One Dollar, Many Multipliers: Government Spending Composition, Household-Level Incidence, and Aggregate Outcomes

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Abstract

This paper connects the industry composition of government spending with household-level and aggregate multipliers. In a general analytical framework, it shows that the industry composition of government spending matters only if factor markets are segmented and industries use different combinations of primary factors (labor occupations and capital assets). By changing the relative demand for primary factors, government spending redistributes income across households. Moreover, shifting demand toward factors with flatter supply curves expands aggregate supply, yielding larger multipliers. Quantitatively, aggregate multipliers vary from 0.3 to 0.7 across target industries. Variation across employment and income responses is one order of magnitude larger.

1 Introduction

Estimates of government spending multipliers vary widely across studies (Ramey, 2019). Previous research highlighted that spending has a stronger expansionary effect on aggregate demand during recessions, or when interest rates are at the zero lower bound (Auerbach and Gorodnichenko, 2011, 2012). This paper points out that government spending also has a time-varying effect on aggregate supply, because its industry composition changes over time.[1]

The core insight is that government spending boosts the economy more when it uses production factors – labor occupations, land, equipment, structures, etc. – with flatter supply curves, whose employment can expand with minimal price increases. These are elastically supplied factors (for example labor, as opposed to land), or factors employed in industries which adjust prices infrequently (service workers, as opposed to manufacturing workers).

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[1] Cox et al. (2024) and Bouakez et al. (2023) make a related argument, connecting the spending composition with aggregate multipliers. This paper underscores the role of factor market segmentation in shaping the connection between spending composition and aggregate multipliers. It provides analytical results in a general framework, which handles arbitrary numbers of industries and production factors, deriving both aggregate and redistributive implications.

Quantitatively, the output multiplier is twice as large when the government purchases sticky priced, labor intensive goods, such as professional services, than when it purchases flex-priced goods with low labor share, such as utilities.

These are important considerations, and recent policy debates illustrate their practical relevance. For example, critics of the Biden administration's infrastructure spending argued that it 'ran up against an inelastic supply curve,' resulting in 'higher prices rather than more quantity'.[2] This paper establishes that governments aiming at boosting output should spend on goods with flat supply curves. Regardless of government objectives, monetary policy faces a better inflation-output tradeoff when purchases are directed toward flat-supply goods.

Beyond aggregate effects, the industry composition of government spending also matters for income redistribution. Government spending changes the demand for different goods, and producing these goods requires different combinations of labor occupations and other productive assets. This translates into changes in the relative demand for production factors. In turn, factors are owned by different households, who then experience differential income changes. This paper provides a framework to track how spending affects labor income, income from other productive assets, and consumption prices across households. Quantitatively, changes in labor demand are the main source of redistribution, followed by income from non-labor assets, while consumption price incidences are fairly homogeneous.

Regardless of the motives driving government purchases, being aware of their differential incidences helps policy makers evaluate whether it is desirable to pair government spending with offsetting redistributive policies.

My approach is new and complementary compared to earlier studies (Bilbiie and Straub, 2004; Dupor et al., 2018; Flynn et al., 2021; Beraldi and Malgieri, 2024; Schaab and Tan, 2023) which focus on heterogeneous marginal propensities to consume (MPCs), showing that aggregate multipliers are larger when spending raises labor demand for high-MPC households. I abstract from heterogeneous MPCs, to point out that heterogeneous supply curves create another important connection between income redistribution and aggregate multipliers.

Section 2 uses a simplified version of the model, with two industries and a representative household, to highlight the key economic mechanisms. In traditional RBC models, with labor as the only primary factor of production, government spending affects output by shifting aggregate supply through a *wealth effect* – households are taxed to finance spending, therefore they feel poorer and work more at a given wage. This effect is quantitatively small, implying small spending multipliers. New Keynesian models with nominal rigidities feature an additional, much larger expansionary effect of government spending on aggregate demand. Importantly, in benchmark RBC and New Keynesian models – even those allowing for multiple industries – aggregate spending multipliers do not depend on which goods the government decides to purchase.[3] I instead show that, in more realistic economies with multiple segmented factor markets, government spending further affects aggregate supply through a *reallocation effect*, which – depending on its industry composition – can be as large as the aggregate demand response.

Government spending requires taxing households to finance government purchases. Typically, households and the

[2]See Furman (2025), as well as https://sites.harvard.edu/uk-regional-growth/2025/04/07/jason-furman/.

