households spend 36$ "towards hand-to-mouth households" and only 26$ "towards permanent-income households". Note that the average expenditure does not have this bias: out of an average expenditure of 100%, households spend 49$ "towards hand-to-mouth households" and 51$ "towards permanent-income households". Since Orchard, Ramey, and Wieland (2023) highlighted that expenditures data related to the Automotive sector around the rebate period might lead to some inconsistencies, we perform the same exercise by leaving out expenditure towards the Automotive sector when constructing $C_{i,HTM,t}$ and $C_{i,PIH,t}$ and we find similar results.

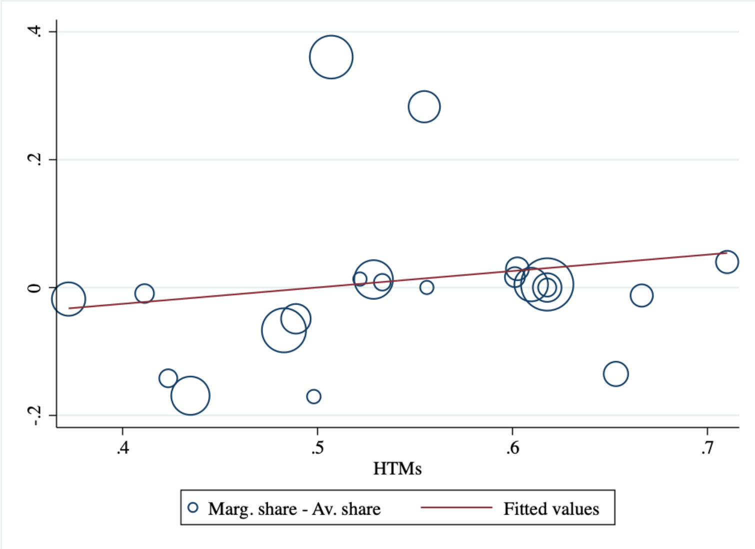

Figure 5: Each circle represents a 2-digits industry, weighted by its value-added. The y-axis captures the difference between marginal consumption share and average consumption share ($MCS_s - ACS_s$). On the x-axis, there is the share of hand-to-mouth households employed in that industry.

	(1)	(2)	(3)
	β	β_{PIH}	β_{HTM}
Baseline	0.61^{**}	0.26^{*}	0.36^{**}
	(0.22)	(0.08)	(0.10)
Excluding cars	0.32	0.13	0.19
	(0.18)	(0.08)	(0.10)

Table 3: The first column reports the estimate of β from the estimation of (2) using total expenditure on the left-hand side. The second and third column report estimates of β_{PIH}, β_{HTM} from the estimation of (4),(3). Standard errors are reported in parenthesis. In the second row we perform the same exercise, but we leave out from our consumption measures any expenditure in the Automotive sector.

3 Model

To study the consequences of our empirical findings, we build a multi-sector, two-agent, new-Keynesian model. The economy is composed of S sectors. Within each sector, there is monopolistic competition among firms producing heterogeneous varieties of the same good. Firms in sector s use labor and intermediate goods from other sectors to produce. Firms can sell their products to households as a final good and to other firms as an intermediate good. We assume that labor is immobile across sectors: each worker is employed in a specific sector, and cannot move across sectors. In the tradition of two-agent models of Galí, López-Salido, and Vallés (2010), Bilbiie (2008), there are two types of workers: permanent-income households (PIH), who behave according to the permanent income hypothesis, and hand-to-mouth households (HTM), who don't have access to financial markets and simply consume their income in every period. The share of PIH and HTM households in each sector is exogenous, so there is heterogeneity in the average MPC of households employed in different sectors. Firms' profits are rebated to PIH households, and the only securities available to households are government bonds. Following standard practice in the New Keynesian sticky-wage literature, labor hours are determined by a labor union. We extend Erceg, Henderson, and Levin (2000), Schmitt-Grohé and Uribe (2005) to our multi-sector economy, where we have sectoral unions and input-output networks. Finally, we allow for non-homothetic preferences, which we model through a subsistence component of demand. Consistently with our empirical findings, with non-homothetic preferences, the marginal consumption basket can differ from the average consumption basket, in a much more general way than what the standard distinction between durables and non-durables would allow.

3.1 Preferences

Household of type $i \in \boldsymbol{S} \times \{\text{HTM,PIH}\}$ has preferences over consumption and labor given by the separable utility function $U(c_t^i, n_t^i)$:

$$U(c_t^i, n_t^i) = u(c_t^i) - v(n_t^i) \tag{5}$$

Households derive consumption utility through the consumption aggregator c_t^i, which aggregates the consumed quantities of goods in each sector according to (6). We follow Fanelli and Straub (forthcoming), and Auclert et al. (2021), and assume agents consume a Stone-Geary CES bundle with a non-negative subsistence need m_s for each sector. Therefore, utility is derived from total consumption of goods in sector s, q_{st}^i, net of the sector-specific subsistence level of consumption m_s, which is the same for all i.

Let us denote the discretionary level of consumption in sector s by $c^i_{st} = q^i_{st} - m_s$.

$$c^i_t = \Big[\sum_s \alpha_s^{\frac{1}{\eta}} (q^i_{st} - m_s)^{\frac{\eta-1}{\eta}}\Big]^{\frac{\eta}{\eta-1}} \tag{6}$$

Where notice that total (q^i_{st}) and discretionary (c^i_{st}) consumption are time-varying, while subsistence consumption (m_s) is not. For notation convenience, we drop the time subscript in the derivation of consumption and input demand.
There is monopolistic competition within each sector s, with a continuum of varieties, with measure one, indexed by j. Both the subsistence and the discretionary demand are a CES aggregate of such differentiated varieties so that the consumption basket by household i at time t from all varieties within sector s is aggregated according to:

$$q^i_{st} = \underbrace{\left(\int_0^1 c^i_{st}(j)^{\frac{\epsilon-1}{\epsilon}} dj\right)^{\frac{\epsilon}{\epsilon-1}}}_{c^i_{st}} + \underbrace{\left(\int_0^1 m_{st}(j)^{\frac{\epsilon-1}{\epsilon}} dj\right)^{\frac{\epsilon}{\epsilon-1}}}_{m_{st}} \tag{7}$$

where j denotes different varieties of the goods produced in sector s, and ϵ is the elasticity of substitution between different varieties of goods produced in sector s. Setting up the problem as in (7) allows for a clean aggregation at the variety level, with producers charging a constant markup over production costs. We defer the derivations of consumption and input at the variety-level to Appendix D, and focus here on the choice at the sector-level.

The optimal choice of discretionary consumption c^i_{st} solves:

$$\max_{\{c_{st}\}_s} \Big[\sum_s \alpha_s^{\frac{1}{\eta}} (c^i_{st})^{\frac{\eta-1}{\eta}}\Big]^{\frac{\eta}{\eta-1}} \quad \text{s.t. } P_t c_{it} = \sum_s P_{st} c^i_{st} \tag{8}$$

which leads to the following consumption demand:

$$c^i_{st} = \alpha_s \left(\frac{P_{st}}{P_t}\right)^{-\eta} c^i_t \tag{9}$$

Subsistence demand for goods of sector s is m_s by construction. Therefore, the total consumption demand for goods produced in sector s is

$$q_s = m_s + \alpha_s \left(\frac{P_{st}}{P_t}\right)^{-\eta} C_t \tag{10}$$
$$\text{with } C_t = \sum_i c^i_t$$

This concludes the derivation of consumption demand for sector s goods. We next turn to derive the input demand.

3.2 Firms

3.2.1 Inputs' choice

All firms in sector s produce with the same CES technology, using labor N_{st} and a composite bundle of intermediate goods from other sectors X_{st}.

$$y_{st} = Z_{st}\Big(\omega_s^{\frac{1}{v}}(N_{st})^{\frac{v-1}{v}} + (1-\omega_s)^{\frac{1}{v}}(X_{st})^{\frac{v-1}{v}}\Big)^{\frac{v}{v-1}} \tag{11}$$

$$\text{with} \qquad X_{st} = \Big(\sum_k \delta_{sk}^{\frac{1}{\gamma}} x_{skt}^{\frac{\gamma-1}{\gamma}}\Big)^{\frac{\gamma}{\gamma-1}}, \qquad \sum_k \delta_{sk} = 1$$

There is a continuum of differentiated varieties, denoted by j, of goods produced in sector k. Therefore, just like for consumers, x_{skt} is an aggregator of varieties j produced in sector k according to (12). For simplicity, we impose that the elasticity of substitution across different varieties ϵ is the same for households that demand final goods and for firms that demand intermediate goods.

$$x_{skt} = \Big(\int_0^1 x_{skt}(j)^{\frac{\epsilon-1}{\epsilon}} dj\Big)^{\frac{\epsilon}{\epsilon-1}} \tag{12}$$

Just like for consumption, we defer to Appendix D the derivation of demand at the variety-level, and focus on the upper nest of sector-level input demand.