[3]The result applies to frontier input-output frameworks, including Nakamura and Steinsson (2010), Acemoglu et al. (2012), Pasten et al. (2019), Baqaee and Farhi (2020), La'O and Tahbaz-Salehi (2022), Rubbo (2023).

government demand different goods. If, for example, households spend on services and the government spends on infrastructure, transferring resources from households to the government raises the relative demand for construction. If industries drew from the same undifferentiated labor market, labor demand – and hence wages and prices – would only depend on total spending, regardless of how much services versus construction the government purchases. In practice, however, services and construction rely on different production factors – labor vs raw materials – therefore increasing government spending raises the relative demand for raw materials. If in addition the supply of raw materials is constrained, while workers can increase their hours – i.e. raw materials have a steeper supply curve than labor – increasing the demand for raw materials triggers a larger price response and a smaller quantity response.

On net, reallocating demand toward steep-supply factors used in construction implies an aggregate supply contraction. Thus, the aggregate multiplier is smaller than predicted by textbook models where all industries draw resources from a single, unsegmented factor market. Vice versa spending on services would expand aggregate supply, yielding a larger multiplier.

The key requirements for the spending composition to shape aggregate multipliers are: primary factors face supply curves with different slopes, and government expenditure shares are correlated with factor supply slopes. Factor market segmentation is essential.[4] Reallocation effects are partially offset by a cross-sectional crowding out of private demand – mirroring a conventional result from aggregated models – and they completely disappear when all goods and factors are perfectly substitutable.

While capturing the main economic mechanisms, the simplified model of section 2 misses important realistic elements. Factor market boundaries typically do not coincide with industries – construction and services use both labor and raw materials, although in different proportions – and direct factor contents differ from total contents because of intermediate inputs. Factors are owned by different households, who smooth income fluctuations through asset trades. Moreover, the national accounts categorize government spending by function (such as defense, public administration, education, healthcare), rather than by industry. Functions differ in whether the goods they provide are also offered on private markets. Using a more general version of my framework, I characterize both analytically and quantitatively how expanding or contracting each government function affects aggregate output, employment, and consumption, and how income gets redistributed across households in different occupations and income quintiles.

In the general model, presented in section 3, multiple industries use different combinations of primary factors – including various labor occupations, and other productive assets such as land, equipment, and structures – and intermediate goods. Their products are purchased by heterogeneous households, firms, and the government. Government spending takes two forms: providing *market goods* like education and healthcare that households also purchase privately, and providing *government goods* like defense and public administration. I model government goods as conventional government spending, while I treat market goods as a pure transfer among households

[4]The same economic mechanism applies when industries have decreasing returns to scale – which is conceptually equivalent to a form of factor market segmentation. In fact, production functions with decreasing returns can be represented via constant-return functions with an additional input, consisting in unobserved industry-specific fixed assets.

(depending on how much taxes each pays compared to the value of goods it receives).

This framework represents a significant departure from previous input-output models in macroeconomics, which typically assume a single, undifferentiated labor market, and a representative household.[5] By incorporating multiple segmented factor markets, the model opens the door to richer aggregate and redistributive patterns. To maintain analytical tractability, I adopt a vector-matrix notation. Variables (prices, employment, consumption) are vectors whose components correspond to different agents, while supply and demand relations are governed by elasticity matrices, which capture own-effects and cross-spillovers. This approach yields equations with familiar forms despite the underlying complexity of the disaggregated model, making economic mechanisms immediately transparent.

Section 4 extends the key insights to this general framework. It first shows how to compute factor supply slopes in complex environments where factor market boundaries do not necessarily coincide with industries, and industries are interconnected via input-output linkages. It then connects the industry composition of government spending with the relative demand for different production factors, accounting for direct effects, propagation through the input-output network, and cross-sectional crowding out of private demand in general equilibrium. Finally, it demonstrates that government spending has a greater expansionary effect on aggregate supply when it raises demand for factors with flatter supply slopes, resulting in a smaller incidence on aggregate prices.

The general model also allows us to relate the industry composition of government spending with the relative size of output, employment, and consumption multipliers. With non-labor primary factors, employment multipliers can differ from output multipliers because industries vary in labor intensity. For the same reason, consumption multipliers are no longer mechanically related with output multipliers. When government spending reallocated demand toward labor-intensive industries, employment and consumption increase relatively more than output. Importantly, when labor-intensive industries have stickier prices or when labor is more elastically supplied than other production factors, there is no tradeoff between maximizing output and maximizing employment or consumption.

Section 5 presents quantitative results. I first provide a test of the core economic mechanism, estimating industry-level price and quantity responses to changes in the industry composition of government spending. Consistent with the theory, I find that prices increase by more and quantities increase by less in industries with higher price adjustment frequencies and smaller labor shares in value added.

I then examine calibrated output multipliers across government functions and target industries. The largest difference is between government and market functions, with market functions yielding near-zero multipliers. Across industries, aggregate multipliers double from 0.3 when spending is concentrated on mining, to 0.7 when it is concentrated on information technology.

I conclude by analyzing the distributional effects of government spending. Given the spending composition in 2019, the overall impact is progressive across income quintiles. Lower-income households benefit from increased labor income, while the top quintile benefits from higher returns to semi-fixed assets. However, quintile-level averages

[5] See for example Acemoglu et al. (2011), Carvalho and Tahbaz-Salehi (2019), La'O and Tahbaz-Salehi (2022), Rubbo (2023).

mask substantial heterogeneity across labor occupations within income groups. Labor income responses vary widely across occupations, with spending having the strongest effect on protective service occupations (with a cumulative multiplier on labor income of about 7) and the weakest effect on food service occupations (with a multiplier of 0.1).

1.1 Related Literature

Empirical estimates of spending multipliers vary widely across studies (Ramey, 2019). These differences have been attributed to a time-varying effect of spending on aggregate demand, which is higher during economic downturns when interest rates are at the zero lower bound (Christiano et al., 2011; Farhi and Werning, 2016; Auerbach and Gorodnichenko, 2011, 2012; Ramey and Zubairy, 2018), or when households have higher marginal propensities to consume (Bilbiie and Straub, 2004; Auclert et al., 2018; Hagedorn et al., 2019). This paper considers a complementary explanation: government spending has a time-varying effect on aggregate supply, becoming more powerful when it increases demand for industries that can expand production with smaller price increases.

Several studies recognized that government spending concentrates in relatively few industries, and explored the implications for aggregate multipliers using quantitative input-output models (Bouakez et al. (2018), Bouakez et al. (2023), Barattieri et al. (2023), Cox et al. (2024)).[6] A recurring finding is that targeting industries with sticky prices produces a larger output response.

I contribute an analytical, yet quantitatively realistic framework. Compared to previous work, I highlight fundamental economic mechanisms through general analytical results, while allowing for more flexibility in matching actual expenditure shares and elasticities. I underscore that factor market segmentation is necessary for the spending composition to matter, through the covariance between factor supply slopes and government demand. Other novel results characterize differences between output, employment, and consumption multipliers, and redistributive effects.

A growing body of research shows that government spending has stronger effects when it raises labor income for households with higher marginal propensities to consume (Dupor et al., 2018; Flynn et al., 2021; Beraldi and Malgieri, 2024). I highlight another important connection between redistributive effects and aggregate multipliers, through heterogeneous supply slopes. To maintain the focus on production-side mechanisms, I assume all households have the same marginal propensity to consume.

My analysis of redistributive effects extends previous work in three ways. First, I do not just consider how government spending affects labor demand, but also how it influences consumption prices and income from profits and non-labor factors. Second, I allow for differential sensitivity of labor income to government demand across occupations, through heterogeneous price adjustment frequencies and factor supply elasticities. Third, I account for

[6] Ramey and Shapiro (1998) and Proebsting (2022) take a different approach, examining economies where capital cannot be reallocated between sectors and government spending targets specific industries. The capital reallocation constraints in Ramey and Shapiro (1998) create a non-linear effect where the industries toward which spending is targeted become increasingly supply-constrained. This affects both the overall spending multiplier and the behavior of consumption, investment, and wages.

Other relevant research includes Monacelli et al. (2010) on spending multipliers when labor markets have search frictions, Monacelli and Perotti (2010) on government spending in open economies, and Slavtchev and Wiederhold (2016) on how spending affects R&D activity.

general equilibrium adjustments through private expenditure switching.

2 Segmented Factor Markets, Reallocation, and Aggregate Multipliers

This section introduces a simplified framework, to illustrate the key economic mechanisms connecting the industry composition of government spending with aggregate multipliers and income redistribution. The simplified framework features an economy with one representative household and two heterogeneous industries. I first analyze a version of this economy with a single, unsegmented labor market, and then a version where labor markets are segmented across industries.

The model with unsegmented factor markets demonstrates that – even with multiple heterogeneous industries – the composition of government spending is irrelevant for aggregate multipliers. The segmented-market model illustrates how factor market segmentation creates a connection between spending composition and aggregate multipliers.