The optimal demand for intermediates from sector k by firms in sector s is characterized by (13). Given prices P_s^t, producers will demand

$$x_{sk} = \delta_{sk}\Big(\frac{P_k}{PPI_{st}}\Big)^{-\gamma} X_{st} \tag{13}$$

where PPI_{st} is the *Producer Price Index* for producers in sector s, which is defined in (14).

$$PPI_{st} = \Big(\sum_k \delta_{sk} P_{kt}^{1-\gamma}\Big)^{\frac{1}{1-\gamma}} \tag{14}$$

By solving the outward nest, the demand for labor and the composite bundle of intermediate goods for firms in sector s are characterized in (15), (16).

$$N_{st} = \omega_s\Big(\frac{W_{st}}{PC_{st}}\Big)^{-v} y_{st}/Z_{st} \tag{15}$$

$$X_{st} = (1-\omega_s)\Big(\frac{PPI_{st}}{PC_{st}}\Big)^{-v} y_{st}/Z_{st} \tag{16}$$

where PC_{st} denotes *Producer Cost* in sector s. Producer Cost is defined in (17) and it satisfies (18)

$$PC_{st} = \Big(\omega_s W_{st}^{1-v} + (1-\omega_s)PPI_{st}^{1-v}\Big)^{\frac{1}{1-v}} \tag{17}$$

$$PC_{st} y_{st}/Z_{st} = W_{st}N_{st} + PPI_{st}X_{st} \tag{18}$$

3.2.2 Pricing rule and dividends

To characterize the optimal pricing rule in this monopolistic competitive environment, we need an equation for the total demand of variety j produced by firms in sector k. We show in Appendix that the total demand for variety j in sector k can be written as:

$$y_{kt}(j) = \left(\frac{P_{kt}(j)}{P_{kt}}\right)^{-\epsilon} \underbrace{\left[q_k + \sum_s x_{skt}\right]}_{Q_{kt}} \tag{19}$$

where q_k is defined in (10) and x_{skt} is defined in (13).
Each firm takes Q_{kt} as given, and simply solves (20) to maximize profits[4]

$$\max_{P_{kt}(j)} \left[P_{kt}(j) - \frac{PC_{kt}}{Z_{kt}}\right] \left(\frac{P_{kt}(j)}{P_{kt}}\right)^{-\epsilon} Q_{kt} \tag{20}$$

Therefore, under the assumption of flexible prices, and since $P_{kt}(j) = P_{kt}$, we obtain (21)

$$P_{kt} = \frac{\epsilon}{\epsilon - 1} \frac{PC_{kt}}{Z_{kt}} \tag{21}$$

We can finally derive an expression for dividends in (22):

$$D_t = \sum_s \frac{y_s}{Z_s} \Big(\frac{\epsilon}{\epsilon - 1} PC_s - \omega_s \Big(\frac{W_{st}^{1-v}}{PC_{st}^{-v}} \Big) - (1 - \omega_s) \Big(\frac{PPI_{st}^{1-v}}{PC_{st}^{-v}} \Big) \Big) \tag{22}$$

3.3 Two-agents block

Within each sector, there are two types of workers: hand-to-mouth (HTM) workers, and workers that behave according to the permanent income hypothesis (PIH). Since labor is immobile, workers are not allowed to change the sector of employment. Therefore, a worker is characterized by type $i \in \boldsymbol{S} \times \{\text{HTM}, \text{PIH}\}$ and cannot change type. Let H^s be the share of HTM workers in sector s, so that the remaining $(1 - H^s)$ workers behave according to the permanent income hypothesis (PIH). In sector s, HTM and PIH households consume $c_t^{s,PIH}, c_t^{s,HTM}$, and we define total consumption of workers employed in sector s as

$$c_t^s = (1 - H^s) \times c_t^{s,PIH} + H^s \times c_t^{s,HTM}$$

[4]Note that profits are equal to

$$P_{kt}(j) y_{kt}(j) - \underbrace{W_{kt} N_{kt} - PPI_{kt} X_{kt}}_{= PC_{kt} y_{kt}(j) / Z_{kt}}$$

where the underbraced identity follows from the definition Producer Costs.

To incorporate subsistence consumption in this framework, let us denote by M the sum of subsistence consumption across sectors, $M = \sum_s m_s$, and by P_t^M a price index such that $(P_t^M M)$ is the total expenditure on subsistence goods[5].

The household that behaves according to the PIH chooses consumption and assets to solve a standard consumption-savings problem. Dividends are rebated to PIH households only, and they are equally distributed to PIH households employed in different sectors. Therefore, each PIH household will receive an amount equal to d_t in every period according to (23), where D_t are total dividends in the economy.

$$d_t = \frac{D_t}{\sum_s (1 - H^s)} \tag{23}$$

We write the budget constraint of PIH households in nominal terms, where $a_t^{s,PIH}$ is nominal asset holdings, and i_{t-1} is a predetermined nominal interest rate. Let denote by $DI(W_t^s N_t^s)$ after-tax income (disposable income), and by $T_t^{s,PIH}$ potentially targeted lump-sum transfers.

$$\begin{aligned}
&\max_{\{c_t^{s,PIH}, a_{t+1}^{s,PIH}\}} \sum_{t=0}^{\infty} \beta^t u(c_t^{s,PIH}) \\
\text{s.t.} \quad & P_t^M M + P_t c_t^{s,PIH} + a_t^{s,PIH} \leq a_{t-1}^{s,PIH}(1 + i_{t-1}) + DI(W_t^s N_t^s) + d_t + T_t^{s,PIH} \\
& \text{given } a_0^{PIH,s}
\end{aligned}$$

The problem of PIH households employed in sector s is summarized by the budget constraint and by the Euler equation for discretionary consumption:

$$u'(c_t^{s,PIH}) = \beta \mathbb{E}\left[(1 + i_t)\frac{P_t}{P_{t+1}} u(c_{t+1}^{s,PIH})'\right] \tag{24}$$

The discretionary consumption function of HTM workers is simply equal to their real income, net of expenditures on subsistence goods:

$$c_t^{s,HTM} = \frac{DI(W_t^s N_t^s) + T_t^{s,HTM} - P_t^M M}{P_t} \tag{25}$$

3.4 Unions

Wages in each sector are set by unions, which face quadratic adjustment costs. We follow the literature and we impose rationing in a symmetric way, so that each worker within the same sector works the same amount of hours N_{st}. This problem differs from standard unions' setup in the literature because of the multi-sector structure of the economy and because of input-output networks. The latter matters because it

[5]We define $P_t^M = \sum_s P_{st}(m_s/M)$

affects $\partial N_{s,t}/\partial W_{s,t}$, that is, it affects the elasticity of labor demand. Intuitively, it is possible that if labor and inputs are strong substitutes, the unions lose market power. When computing $\partial N_{s,t}/\partial W_{s,t}$, we need to understand which prices the union is going to affect by raising wages. We assume that sectoral unions set wages at the firm-level, since this approach has the advantage that the union takes prices as given, thus simplifying the problem. If instead unions set wages at the sector-level, they should take into account not only the effect of their decision on prices in their own sector but also the effect on prices of other sectors, since quantities produced in each sector will in turn affect demand for other goods through the input-output network.

Union in sector s sets wages W_t^s in order to maximize a weighted average of households' utility in sector s subject to quadratic adjustment costs, according to (26).

$$\max_{W_{st}} \quad \sum_t \beta^t \left\{ (1 - H^s) \times u(c_t^{s,PIH}) + H^s \times u(c_t^{s,HTM}) - v(N_{st}) - \frac{\phi}{2} \left(\frac{W_{st}}{W_{st-1}} - 1 \right)^2 \right\} \tag{26}$$

where notice that we used the fact that workers in the same sector work the same number of hours irrespectively of their HTM status.

To solve the problem, we can write c and N as functions of the wage chosen by the union.

Once the union sets the wage, the quantity of labor is pinned down by firm labor demand. Since firms within a sector use the same production technology, firm labor demand is just the firm-level equivalent of sector labor demand in(15):

$$N_{st}(j) = \omega_s \Big(\frac{W_{st}(j)}{PC_{st}(j)} \Big)^{-v} y_{st}(j) / Z_{st} \tag{27}$$

to understand the incentives of the union, it is useful to write down the full expression for $y_{st}(j)$ in (15), as derived in (73) in Appendix D:

$$N_{st}(j) = \omega_s \Big(\frac{W_{st}(j)}{PC_{st}(j)} \Big)^{-v} \frac{1}{Z_{st}} \left(\frac{P_{kt}(j)}{P_{kt}} \right)^{-\epsilon} y_{kt} \tag{28}$$

Sectoral output y_{kt} and sectoral price P_{kt} are outside of the influence of the single firm and union. Instead, when contracting with firm j, the union takes into account the way it affects labor demand through $W_{st}(j)$, and thus also indirectly through $PC_{st}(j)$ and $P_{st}(j)$[6].

[6]Indeed, a change in $W_{st}(j)$ will affect total Producer Costs, as well as prices through the optimal

With some manipulations of (28), we obtain the following expression for the firm-level elasticity of labor demand:

$$\frac{\partial N_s^t(j)}{\partial W_s(j)} \frac{W_s^t(j)}{N_s^t(j)} = -\epsilon \times \left[\frac{W_s N_s}{PC_s y_s / Z_s} \right] - v \times \left[1 - \frac{W_s N_s}{PC_s y_s / Z_s} \right] \tag{29}$$

The elasticity which is relevant to the union is a weighted average between the elasticity of substitution across varieties ϵ and the elasticity of substitution across labor and intermediate inputs v, where the weights are the cost shares of labor and intermediate inputs. Intuitively, the more the firm is labor-intensive, the more the elasticity of labor demand is disciplined by ϵ. Conversely, the less the firm is labor-intensive, the more the elasticity of labor demand is disciplined by v. This characterization of the union problem in a setting with Input-Output networks is a stand-alone contribution of the paper, which goes beyond the application in the context of fiscal policy that we discuss throughout the paper.