Two-Industry Environment I start by outlining the two-industry environment. Throughout, lowercase letters denote log-deviations from an initial equilibrium.

Production: Two industries 1 and 2 produce different intermediate inputs using labor, according to $Y_{1t} = L_{1t}$, $Y_{2t} = L_{2t}$. Firms within each intermediate good industry set prices according to the Calvo model, with adjustment probabilities $\delta_1 \neq \delta_2$.

Final Users: The economy has two final users, a representative household and the government, who purchase different final goods. Both final goods combine the two intermediate inputs with constant elasticity of substitution θ, but different expenditure shares. Household consumption is $C = \left(C_1^{\frac{\theta-1}{\theta}} + C_2^{\frac{\theta-1}{\theta}}\right)^{\frac{\theta}{\theta-1}}$, while government spending is $G = \left(\beta_{G1}^{\frac{1}{\theta}} G_1^{\frac{\theta-1}{\theta}} + \beta_{G2}^{\frac{1}{\theta}} G_2^{\frac{\theta-1}{\theta}}\right)^{\frac{\theta}{\theta-1}}$. Input market clearing requires $C_i + G_i = Y_i$, $i = 1, 2$. Nominal GDP is $P_C C + P_G G$, and changes in real GDP are $y = \frac{1}{2}(\ell_1 + \ell_2)$. For simplicity I assume $G = 0$ in the initial equilibrium, to ensure that industries have equal initial shares in total GDP. Government spending is financed by taxes $T_t = P_{Gt} G_t$. The steady-state spending share in GDP is denoted s_G^*, while changes in the spending share are denoted $ds_G t$.

Household: The representative household maximizes utility $\sum_{t=0}^{\infty} e^{-\rho t}\left[\frac{C_{Ht}^{1-\gamma}}{1-\gamma} - V(L_{1t}, L_{2t}) + G_t\right]$ subject to the budget constraint $P_{Ht} C_{Ht} = W_{1t} L_{1t} + W_{2t} L_{2t} + \Pi_t - T_t$, taking government spending as given. The parameter γ governs wealth effects in labor supply, and Π_t denotes total profits. The household has access to a risk-free bond paying nominal interest rate i_t.

Monetary Policy: The central bank follows a Taylor rule, setting the nominal interest rate i_t in response to average inflation $\pi_t = \frac{1}{2}(\pi_{1t} + \pi_{2t})$ and real GDP growth y_t.

2.1 One Primary Factor: the Spending Composition is Irrelevant

Let's start by considering an economy with a single, unsegmented labor market, such that $V(L_{1t}, L_{2t}) = \frac{(L_{1t}+L_{2t})^{1+\varphi}}{1+\varphi}$ and $W_{1t} = W_{2t}\ \forall t$. The parameter φ is the inverse Frisch elasticity. Proposition 2.1 characterizes the equilibrium.

Proposition 2.1. Log-linearized equilibrium. *Aggregate consumption (c), employment ($\bar{\ell}$), and real GDP (y) are given by $\bar{\ell} \equiv \frac{\ell_1+\ell_2}{2} = y = c + \frac{ds_{Gt}}{1-s_G^*}$. The log-linearized equilibrium is described by the following five equations.*[7]

$$w_t = \varphi y_t + \gamma\left(y_t - \frac{ds_{Gt}}{1-s_G^*}\right) + \bar{p}_t \tag{1}$$

$$p_{it} = \hat{\delta}_i w_t + \left(1-\hat{\delta}_i\right)\left(p_{it-1} + \rho\mathbb{E}\pi_{it+1}\right) \tag{2}$$

$$\ell_{it} = y_t - \theta\left(p_{it} - \bar{p}_t\right) + \left(\beta_{Gi} - \frac{1}{2}\right)\frac{ds_{Gt}}{1-s_G^*} \tag{3}$$

$$c_{t+1} = c_t + \frac{1}{\gamma}\left(i_t - \log\rho - \bar{\pi}_{t+1}\right) \tag{4}$$

$$i_t - \log\rho = \phi_y y_t + \phi_\pi \bar{\pi}_t \tag{5}$$

The first three equations in Proposition 2.1 describe the supply side of the economy, meaning how primary factors (in our case, labor) are transformed into real GDP. The last two equations describe aggregate demand.