3.5 Government

In each period, the government can issue debt B_t, it can make transfers to households $\{T_t^{s,HTM}, T_t^{s,PIH}\}_{s \in \mathcal{S}}$, which can be targeted or un-targeted, and collect labor income taxes from households. We consider a proportional labor income tax so that the disposable income of households of type i is

$$DI(W_t^i N_t^i) = (1 - \tau_t) \times W_t^i N_t^i$$

The present-value budget constraint of the government must hold according to (30), where T_t is the sum of all period t transfers, and $Taxes_t$ are total taxes collected from households in period t given the tax rate τ_t.

$$(1 + r_{-1}) B_{-1} + \sum_{t=0}^{\infty} \left(\prod_{s=0}^{t-1} \frac{1}{1 + r_s} \right) T_t = \sum_{t=0}^{\infty} \left(\prod_{s=0}^{t-1} \frac{1}{1 + r_s} \right) \underbrace{\sum_s \tau_t \times W_{st} N_{st}}_{Taxes_t} \tag{30}$$

While we restrict the government to running a balanced-budget fiscal policy in the long run, we allow for short-run debt-financed fiscal policy. To do so, we parameterize the persistence of government debt by ρ_B according to (31). In the extreme case of

pricing rule as

$$PC_{st}(j) = \left(\omega_s W_{st}(j)^{1-v} + (1 - \omega_s) PPI_{st}^{1-v} \right)^{\frac{1}{1-v}}, \qquad P_{st}(j) = \frac{\epsilon}{\epsilon - 1} \frac{PC_{st}(j)}{Z_{st}}$$

$\rho_B = 0$, the government must balance its budget period by period. Therefore, the government chooses a sequence of tax rates $\{\tau_t\}_t$ such that (32) holds in each period, given a sequence of total transfers and debt $\{T_t, B_t\}_t$ that satisfy (31).

$$B_t = B_{-1} + \rho_B \big((B_{t-1} - B_{-1}) + \underbrace{(T_t - T_{-1})}_{\text{Transfer Shock}} \big) \tag{31}$$

$$B_t = (1 + r_{t-1}) B_{t-1} + G_t - \underbrace{\sum_s \tau_t \times W_{st} N_{st}}_{Taxes_t} \tag{32}$$

Finally, the monetary authority sets a Taylor rule for the nominal interest rate according to (33), where π_t is a measure of price inflation. Note that in our framework there is not an obvious choice for a price index to be targeted by the monetary authority. For now, we consider a Taylor rule that targets the consumer price index P_t. Note that i_{ss}, π_{ss} denote steady-state values for the nominal interest rate and the inflation index.

$$i_t = i_{ss} + \phi_\pi (\mathbb{E}[\pi_{t+1}] - \pi_{ss}) \tag{33}$$

3.6 Equilibrium

Given an exogenous sequence of transfers $\{T_t^{s,HTM}, T_t^{s,PIH}\}_{t=0}^{\infty}$, initial conditions for households' assets $\{a_{-1}^{s,PIH}\}_{s \in S}$, a recursive equilibrium is a sequence of quantities, prices, and taxes such that *(i)* all households optimally choose consumption across sectors, *(ii)* permanent-income households optimally choose next-period assets, *(iii)* firms optimally choose labor, intermediate inputs, and goods' prices, *(iv)* unions optimally set wages, *(v)* the government present-value budget constraint is satisfied, *(vi)* all the S goods markets clear, *(vii)* all the S labor markets clear, *(viii)* the asset market clears.

4 Fiscal policy with non-homothetic preferences

4.1 Analytical results

In this section, we make a few assumptions that substantially simplify the model and help derive some analytical results on the first-order effect of fiscal policy in this economy. The advantage lies not only in the higher tractability but also in leaving out many channels that, though important, are not the core of the mechanism we propose. The cost of this simplification is ignoring dynamic consideration on demand, as well as inflation dynamics and strategic complementarities in production.

The first important restriction we impose is to consider a perfectly sticky wages limit of our model, which is achieved when $\phi \to \infty$ in the union problem laid out in (26). Note that from the optimal pricing rule in (21), this condition also implies perfectly sticky prices. This assumption also rules out any dynamics coming from the Unions' block of the model. The second important restriction is to restrict our attention to fiscal policy that is fully funded by government debt. Note that, since PIH households are Ricardian, this assumption implies that these households have a zero MPC out of a government transfer, as their permanent income is unchanged. This assumption rules out any dynamics associated with the Euler equation. Since Unions' first-order conditions and households' Euler equation are the only dynamic equations in our model, it follows that any result implied by these assumptions will be static. In order to make fiscal policy not dependent on the initial stock of government debt, we consider a "zero-liquidity" steady-state, where the stock of government debt and households' assets are equal to zero. Without loss of generality, we further impose $\epsilon \to \infty$ to make our results cleaner. Finally, we consider for now only un-targeted fiscal policy interventions, so that transfers are proportional to labor income. To simplify the derivation of proposition 1, we further assume that the production function is Cobb-Douglas, meaning $v = \gamma = 1$. This is without loss of generality, given our assumption of perfectly sticky prices.

In Proposition 1 we explicitly characterize the effect on aggregate output of untargeted transfers fully funded with government debt, up to a first-order approximation. Before formally stating our result, let us provide some notation. First, a notion of aggregate output is needed. To be consistent with the data, and specifically with BEA input-output tables, we define aggregate output as the sum of value added across industries. This definition comes naturally and with fewer concerns than it would in a model with flexible prices. Moreover, the distinction between nominal and real variables is not relevant when working with percentage deviations from steady state, because prices are fully rigid. In this environment, we define sectoral value added as the difference between total output and the composite bundle of intermediates. In the Cobb-Douglas case, it is easy to show that sectoral value added is just a share ω_s of sectoral output.

Because of the way we modeled non-homotheticity in households' preferences, the marginal consumption share of sector s, defined in (34), is simply equal to α_s

$$MCS_s = \frac{d(p_j m_j + p_j c_j)}{d(P_M M + P_C C)} = \alpha_s \tag{34}$$

Let us denote by $\mathcal{C}, \mathcal{T}, \mathcal{H}$ three matrices, with size $S \times S$. We define $\mathcal{C}$ in (35) as the matrix of the consumption network, whose column s maps an increase in production in sector s to an increase in demand in all the other sectors. When production in sector s increases by one unit, labor income of workers in sector s increases by the labor share ω_s. For each dollar increase in labor income, household expenditure in sector s increases by MPC_s. Though MPC_s is an endogenous equilibrium object, we show in Appendix A that after an un-transfer fiscal transfer, we simply have $MPC_s = H_s$, since HTM households spend all the extra income, while PIH households don't change their consumption in response to the shock [7]. Therefore, household expenditure increase by $\omega_s H_s$. A fraction α_k of this increase, that is the marginal consumption share of sector k, is spent on sector k's goods.

$$\{\mathcal{C}\}_{ks} = \alpha_k \omega_s H_s \tag{35}$$

We define $\mathcal{H}$ in (36) as a matrix that maps an increase in household income in sector s to an increase in demand in all the other sectors. Note that the only difference between elements of $\mathcal{C}$ and $\mathcal{H}$ is the labor share ω_s.

$$\{\mathcal{H}\}_{ks} = \alpha_k H_s \tag{36}$$

We define $\mathcal{T}$ in (37) as a standard input-output matrix. When production in sector s increases by one unit, firms in sector s increase their intermediate demand by the intermediate share, $(1 - \omega_s)$, and this demand is directed across sectors depending on the input shares δ_{sk}.

[7] The result that PIH households don't change their consumption in response to the shock is more than a Ricardian equivalence. Not only PIH households do not respond to the transfer, since they anticipate higher future taxes, but they do not respond to the economic boom either. The reason is that the initial boom reverts in a small recession in future periods, since HTM workers cut back consumption to pay the tax. Under rigid prices, this equilibrium persistent recession is precisely large enough so that the cumulative discounted output response is zero. Therefore, the permanent income of PIH households is unchanged even after accounting for GE effects.

$$\{\mathcal{T}\}_{ks} = (1 - \omega_s)\delta_{sk} \tag{37}$$

Finally, let us denote by $\boldsymbol{\omega}$ the $(S \times 1)$ vector of labor shares ω_s. This vector is needed to map the changes in sectoral output into changes in sectoral value added, whose sum captures the change in aggregate output.

Proposition 1: Consider a stationary equilibrium, with $\phi \to \infty$, $\epsilon \to \infty$, and $B_{-1} = 0$. The first-order effect of un-targeted transfers fully funded with government debt on aggregate output, on impact, is characterized by (41).

$$dY \approx \boldsymbol{\omega}' \underbrace{(\mathcal{I} - \mathcal{T} - \mathcal{C})^{-1}}_{\text{amplification}} \underbrace{(\mathcal{H}\ d\boldsymbol{T})}_{\text{first round}} \tag{38}$$

The intuition behind (41) is as follows. Note that the "primitive" shock to the production structure is the increase in sectoral demand implied by the transfer. This effect is captured by the product $(\mathcal{H}\ d\boldsymbol{T})$, which maps the fiscal transfers into sectoral demand; this effect can also be thought of as the "first round" of a Keynesian cross. The effect of this first round is further amplified by a generalized Keynesian cross. This amplification mechanism is captured by the inverse $(\mathcal{I} - \mathcal{T} - \mathcal{C})^{-1}$, which recalls both a Leontief inverse from the IO literature and a Keynesian cross from the fiscal policy literature. The spirit of Proposition 1 is similar to results in Baqaee and Farhi (2018) and Flynn, Patterson, and Sturm (2021), which study general networked economies and some applications to fiscal policy. Our result in (41) differs from similar results in the literature in the assumptions that we made. Indeed, the aggregate effect of a fiscal transfer is pinned down by just two groups of parameters: the input-output network structure of the economy, characterized by $\{\{\delta_{sk}\}_{k\in\mathcal{S}}, \omega_s\}_{s\in\mathcal{S}}$, and the consumption network structure of the economy $\{\alpha_s, H_s\}_{s\in\mathcal{S}}$.

Since (41) does not depend on many parameters, we find it ideal to provide a first quantification of our mechanism. In practice, we would like to compare the effect of fiscal policy on aggregate output when the values of $\{\alpha_s\}_{s\in\mathcal{S}}$ are equal to the marginal consumption share $\{MCS_s\}_{s\in\mathcal{S}}$ we estimated in the data, with an alternative case in which the α_s's are equal to the estimated average consumption shares $\{ACS_s\}_{s\in\mathcal{S}}$. For this purpose, let us define the following matrices $\mathcal{C}^{marg}, \mathcal{H}^{marg}, \mathcal{C}^{aver}, \mathcal{H}^{aver}$ as

$$\{\mathcal{C}^{marg}\}_{ks} = \omega_s MCS_k H_s \qquad \{\mathcal{H}^{marg}\}_{ks} = MCS_k H_s$$
$$\{\mathcal{C}^{aver}\}_{ks} = \omega_s ACS_k H_s \qquad \{\mathcal{H}^{aver}\}_{ks} = ACS_k H_s$$

Then, we define the effect of aggregate output using marginal consumption shares (MCS) and average consumption shares (ACS) respectively as dY^{marg}, dY^{aver}, such that

$$dY^{marg} \approx \boldsymbol{\omega}'(\mathcal{I} - \mathcal{T} - \mathcal{C}^{marg})^{-1} \left(\mathcal{H}^{marg}\, d\boldsymbol{T}\right)$$
$$dY^{aver} \approx \boldsymbol{\omega}'(\mathcal{I} - \mathcal{T} - \mathcal{C}^{aver})^{-1} \left(\mathcal{H}^{aver}\, d\boldsymbol{T}\right)$$

We use BEA input-output tables to calibrate $\{\{\delta_{sk}\}_{k\in S}, \omega_s\}_{s\in S}$, by choosing 2018 as a reference year. Then, we use our results from Section 2.1 for values of $\{H_s\}_{s\in S}$, and our results from Section 2.2 for values of $\{ACS_s, MCS_s\}_{s\in S}$. We are interested in the increase of aggregate output per dollar spent in fiscal transfers, that is $dY/(\mathbb{1}' d\boldsymbol{T})$. The fiscal multiplier of transfers is 10% larger with marginal consumption shares than it is with average consumption shares. [8].

$$\frac{dY^{aver}}{\mathbb{1}' d\boldsymbol{T}} = 1.27 \qquad\qquad \frac{dY^{marg}}{\mathbb{1}' d\boldsymbol{T}} = 1.37$$

In other words, our findings suggest that for each dollar spent on fiscal transfers, aggregate output increases by 1.37$ when we use marginal consumption shares, while it increases by 1.27$ when we use the average consumption shares.

4.1.1 Analytical results without IO network

In this section, we derive the simple equation (1) discussed in the introduction, which captures the fiscal multiplier under the simplifying assumption that there is no Input-Output network. That is, the labor share $\omega_s \to 1$ in all sectors.

Under the simplifying assumption that there is no Input-Output Network, we obtain that: (i) $\mathcal{T} = 0$, since employees' compensation is equal to sectoral value added, given that there are no inputs and no profits; (ii) $\mathcal{C} = \mathcal{H}$, since the labor share is equal to one. We thus obtain: $\mathcal{C}_{ij} = \mathcal{H}_{ij} = \alpha_i MPC_j$. We could equivalently write $\mathcal{C}_{ij} = \alpha_i H_j$, given that the MPC is equal to one for HTM and zero for PIH. We choose to use the MPC formulation in Proposition 2 to highlight the comparison with the classic Keynesian multiplier $\frac{\overline{MPC}}{1-\overline{MPC}}$.

[8] The benchmark result we propose here is obtained aggregating industries at three-digits NAICS level. Similar results are obtained when aggregating industries at two-digits NAICS level. In the latter case, we have

$$dY^{aver}/(\mathbb{1}' d\boldsymbol{T}) = 1.10 \qquad\qquad dY^{marg}/(\mathbb{1}' d\boldsymbol{T}) = 1.17$$

Proposition 2: Consider a stationary equilibrium, with $\phi \to \infty$, $\epsilon \to \infty$, $B_{-1} = 0$ and $\omega_s \to 1 \ \forall s$. The first-order effect of un-targeted transfers, that is, proportional to household income, fully funded with government debt on aggregate output, on impact, is characterized by (39).

$$dY \approx \frac{\overline{MPC}}{1 - \left[\overline{MPC} + S \times cov(MPC_s, MCS_s - ACS_s)\right]} \tag{39}$$

where MPC_s is the MPC *from* households employed in sector s (or, equivalently, the fraction of HTM households in sector s); $\overline{MPC}$ is the average MPC in the economy; MCS_s is the marginal consumption share *towards* sector s; and ACS_s is the average consumption share *towards* sector s.

We can also provide a characterization for the first-order effect of a transfer which is targeted across sectors. However, in such cases MPC_s are endogenous objects that depend on the structure of the transfer, and we are not able to provide an analytical expression for them. That is, while we expect H_s to be a good predictor of MPC_s, this is no longer a one-to-one mapping.

$$dY \approx \frac{MPC^{TW}}{1 - \left[\overline{MPC} + S \times cov(MPC_s, MCS_s - ACS_s)\right]} \tag{40}$$

where MPC^{TW} is the transfer-weighted average MPC, which captures the first-round of expenditures and is higher if the transfer is targeted toward high MPC households.

4.2 General quantitative model

The spirit of our results from Section 4.1 holds in the general framework as well. Moreover, the magnitude of the results is also similar. The simplified model from Section 4.1 ruled out any effect related to changes in relative prices, wages, and inflation.

Indeed, if it is true that some of the assumptions we made to derive the analytical results would usually make the fiscal multiplier from Section 4.1 an upper bound, they do not necessarily characterize an upper bound to the strength of our mechanism. To make a concrete example, the assumption of perfectly rigid prices ($\phi \to \infty$) would naturally characterize an upper bound to the fiscal multiplier, as supply would be perfectly elastic. However, as we will discuss below, price flexibility provides new endogenous redistribution channels in favor of HTM households, as sectors with more HTM households will experience stronger wage inflation. In models with homothetic preferences where different households buy different goods (Argente and Lee (2020), Jaravel (2018), Flynn, Patterson, and Sturm (2021)) these redistribution channels are not present, as the inflation of the price index of each household comoves with the wage.

4.2.1 Calibration

In the quantitative version of the model, we have 21 sectors, so that one sector in the model corresponds to a 2-digits NAICS sector. We make this choice to keep the computation simple, though we could also use a finer industry classification as we did in Section 4.1, where a sector in the model was equal to a 3-digits NAICS sector.[9]. There are two sets of parameters that we need to calibrate. The first is the set of classic parameters for the aggregate economy, for which we choose standard values from the literature, as shown in the first panel of Table 4. The second is the set of sector-specific parameters characterizing the Consumption and Input-Output networks, as illustrated in the second panel of Table 4. The consumption side of the network is determined by $\{H_s\}_s$, $\{m_s\}_s$, $\{\alpha_s\}_s$. The share of hand-to-mouth households $\{H_s\}_s$ is calibrated to match evidence from the PSID, as described in Section 2.1. The sectoral shares of discretionary consumption, $\{\alpha_s\}_s$, are calibrated together with the sectoral shares of subsistence consumption, $\{m_s\}_s$, to match the marginal consumption shares and the average consumption shares estimated from CEX, as described in Section 2.2 [10] In practice, we first set $\{\alpha_s\}_s$ equal to the estimated marginal consumption shares, and then we find values of $\{m_s\}$ in so that average consumption shares of the model in steady-state are equal to the estimated average consumption shares. In the estimates, we reported in Figure 4, the marginal consumption shares of some sectors are negative; since the model cannot accommodate negative values of α_s, for these sectors we simply set α_s=0, which might slightly dampen the amplification implied by the analytical results.

The production side of the network is characterized by $\{\omega_s\}_s, \{\delta_{st}\}_{s,t}$, that are the shares of labor input and intermediate inputs in the production function. We set these parameters in order to match the cost-based shares of labor and intermediate goods measured from the Input-Output Accounts Data made available by the Bureau of Economic Analysis (BEA). We set sectoral productivity z_s such that in steady-state the prices of all goods are equal to 1, namely $p_s = 1$ for all s. Note that this is just a way to normalize prices in steady-state, with the goal of making them more comparable. Indeed, if this normalization still allows for heterogeneity of sectoral inflation in the dynamic model, it allows for more intuitive cross-sectoral steady-state comparisons.

[9] In Section 4.1 we show results using both 2-digits and 3-digits NAICS sectors, and results are similar across the two specifications

[10] For our benchmark homothetic economy, we set subsistence consumption m_s to zero for all sectors, and we choose α_s to match the average consumption shares.

Moreover, note that when $p_s = 1$ for all sectors, there is no distinction between real and nominal variables in the steady state.

Aggregate parameters		
Parameter	Description	Value
γ	Elasticity of substitution across sectors (firms)	1
η	Elasticity of substitution across sectors (households)	1
v	Elasticity of substitution between labor inputs and intermediate goods	1
ϵ	Elasticity of substitution across varieties, within sectors	20
σ	CRRA	1
ψ	Frisch elasticity	1
β	Households' discount factor	0.98
ϕ	Wage rigidity, adjustment costs (scale parameter)	50
ρ_B	Persistence of government debt	0.8
Sector specific parameters		
Parameter	Description	Target
$\{H_s\}_s$	Shares of HTM households	Evidences from PSID (Section 2.1)
$\{m_s\}_s$	Shares of subsistence consumption	Evidences from CEX (Section 2.2)
$\{\alpha_s\}_s$	Shares of discretionary consumption	Evidences from CEX (Section 2.2)
$\{\omega_s\}_s$	Labor share in production	Labor share (BEA IO tables)
$\{\delta_{st}\}_{s,t}$	Intermediates' shares in production	Intermediates' share (BEA IO tables)
$\{z_s\}_s$	Sectoral productivity	Steady-state: $p_s = 1$
$\{\lambda_s\}_s$	Measure of households in sector s	

Table 4: Model's parameters

4.2.2 Fiscal multiplier

We generalize the results from Section 4.1 to our full dynamic model with sticky wages. We consider two calibrations of the model: the baseline calibration described in Table 4, and a counterfactual calibration with homothetic preferences. In the counterfactual calibration, there is no subsistence consumption, namely $m_s = 0\ \forall s$, so that preferences are homothetic, and $\{\alpha_s\}_s$ are calibrated to match the average consumption shares from CEX. All the other parameter values are constant across the two calibrations. As a result, both models match the average consumption shares in CEX, and the values of prices and real variables in steady-state are the same across calibrations.[11] The main difference between the two models lies in their response to shocks, where households with non-homothetic and homothetic preferences behave differently. We

[11]The only difference lies in the shares of discretionary and subsistence consumption. If households consume the same quantity of good s in steady-state, in one case it will be all discretionary consumption while in the other it will be split between discretionary and subsistence consumption.

define real aggregate value added as the sum of the real sectoral value added:

$$\text{Real value added} = \sum_{s} \left(\frac{P_s y_s - PPI_s X_s}{P_s} \right)$$

We consider a fiscal transfer equal to 1% of aggregate real value added. Since the steady states of the two economies are identical, the real value of the transfer is also identical in the two economies. Moreover, it is crucial here to be able to compare economies such that in steady-states the price is the same in each sector.[12]

The cumulative multipliers for the economies with and without homothetic preferences are plotted in Figure 6. There are two main results. First, the fiscal multiplier is approximately 10% (or equivalently 8 percentage points) larger in the economy with non-homothetic preferences on impact: this result is quantitatively similar to the one from Section 4.1. The results obtained in the simplified model with perfectly rigid prices don't necessarily provide an upper bound to the amplification of our mechanism. Indeed, flexibility in prices comes with flexibility in wages, which implies a re-distribution of income from PIH households towards HTM households if the marginal consumption basket is biased towards sectors with more HTM households. This re-distribution channel is not present in models with homothetic preferences where different households buy different goods (Argente and Lee (2020), Jaravel (2018), Flynn, Patterson, and Sturm (2021)), as in these cases the inflation of the price index of each household comoves more with their own wage.