The aggregate demand side of this economy is the same as in textbook aggregated models. Combining the Euler equation (4), the Taylor rule (5), and the aggregate resource constraint, we see that increasing government spending shifts aggregate demand outward:

$$y_{t+1} = \frac{\gamma+\phi_y}{\gamma}y_t - \frac{\bar{\pi}_{t+1} - \phi_\pi\bar{\pi}_t}{\gamma} + \frac{ds_{Gt+1} - ds_{Gt}}{1-s_G^*}. \tag{6}$$

Let's now turn to the supply side, starting from the industry level and aggregating up. To build intuition, it is convenient to first relate industry-level relative prices $p_i - \bar{p}$ with relative employment $\ell_i - y$.

Relative labor demand in the two industries is described by equation (3). Employment in each industry, relative to the aggregate, depends on the industry's relative price and government spending. When households and government have different expenditure shares ($\beta_G \neq \frac{1}{2}$), taxing households to finance government spending reallocates demand toward the government's preferred labor type.

To derive industry-level supply curves, we combine the consumption-leisure tradeoff (1) with real marginal cost Phillips curves (2):

$$p_{it} - \bar{p}_t = \hat{\delta}_i\left[\left(\gamma+\varphi\right)y_t - \gamma\frac{ds_{Gt}}{1-s_G^*}\right] + \left(1-\hat{\delta}_i\right)\left(p_{it-1} + \rho\mathbb{E}\pi_{it+1} - \bar{p}_t\right). \tag{7}$$

Figure 1 represents equilibrium in the (relative employment, relative price) space.

[7] In equation (2) we denoted the slope of real marginal cost Phillips curves $\hat{\delta}_i \equiv \frac{\delta_i(1-\rho(1-\delta_i))}{1-\rho\delta_i(1-\delta_i)}$.

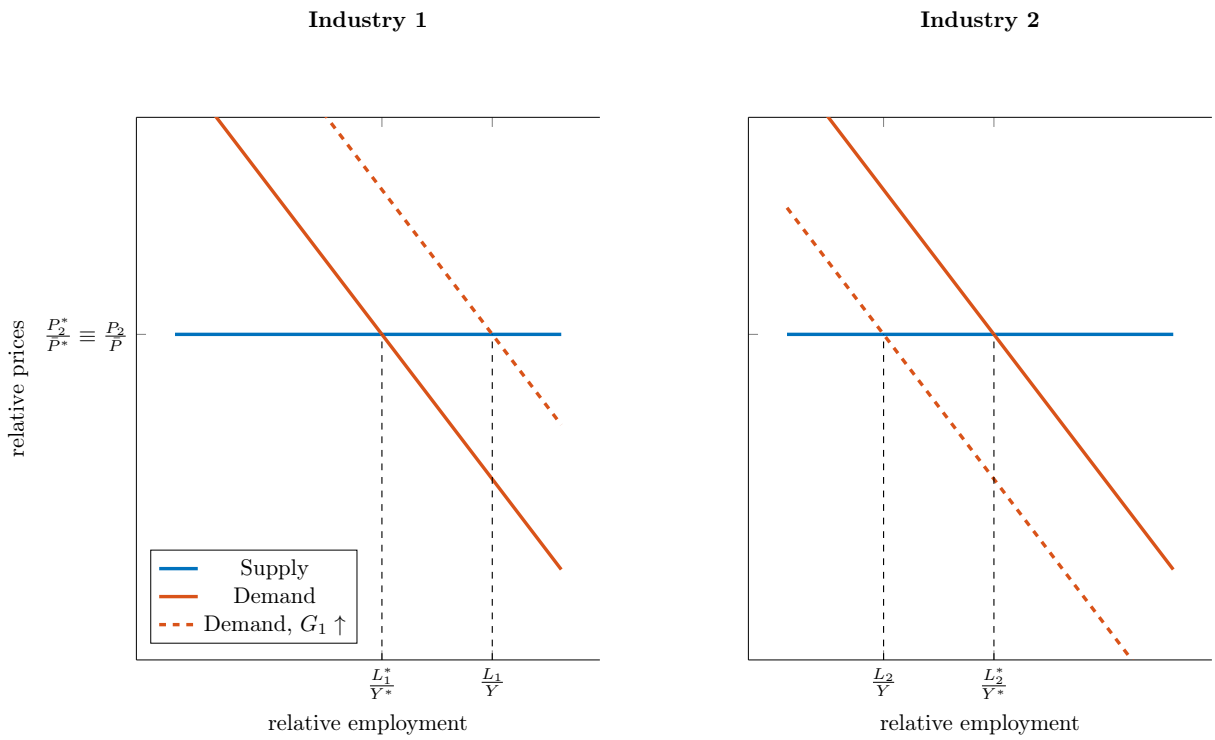


Figure 1: Industry-level demand and supply responses to an increase in government spending, when $\beta_{G1} > \beta_{G2}$

Notably, industry-level supply curves are horizontal. We can see this from equation (7), where industry-level prices only depend on aggregate employment y. In particular, they do not depend on industry-level employment or on the government's expenditure shares β.