The second result concerns the cumulative multiplier, which is also larger in the economy with non-homothetic preferences and is non-zero in both economies. This result is driven by the interaction of two re-distributional forces. The first is related to aggregate inflation: with flexible prices, inflation acts as an implicit tax on nominal assets, which are held by PIH households. Therefore, even in a standard TANK model, the cumulative multiplier is non-zero if there is inflation. The second force is proper of our mechanism and goes back to the distributional effects of wage inflation explained above. Indeed, with flexible wages, since in the non-homothetic economy, marginal consumption is biased towards sectors with more HTM households, these sectors occur stronger wage inflation, thus increasing the average wage of HTM households relative to the average wage of PIH households. Because of this redistribution of wages, and since labor supply in sectors with more HTM households also increased more in order to meet the higher demand, the transfer is endogenously biased towards HTM households throughout the amplification mechanism. In other words, the econ-

[12] Indeed, even if the two economies are identical in steady-state, but on the margin, households consume goods produced in different sectors, it would be hard to compare the dynamic behavior of the two economies if, for instance, the goods in the marginal consumption basket are simply "cheaper" in steady-state than the goods in the average consumption basket

omy behaves as if the fiscal stimulus was targeted toward HTM households, even if everyone receives the same transfer. In order to clarify the role of redistribution in determining the cumulative multiplier, in Appendix C we compute the cumulative response to a targeted transfer in the simplest version of our economy, a one-sector TANK economy: if transfers are targeted towards HTM households the cumulative fiscal multiplier is non-zero.

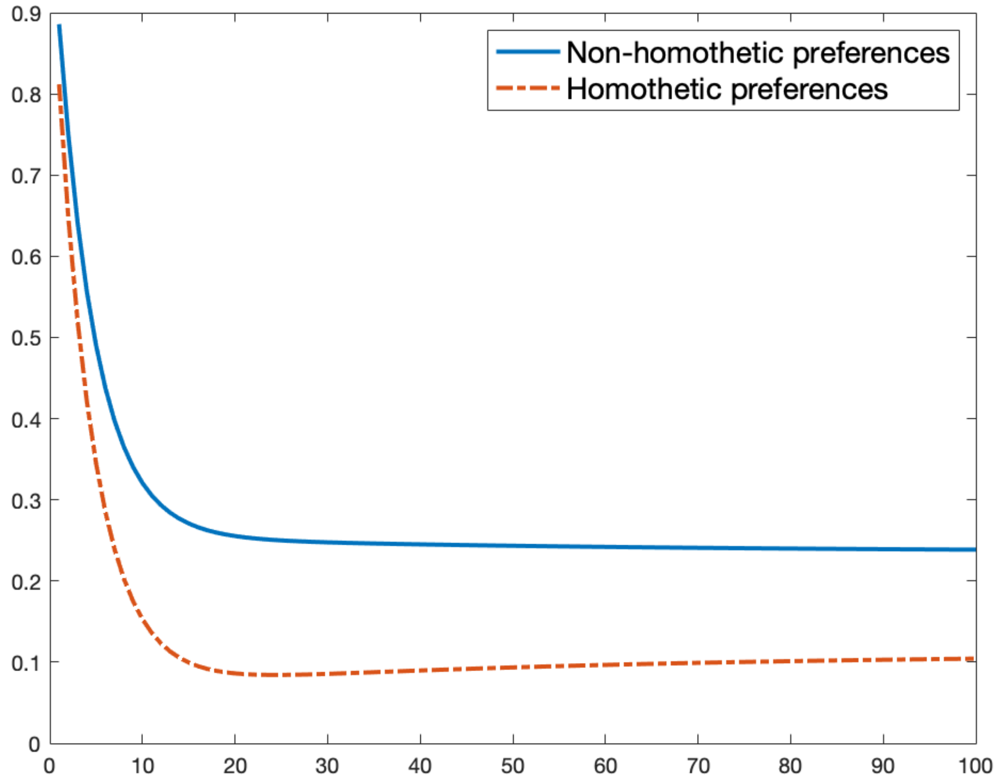

Figure 6: Cumulative fiscal multipliers for the economy with non-homothetic preferences (solid line) and with homothetic preferences (dashed line). On the x-axis there is time expressed in number of periods from the shock, that occurs at $t = 0$.

4.2.3 Price indexes

Without homothetic preferences, there is only one natural way to define a consumer price index, which we denote as the average price index (API):

$$\text{Average price index} = \left(\sum_s ACS_s \times P_s^{1-\eta} \right)^{\frac{1}{1-\eta}} \tag{API}$$

The API weights each price accordingly to the average consumption share of sector s, that is ACS_s. However, with non-homothetic preferences, the API is not necessarily the natural price index, as we can define the marginal price index (MPI) as:

$$\text{Marginal price index} = \left(\sum_s MCS_s \times P_s^{1-\eta}\right)^{\frac{1}{1-\eta}} \tag{MPI}$$

The MPI weights each price accordingly to the marginal consumption share of sector s, that is MCS_s. Since sectoral productivities z_s have been calibrated so that all sectoral prices are equal to one, it follows that the average price index (API) and the marginal price index (MPI) are equal in steady-state. In standard models with homothetic preferences, the marginal price index is exactly equal to the average price index. Since the marginal price index, and not the API, drives the dynamic of consumption, it seems to track better than the API the dynamic of prices, consumption, and output in an economy with non-homothetic preferences.

Consider an un-targeted transfer shock as the one introduced in Section 4.2.2. Since marginal consumption is biased towards sectors with more hand-to-mouth households, inflation will be more concentrated in these sectors, so that the marginal price index inflation is larger than the average price index inflation in response to this type of shock. Moreover, this is true for any "un-targeted" demand shock in the economy. On the other hand, when the economy is hit by a supply shock, which in our framework means a shock to aggregate productivity, average price index inflation is larger than marginal price index inflation. Consider a sector s where $ACS_s > MCS_s$: this means that demand for consumption goods in sector s comes mostly in the form of demand subsistence consumption m_s rather than discretionary consumption c_s. Since m_s is assumed to be a constant, demand for consumption goods in such "subsistence sectors" is more rigid than it is in "marginal sectors" where $ACS_s < MCS_s$. As a result, when the economy is hit by a supply shock prices will be more responsive in "subsistence sectors", so that average price index inflation will be larger than marginal price index inflation.

An additional contribution of this paper is to provide empirical estimates of MCS_s and ACS_s that would allow to construct the two price indexes if we have information on sectoral prices $\{P_s\}_s$. Though a serious attempt to construct a new and rigorous series for the two price indexes goes beyond the scope of this paper, as many statistical and practical considerations should be taken into account when constructing a price index, we can provide suggestive evidence about what are the data counterparts of two relevant objects of the model we proposed in the paper. We provide more details and we plot our series in Appendix E.

5 Conclusions

In this paper, we document a new channel for redistribution and amplification of aggregate shocks operating through a consumption network. We show theoretically what the key elements of the consumption networks are and we combine household data from CEX and the PSID to measure them. Households' heterogeneity is relevant not only in terms of their MPC but also because they might be employed in different sectors: households employed in different sectors have different marginal propensity to consume, which we capture in reduced form by measuring the share of hand-to-mouth households employed in different sectors. We also show that the way households spend the average dollar across sectors, which we refer to as the "average consumption basket", is different from the way households spend the marginal dollar across sectors, which we refer to as the "marginal consumption basket": it is the latter and not the former that should be used to properly evaluate the effects of transitory fluctuations on aggregate output. Finally, the main empirical contribution of this paper is to show that households spend disproportionately more on the margin in sectors whose employees have higher MPC. Motivated by these findings, we use a multi-sector, two-agents, new-Keynesian model to quantify the importance of this mechanism for the amplification of fiscal policy. Importantly, we allow for non-homothetic preferences of households, so that we can match both the marginal and the average consumption shares that we estimate in the data. In a simplified setting, we derive the first-order effect of fiscal policy on aggregate output. We then compare the effect of government transfers on aggregate output in our calibrated model with respect to a similar economy where households spend the marginal dollar in the same way as the average dollar. This exercise shows that our mechanism, based on the empirical finding that the marginal consumption basket is biased towards sectors with more HTM workers, can make the fiscal multiplier 10% larger. In a quantitative setting, we show that the dynamics of wage inflation across sectors enhance the redistributive forces operating under fixed prices, making the cumulative multiplier substantially higher in the non-homothetic economy.

We see a few relevant directions to extend our work. Our results are mostly related to the effect of fiscal policy on aggregate output and sectoral dynamics. However, the mechanisms described in the paper are at work also when the economy is hit by different types of disturbances. More importantly, we have developed a framework that maps several important features of the data, such as non-homotheticity, and heterogeneity across sectors and households, in a workhorse business cycle model. This framework could thus represent a useful starting point to analyze questions that abstract from the core amplification mechanism we highlight in this paper.

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A Derivation of Proposition 1

Proposition 1: Consider a stationary equilibrium, with $\phi \to \infty$, $\epsilon \to \infty$, and $B_{-1} = 0$. The first-order effect of un-targeted transfers fully funded with government debt on aggregate output, on impact, is characterized by (41).

$$dY \approx \boldsymbol{\omega}' \underbrace{(\mathcal{I} - \mathcal{T} - \mathcal{C})^{-1}}_{\text{amplification}} \underbrace{(\mathcal{H}\, d\boldsymbol{T})}_{\text{first round}} \tag{41}$$

Derivation

Suppose that the economy is hit by a fiscal transfer $\boldsymbol{dT}$. To study the propagation of such shock in our simplified demand-driven framework, it is sufficient to study the demand equation. we start from the demand equation (73). Compared to (73), we can simplify the relative prices of different varieties within a sector, which are all equal in equilibrium. Therefore, the demand for goods of variety in sector k is:

$$y_k = m_k + \alpha_k \left(\frac{P_{kt}}{P_t}\right)^{-\eta} C_t + \sum_s \delta_{sk} \left(\frac{P_{kt}}{PPI_{st}}\right)^{-\gamma} (1 - \omega_s) \left(\frac{PPI_{st}}{PC_{st}}\right)^{-v} \frac{y_s}{Z_{st}} \tag{42}$$

Assuming that the production function is Cobb-Douglass, leads to a further simplification:

$$y_k = m_k + \alpha_k \frac{P}{P_k} C + \sum_s \delta_{sk} \frac{PC_s}{P_k} (1 - \omega_s) \frac{y_s}{Z_s} \tag{43}$$

Notice that since $\epsilon \to 0$, $P_s = W_s$. Thus, given the Cobb-Douglass assumption, we get that $PC_s = P_s Z_s$. Therefore (43) becomes:

$$P_k y_k = P_k m_k + \alpha_k \Big(\sum_s Pc_s \Big) + \sum_s \delta_{sk} (1 - \omega_s) P_s y_s \tag{44}$$

Differentiating (44) we get:

$$d(P_k y_k) = d(P_k m_k) + \sum_s \alpha_k d(Pc_s) + \sum_s \delta_{sk} (1 - \omega_s) d(P_s y_s) \tag{45}$$

The key object we need to pin down is $d(Pc_s)$, the change in household discretionary expenditures. By definition of MPC, the change in expenditure is equal to the product of household MPC to the change in household disposable income, inclusive of the transfer. We will discuss at the end of the derivation an explicit formulation of MPC for each type of household. In addition to the transfer, the disposable income changes because of the endogenous change in labor income. In an environment with zero profits, this simply equals the change in sectoral sales multiplied by the labor share. Therefore, we get the following expression for the change in consumption expenditures:

$$d(Pc_s) = MPC_s d(DI_s) = MPC_s \omega_s d(P_s y_s) + MPC_s dT_s \tag{46}$$

Plugging (46) into (45), and noticing that with fixed prices the expenditure on subsistence goods does not change we obtain:

$$d(P_k y_k) = \underbrace{\sum_s \alpha_k MPC_s \omega_s d(P_s y_s) + \sum_s \delta_{sk}(1-\omega_s) d(P_s y_s)}_{\text{amplification}} + \underbrace{\sum_s \alpha_k MPC_s dT_s}_{\text{first round}} \tag{47}$$

What is the average MPC in each sector? For HTM households the answer is simple: since they consume any amount of income they receive, their MPC is equal to one: $MPC^{HTM} = 1$ s equal to one. Moreover, for a transfer shock fully funded by debt, we have that on impact

$$d(Pc^{s,HTM}) = d(W_s N_s) + d(T^{s,HTM}) \tag{48}$$

For PIH households, we claim that $MPC^{PIH} = 0$, as it would be in a standard TANK model in response to a fiscal transfer. First, since the interest rate is constant over time because of perfectly rigid prices, the consumption of PIH is also constant over time. Therefore, in response to a transfer shock total consumption of PIH can either stay constant, permanently increase, or permanently decrease. From the lifetime budget constraint of PIH we have

$$d(Pc^{s,PIH}) = \frac{r}{1+r} \sum_{n=0}^{\infty} \left[\frac{1}{(1+r)^n} d\left(DI_{t+n}\right) + d\left(T^{s,PIH}_{t+n}\right) \right] \tag{49}$$

that is, PIH households internalize higher future taxes. Our approach is to guess and verify that $d\left(Pc^{s,PIH}\right) = 0$. If consumption of PIH is constant over time (47) becomes a static equation. Further, notice that (47) can be seen as the row k of a matrix. For compactness, let us denote by $\boldsymbol{dy}$ the vector of changes in sectoral nominal output. Then, under our guess, we obtain:

$$\boldsymbol{dy} = \mathcal{C}\boldsymbol{dy} + \mathcal{T}\boldsymbol{dy} + \mathcal{H}\boldsymbol{dT} \tag{50}$$

which implies:

$$\boldsymbol{dy} = (\mathcal{I} - \mathcal{C} - \mathcal{T})^{-1}(\mathcal{H}\boldsymbol{dT}) \tag{51}$$

where, as described in detail in Section 4.1, we have:

$$\{\mathcal{C}\}_{ks} = \alpha_k \omega_s H_s \tag{35}$$

$$\{\mathcal{H}\}_{ks} = \alpha_k H_s \tag{36}$$

$$\{\mathcal{T}\}_{ks} = (1-\omega_s)\delta_{sk} \tag{37}$$

notice that in $\mathcal{C}$ and $\mathcal{H}$ we have imposed our guess that $MPC_s = H_s$.

We now proceed to verify our guess. In practice, we combine (51) and the per-period budget constraint of the government to compute the elements on the RHS of (49) and show that they sum to zero.

A fiscal transfer $\boldsymbol{dT}$ fully financed by debt requires that in the future

$$\boldsymbol{dy}_t = (\mathcal{I} - \mathcal{C} - \mathcal{T})^{-1}(\mathcal{H}\boldsymbol{dT}) \tag{52}$$

$$\boldsymbol{dy}_{t+n} = -r \times (\mathcal{I} - \mathcal{C} - \mathcal{T})^{-1}(\mathcal{H}\boldsymbol{dT}) \quad \text{for } n \geq 1 \tag{53}$$

One can now evaluate the RHS of (49), and it verifies the guess $d\left(Pc^{s,PIH}\right) = 0$.

Finally, notice that we can map sectoral output into aggregate output by summing sectoral value added. In each sector, a fraction ω_s of production is value-added, while a fraction $(1 - \omega_s)$ of the value comes from input purchase. Therefore:

$$dY = \boldsymbol{\omega}'\boldsymbol{dy} = \boldsymbol{\omega}'(\mathcal{I} - \mathcal{C} - \mathcal{T})^{-1}(\mathcal{H}\boldsymbol{dT}) \tag{54}$$

B Fiscal Multiplier without IO Network

In this section, we derive the simple expression illustrated in equation (1) in the introduction.
We start from the general fiscal multiplier in matrix form (55), and we make three simplifying assumptions:
Suppose for simplicity that there is no IO network, then:

- We can replace $\mathcal{T} = 0$ in (55), since the Keynesian effect of input spending is absent
- We can replace $\boldsymbol{\omega}$ with $\mathbb{1}$, since the compensation of employees equals output, given that labor is the only input
- $\omega_s = 1 \implies \mathcal{C} = \mathcal{H}$ with $C_{ij} = \alpha_i MPC_j$

The general fiscal multiplier in equation (55) thus simplifies to:

$$dY = \mathbb{1}'\boldsymbol{dy} = \mathbb{1}'(\mathcal{I} - \mathcal{C})^{-1}(\mathcal{C}\boldsymbol{dT}) \tag{55}$$

Let us now proceed to the derivation of (1).

First of all, recall that $C_{ij} = \alpha_i MPC_j$, where α_i is the marginal consumption share of sector i.

Let $\boldsymbol{\alpha}$ be the vector of marginal consumption shares and $\boldsymbol{\beta}$ be the vector of marginal propensities to consume. Then, $\mathcal{C} = \boldsymbol{\alpha}\boldsymbol{\beta}'$, which is the average MPC weighted by the Marginal Consumption Shares.

Notice that

$$(I - \mathcal{C})^{-1} = I + \frac{1}{1-c}\mathcal{C}$$

where $c = \sum_s \alpha_s MPC_s = \boldsymbol{\alpha}'\boldsymbol{\beta}$.

Therefore, the fiscal multiplier reads:

$$\begin{aligned} dY &= \mathbb{1}'(\mathcal{I} - \mathcal{C})^{-1}(\mathcal{C}\boldsymbol{dT}) \\ &= \mathbb{1}'(\mathcal{I} + \frac{1}{1-c}\mathcal{C})(\mathcal{C}\boldsymbol{dT}) \\ &= \mathbb{1}'\mathcal{C}\boldsymbol{dT} + \mathbb{1}'\frac{1}{1-c}\mathcal{C}(\mathcal{C}\boldsymbol{dT}) \\ &= \underbrace{\mathbb{1}'\boldsymbol{\alpha}}_{=1}\boldsymbol{\beta}'\boldsymbol{dT} + \frac{1}{1-c}\underbrace{\mathbb{1}'\boldsymbol{\alpha}}_{=1}\underbrace{\boldsymbol{\beta}'\boldsymbol{\alpha}}_{=c}\boldsymbol{\beta}'\boldsymbol{dT} \\ &= \underbrace{\boldsymbol{\beta}'\boldsymbol{dT}}_{\text{First Round}} + \underbrace{\frac{c}{1-c}\boldsymbol{\beta}'\boldsymbol{dT}}_{\text{Further Rounds}} \\ &= \frac{1}{1-c}\boldsymbol{\beta}'\boldsymbol{dT} \end{aligned} \tag{56}$$

That is:

$$dY = \frac{1}{1-\boldsymbol{\beta}'\boldsymbol{\alpha}}\boldsymbol{\beta}'\boldsymbol{dT} \tag{57}$$

Equation (57) shows that the relevant multiplier for first-round expenditures is the transfer-weighted MPC, while further rounds of expenditures are governed by the MCS-weighted MPC, since households receive additional income depending on sectoral MCS.

Since at the numerator, we have $MPC^{TW} = \boldsymbol{\beta}'\boldsymbol{dT}$, which is the weighted average MPC of the economy using as weights the composition of the fiscal transfer, if the transfer is targeted toward high-MPC households, the numerator becomes larger.