This is because industries draw resources from a common labor market, therefore their costs depend on a common wage w_t, as we can see from the real marginal cost Phillips curves (2). The wage in turn depends on employment of a single labor factor, through the consumption-leisure tradeoff. All that government spending does is changing demand for this single labor factor. The effect on wages and prices is the same, regardless of the spending composition.

As a key implication, the aggregate supply curve (8) – which is as an average of industry-level ones – only depends on aggregate employment, not on the government's expenditure shares β. Notably, this holds even if the two industries have different price adjustment probabilities:

$$\left(1-\bar{\delta}\right)\bar{\pi}_t = \bar{\delta}\left[\left(\gamma+\varphi\right)y_t - \gamma\frac{ds_{Gt}}{1-s_G^*}\right] + \Upsilon\left(\boldsymbol{p}_{t-1}, \mathbb{E}\boldsymbol{\pi}_{t+1}\right), \tag{8}$$

where $\bar{\delta}$ denotes the consumption-weighted average $\hat{\delta}$ and Υ depends on lagged and expected price dynamics.

When prices are fully flexible ($\hat{\delta} = 1$) the aggregate supply curve is vertical, so that output is entirely determined by the supply shift: $y_t = \frac{\gamma}{\gamma+\varphi}\frac{ds_{Gt}}{1-s_G^*}$. With nominal rigidities, equilibrium output and prices are determined by the intersection between aggregate demand (6) and supply (7), as represented in figure 2.

The solid lines in figure 2 denote initial supply and demand curves, while the dashed lines denote shifted curves, after an increase in government spending takes place. Point A is the initial equilibrium, while point B is the final equilibrium. Crucially, in figure 2 neither supply nor demand shifts depend on the spending composition. When all industries draw from the same pool of freely mobile production factors, government purchases in any industry simply bid up the common factor price, generating identical inflation and output responses.

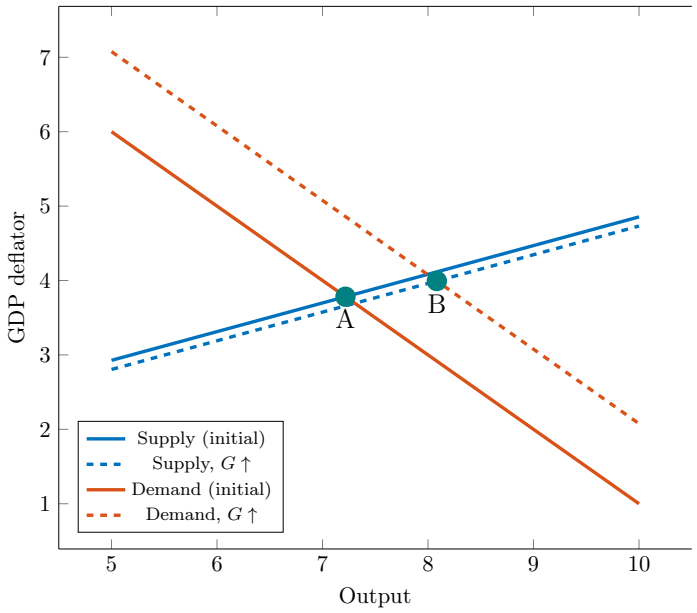


Figure 2: Demand and supply shifts in response to government spending (multi-industry economy with a single primary factor).

2.2 Multiple Heterogeneous Primary Factors: the Spending Composition Matters

Consider now a version of the model where labor markets are segmented across industries, with $V(L_{1t}, L_{2t}) = \sum_i \frac{L_{it}^{1+\varphi_i}}{1+\varphi_i}$. Labor cannot be reallocated between occupations 1 and 2, so that increasing demand for industry i now bids up relative demand for occupation i.

Factor-specific supply slopes. Compared to proposition 2.1, the relative demand equation (3), the Euler equation (4) and the Taylor rule (5) remain unchanged. Thus, aggregate demand is the same as in the benchmark model (6). Factor market segmentation instead matters for the supply-side of the economy. The consumption-leisure and pricing equations now depend on industry-specific employment and wages:

$$w_{it} = \varphi_i \ell_{it} + \gamma \left(y_t - \frac{ds_{Gt}}{1 - s_G^*} \right) + \bar{p}_t \tag{9}$$

$$p_{it} = \hat{\delta}_i w_{it} + \left(1 - \hat{\delta}_i\right) \left(p_{it-1} + \rho \mathbb{E}\pi_{it+1}\right) \tag{10}$$

Let's start by analyzing relative industry-level demand and supply, like we did before. As we said, relative demand (3) is the same as in the one-factor model. Proposition 2.2 derives factor supply curves.