If the fiscal transfer is proportional to household labor income, then we obtain that $MPC^{TW} = \boldsymbol{\beta}'\boldsymbol{dT} = \sum MPC_s ACS_s = \overline{MPC}$. That is, the transfer-weighted MPC is equal to the MPC weighted by the average consumption shares.

Let us now focus on the denominator, which captures the amplification of additional rounds of expenditure. c is the MCS-weighted MPC. We want to open up the definition of c to show how non-homotheticity matters, that is, we want to show how differences between ACS and MCS affect the value of c.
We want to provide a Using the definition of c we get:

$$
\begin{aligned}
c &= \sum_s \alpha_s MPC_s \\
&= \sum_s ACS_s MPC_s + \sum_s (\alpha_s - ACS_s) MPC_s \\
&= \overline{MPC} + \sum_s (MCS_s - ACS_s) MPC_s \\
&= \overline{MPC} + S \times cov\big((MCS_s - ACS_s), MPC_s\big)
\end{aligned}
\tag{58}
$$

where notice that the second term is the covariance since $\sum_s (\alpha_s - ACS_s) = 0$.
Therefore, the fiscal multiplier to a generic transfer scheme is:

$$
dY = \frac{MPC^{TW}}{1 - [\overline{MPC} + S \times cov\big((MCS_s - ACS_s), MPC_s\big)]} \tag{59}
$$

Finally, the fiscal multiplier to a transfer proportional to labor income reads:

$$
dY = \frac{\overline{MPC}}{1 - [\overline{MPC} + S \times cov\big((MCS_s - ACS_s), MPC_s\big)]} \tag{60}
$$

In the case of an untargeted fiscal multiplier, we can use the result in A that $MPC_s = H_s$, and we can thus also rewrite (60) as:

$$
dY = \frac{\overline{H}}{1 - [\overline{H} + S \times cov\big((MCS_s - ACS_s), H_s\big)]} \tag{61}
$$

which is only a function of parameters.
Notice that the role of S is simply that of scaling. For example, if we move from 2-digits to 3-digits NAICS the consumption shares are mechanically going to get smaller, reducing the level of the covariance term. The term S simply corrects for this mechanical change in the covariance.

B.1 Sector-Specific Spending Multipliers

The analysis in this paper is mostly focused on aggregate fiscal shocks and their amplification through sectoral dynamics. However, the heterogeneity in MPC we uncover in the data raises questions regarding the effects of sector-specific spending shocks. Thanks to the characterization of the fiscal multiplier to a generic transfer in equation (57), we can provide a clear answer to this question in Proposition 3.

Proposition 3: Consider a stationary equilibrium, with $\phi \to \infty$, $\epsilon \to \infty$, $B_{-1} = 0$, and no input output network: $\omega_s \to 1\ \forall s$.
Let us study the effect of targeted spending in sector s, fully funded with government debt on aggregate output ($dT_s = 1, dTj = 0 \forall j \neq s$) The first-order effect of such measure, on impact, is characterized by (62).

$$dY \approx \underbrace{\frac{1}{1 - \left[\overline{MPC} + S \times cov(MPC_s, MCS_s - ACS_s)\right]}}_{\text{second-rounds}} \underbrace{MPC_s}_{\text{First Rounds}} \tag{62}$$

Let us now study the effect of targeted spending in sector s, funded by levying a tax proportional to labor income in all sectors ($dT_s = 1 - \frac{w_s N_s}{WN}, dT_j = -\frac{w_j N_j}{WN} \forall j \neq s$). The first-order effect of such measure, on impact, is characterized by (63).

$$dY \approx \underbrace{\frac{1}{1 - \left[\overline{MPC} + S \times cov(MPC_s, MCS_s - ACS_s)\right]}}_{\text{second-rounds}} \underbrace{(MPC_s - \overline{MPC})}_{\text{first-round}} \tag{63}$$

For clarity, notice that without an IO Network ($\omega_s = 1 \forall s$), government spending and transfers have the same effect.
To understand the economics of Proposition 3, first of all, notice that we can separate as usual the multiplier into first-round and second-round effects. The second-rounds term is identical to that of the aggregate spending multiplier. This should not be surprising, once the first-round expenditures are set in motion, the initial source of the shock is irrelevant in our model.
Focusing on the first-round effect, we can notice in (62) that spending in high MPC sectors leads to a larger economic expansion. This result is even starker in (63), which characterizes the case in which government spending is financed by taxation on all sectors. The spending shock is expansionary if and only if it targets a sector with a higher MPC than average. Intuitively, targeting a low MPC sector would be equivalent to redistributing towards low-MPC households, and would provoke a recession.

C Redistribution and cumulative multipliers

To highlight more transparently the role of redistribution in shaping the cumulative multiplier, we consider a one-sector economy with homotheticity in consumption. This is a particular case of our consumption network, with $S = 1$, $m_1 = 0$, and $\alpha_1 = 1$. Alternatively, we could consider a multi-sector symmetric economy. We calibrate the economy to have half PIH households and half HTM households ($H_s = 0.5$), all employed in sector 1.

To analyze the role of redistribution, we consider a transfer shock, fully financed by debt, in which stimulus checks are either (i) *untargeted*, that is, sent to all households, (ii) *targeted* sent to HTM households only. The result of this exercise are reported in Figure 7.

The first result is that the *targeted* fiscal transfer has a larger impact effect. This is intuitive, as we are explicitly targeting high MPC households. The second, and perhaps more surprising result, is that in the *untargeted* scenario the cumulative multiplier returns to zero, that is, the transfer creates an initial boom at the cost of a persistent slump when households have to repay the debt. Instead, the *targeted* fiscal transfer

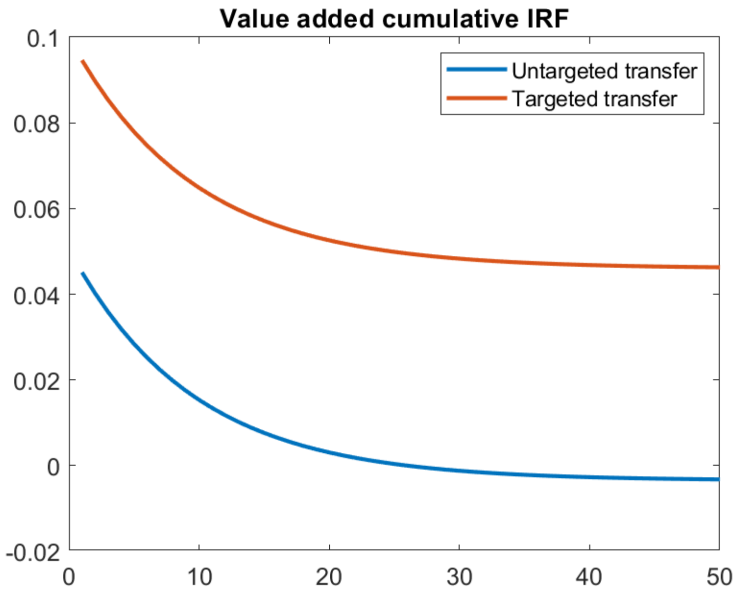

Figure 7: Cumulative Fiscal Multiplier in a one-sector TANK economy for targeted and untargeted fiscal transfer, fully funded by debt.

To gain better intuition behind the mechanism at play, Figure 8 displays the (non-cumulative) impulse responses of consumption of PIH and HTM in the two cases. If the fiscal transfer is *untargeted*, HTM household consumption initial boom is fully reversed since the future tax compress their nominal income by an equivalent amount.

Instead, if the transfer is *targeted*, the initial transfer is larger than the subsequent taxes from the perspective of the HTM households. Therefore, cumulative HTM consumption stays positive. PIH consumption is essentially flat in both cases. As it is well known and shown in appendix II, PIH households do not respond directly to the *untargeted* fiscal transfer, since future taxes offset the current increase in income. In the case of a *targeted* fiscal transfer, this is no longer the case, but the boom created in the economy by HTM consumption, which is not offset by future drops in output, increases the permanent income of PIH households, thus offsetting the negative effects of being excluded from the fiscal transfer.

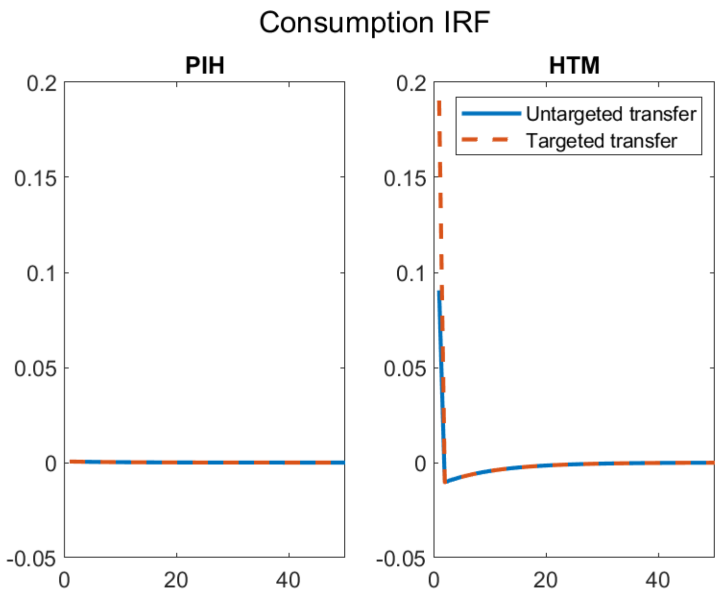

Figure 8: Consumption IRF of PIH and HTM in a one-sector TANK economy for targeted and untargeted fiscal transfer, fully funded by debt.

D Producers of varieties

In the main body of the paper, we have derived consumption demand (c^i_{st}) and input demand (x_{skt}) for goods produced in different sectors. We here delve deeper into the problem faced by households and of the firm purchasing inputs in choosing across varieties within a sector. Ultimately, this is simply an additional CES nest. The contribution is in showing that despite non-homotheticity and an input-output network, we can define such variety-nest so that this layer is well-behaved and gives rise to a typical monopolistic markup.