Proposition 2.2. Factor supply curves. *Factor supply curves are given by*

$$p_{it} - \bar{p}_t = \hat{\delta}_i \varphi_i \left(\ell_{it} - y_t\right) + \hat{\delta}_i \left[\left(\gamma + \varphi_i\right) y_t - \gamma \frac{ds_{Gt}}{1 - s_G^*}\right] + \left(1 - \hat{\delta}_i\right) \left(p_{it-1} + \rho \mathbb{E}\pi_{it+1} - \bar{p}_t\right). \tag{11}$$

Proof. Equation (11) is obtained by combining equations (9) and (10). □

Unlike equation (8) in the baseline model, where supply curves are horizontal in the (relative employment, relative price) space, now supply curves are upward sloping. With segmented labor markets, each industry i's price (11) specifically depends on employment of worker type i.

Figure 3 depicts industry-level demand and supply in the (relative employment, relative price) space.

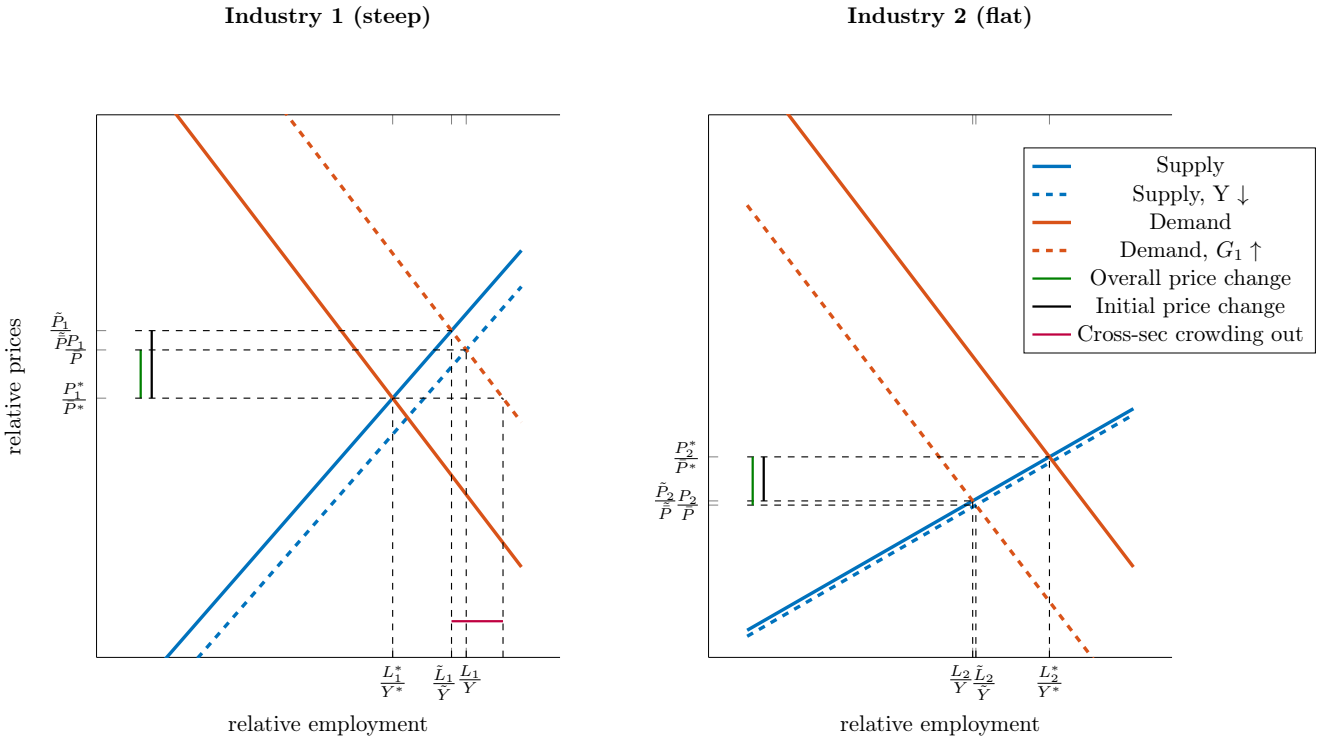


Figure 3: Industry-level demand and supply responses to an increase in government spending ...with $\beta_{G1} > \beta_{G2}$, and to the implied decline in aggregate output.