D.1 Consumption variety demand

We now solve the optimal demand of variety j in sector s, given total demand for sector s goods $c_s t^i$. The optimal choice of varieties within each sector, for discretionary consumption $c^i_{st}(j)$, solves (64).

$$\max_{\{c^i_{st}(j)\}_j} \left(\int_0^1 c^i_{st}(j)^{\frac{\epsilon-1}{\epsilon}} dj \right)^{\frac{\epsilon}{\epsilon-1}} \quad \text{s.t. } P_{st} c^i_{st} = \int_0^1 c^i_{st}(j) P_{st}(j) dj \tag{64}$$

which leads to the optimal discretionary demand:

$$c^i_{st}(j) = \left(\frac{P_{st}(j)}{P_{st}} \right)^{-\epsilon} c^i_{st} \tag{65}$$

The optimal choice of varieties for subsistence consumption within each sector solves (66). Since all firms within a sector are equal and they charge the same price in equilibrium, we can use the same notation for the sectoral price index P_{st} in (64) and (66).

$$\max_{\{m_{ist}(j)\}_j} \left(\int_0^1 m_{ist}(j)^{\frac{\epsilon-1}{\epsilon}} dj \right)^{\frac{\epsilon}{\epsilon-1}} \quad \text{s.t. } P_{st} m_{ist} = \int_0^1 m_{ist}(j) P_{st}(j) dj \tag{66}$$

The resulting demand functions for subsistence consumption is:

$$m_{st}(j) = \left(\frac{P_{st}(j)}{P_{st}} \right)^{-\epsilon} m_s \tag{67}$$

Notice that while m_s, the subsistence level consumption of goods in sector s by households, is fixed in the preferences, households are free to satisfy this basic consumption need by shopping across different producers. Intuitively, households face a subsistence demand for food, but are free to pick whatever shop they like for their groceries.

Finally, the total consumption demand for variety j of good produced in sector s is

$$q_s(j) = \left(\frac{P_{st}(j)}{P_{st}}\right)^{-\epsilon}\left[m_s + \alpha_s\left(\frac{P_{st}}{P_t}\right)^{-\eta} C_t\right] \tag{68}$$
$$\text{with } C_t = \sum_i c_t^i$$

D.2 Input variety demand

Demand for variety j of sector k by firms in sector s is

$$x_{skt}(j) = \Big(\frac{P_{kt}(j)}{P_{kt}}\Big)^{-\epsilon} x_{skt} \tag{69}$$

where P_{kt} is the price aggregator for varieties in sector k according to (70).

$$P_{kt} = \Big(\int_0^1 P_{kt}(j)^{1-\epsilon}\Big)^{\frac{1}{1-\epsilon}} \tag{70}$$

Since different firms within a sector differ only in the variety they produce, we have

$$P_{kt}(j) = P_{kt}$$
$$x_{skt}(j) = x_{skt}.$$

D.3 Total Variety Demand

We have shown in the previous two subsections that demand for variety j produced in sector k has two components: demand for *intermediate goods* $\sum_s x_{sk}(j)$ characterized in (71) and demand for *consumption goods* $q_k(j)$ characterized in (72), which is, in turn, the sum of subsistence and discretionary component. We report here the full expression for variety demand, that clarify the dependence of the demand for the product of each firm on all the upper nests.

$$x_{skt}(j) = \Big(\frac{P_{kt}(j)}{P_{kt}}\Big)^{-\epsilon}\delta_{sk}\Big(\frac{P_{kt}}{PPI_{st}}\Big)^{-\gamma}(1-\omega_s)\Big(\frac{PPI_{st}}{PC_{st}}\Big)^{-v}\frac{y_{st}}{Z_{st}} \tag{71}$$

$$q_{kt}(j) = \left(\frac{P_{kt}(j)}{P_{kt}}\right)^{-\epsilon}\left[m_k + \alpha_k\left(\frac{P_{kt}}{P_t}\right)^{-\eta} C_t\right] \tag{72}$$

Therefore, the total demand for goods of variety j in sector k is:

$$y_{kt}(j) = \left(\frac{P_{kt}(j)}{P_{kt}}\right)^{-\epsilon}\underbrace{\left[m_k + \alpha_k\left(\frac{P_{kt}}{P_t}\right)^{-\eta} C_t + \sum_s \delta_{sk}\Big(\frac{P_{kt}}{PPI_{st}}\Big)^{-\gamma}(1-\omega_s)\Big(\frac{PPI_{st}}{PC_{st}}\Big)^{-v}\frac{y_{st}}{Z_{st}}\right]}_{y_{kt}} \tag{73}$$

E Construct empirical price indexes

In standard economies with homothetic preferences, there is only one natural way to define a consumer price index, which we denote as the average price index (API):

$$\text{Average price index} = \left(\sum_s ACS_s \times P_s^{1-\eta}\right)^{\frac{1}{1-\eta}} \tag{API}$$

The API weights each price accordingly to the average consumption share of sector s, that is ACS_s. However, with non-homothetic preferences, the API is not necessarily the natural price index, as we can define the marginal price index (MPI) as:

$$\text{Marginal price index} = \left(\sum_s MCS_s \times P_s^{1-\eta}\right)^{\frac{1}{1-\eta}} \tag{MPI}$$

The MPI weights each price accordingly to the marginal consumption share of sector s, that is MCS_s. In standard models with homothetic preferences, the marginal price index is exactly equal to the average price index.

We can combine our empirical estimates of ACS_s and MCS_s from Section 2.2 with time series on sectoral price indexes from the BLS to construct the empirical counterpart of our model objects described in (API), (MPI). The time series for the two price indexes are plotted in Figure 9, and in Figure 10 we show only the trend component.

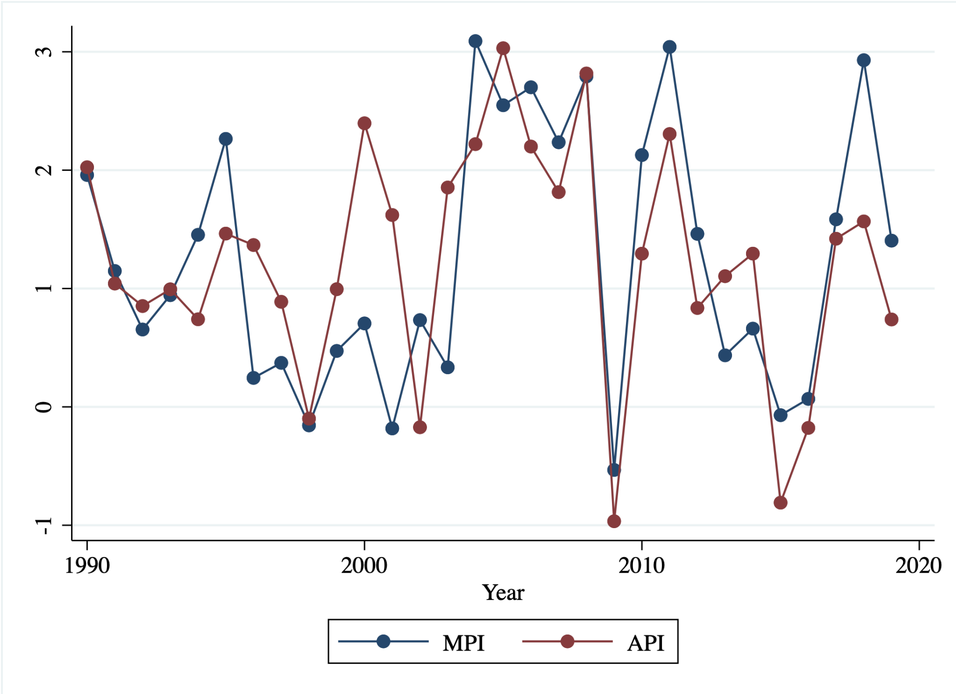

Figure 9: Constructed time series for marginal price index (MPI) and average price index (API) using the estimated values of marginal consumption shares and average consumption shares from CEX (Section 2.2), and sectoral price indexes from BLS.

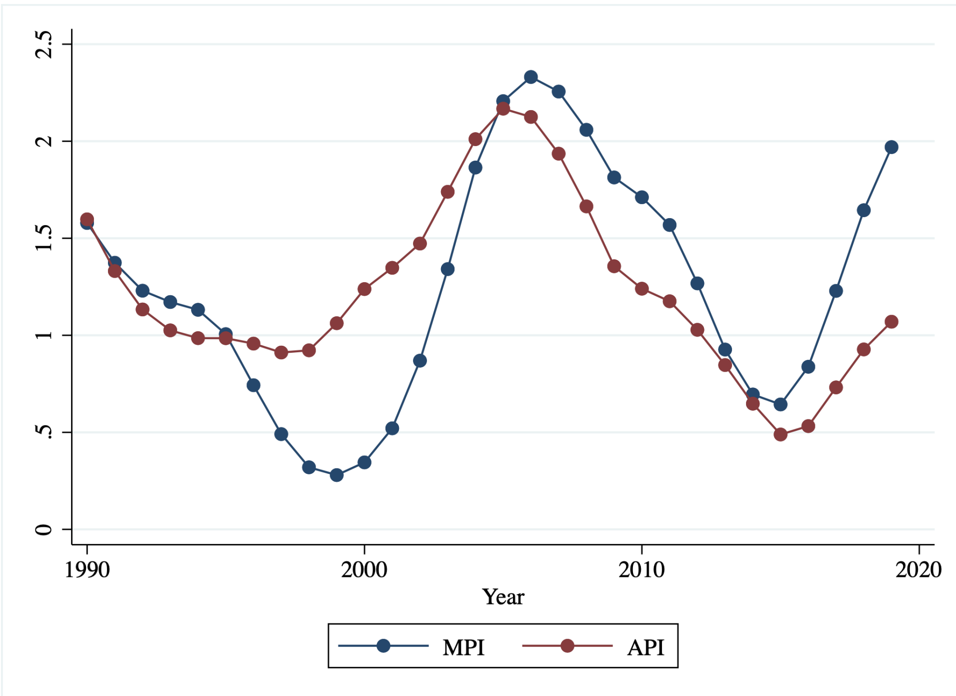

Figure 10: Trend component of marginal price index (MPI) and average price index (API) obtained using an HP filter at annual frequencies.