Notably, the two factors have different supply slopes. More inelastic factors (higher φ_i) or factors used by industries with more flexible prices (higher $\hat{\delta}_i$) have steeper supply curves. In addition, aggregate output enters factor supply curves as a shifter. For given y, the factor with steeper slope typically has a larger shift. Both the slope

and the shift capture responses to increasing employment, thus reflecting the same mechanism: employment has a larger incidence on prices in industries which use inelastically supplied factors or which have more flexible prices.

Equation (11) and figure 3 tell us that increasing relative employment of the factor with a steeper supply curve raises prices in its own industry by more than it lowers prices in the other industry. Likewise, increasing aggregate output raises prices in the steep industry by more. Below, we will see how these two conditions pin down the response of aggregate supply to targeted government spending.

Demand reallocation, heterogeneous supply slopes, and aggregate multipliers. To study how aggregate supply responds to government spending, consider how aggregate output must change at constant aggregate prices.

As figure 3 illustrates, increasing government demand for the factor with a steeper supply curve raises prices in the steep industry by more than it reduces prices in the flat industry. Initial price changes are represented by the black bars in figure 3. If aggregate prices remain constant, however, price changes in the two industries must be of equal size and opposite sign. The only way to achieve this is reducing aggregate output. Prices decline in both industries, so that the steep industry ends up facing a smaller price increase, while the flat industry faces a larger price decline. Overall price changes are represented by the green bars in figure 3.

Thus, by reallocating demand across primary factors, government spending shifts the aggregate supply curve (12): directing government spending toward factors with steeper supply curves reduces output at constant prices. Intuitively, when government spending uses a costlier combination of primary factors to produce real GDP, increasing the spending share reduces aggregate output. Proposition 2.3 formalizes this key insight.

Proposition 2.3. Aggregate supply shift. *The aggregate supply curve is given by*

$$\left(1-\underline{\hat{\delta}}\right)\bar{\pi}_t = \left(\underline{\hat{\delta}\gamma}+\underline{\hat{\delta}\varphi}\right)y_t - \left(\underline{\hat{\delta}\gamma} - \frac{Cov\left(\hat{\delta}\varphi,\beta_G\right)}{1+\theta\overline{\delta\varphi}}\right)\frac{ds_{Gt}}{1-s_G^*} + \Upsilon\left(\boldsymbol{p}_{t-1},\mathbb{E}\boldsymbol{\pi}_{t+1}\right), \tag{12}$$

where $\underline{x}$ denotes expenditure-switching adjusted averages across factors.[8] *When the government has a larger expenditure share than private households on the factor with a steeper supply curve ($\beta_{Gi} > \frac{1}{2}$ for the industry i with $\hat{\delta}_i\varphi_i > \hat{\delta}_j\varphi_j$), increasing government spending shifts aggregate supply inward.*

Proof. The aggregate supply curve (12) combines relative demand (3) and factor-specific supply curves (11). □

The supply shift (12) has two components: conventional wealth effects, and a new reallocation effect. The reallocation term depends on the covariance between spending composition and factor supply slopes. Raising demand for workers with steeper supply curves – a positive covariance $Cov\left(\hat{\delta}\varphi,\beta_G\right) > 0$ – increases aggregate prices for given output, shifting aggregate supply inward, and vice versa.

[8] $\underline{x} \equiv \bar{x}\left(1-\frac{1}{4}\frac{\theta\overline{\delta\varphi}}{1+\theta\overline{\delta\varphi}}\frac{\hat{\delta}_i\varphi_i-\hat{\delta}_j\varphi_j}{\overline{\delta\varphi}}\frac{x_i-\bar{x}}{\bar{x}}\right)$ and $\bar{x} = \frac{1}{2}(x_i+x_j)$. See section 2.2 for a detailed explanation of relative factor demand and expenditure switching.

In principle one can construct many aggregate supply curves, depending on how the two industries are weighted in the aggregate price index. With flexible prices, all supply curves are shifted by the same amount. With sticky prices, different price indices yield different supply shifts. In New Keynesian jargon, supply shifts imply an inflation-output tradeoff. Equilibrium dynamics depend on the full price distribution, and on which price index is targeted by the Taylor rule.

The price index in the Taylor rule is particularly important, as its inflation-output tradeoff determines the monetary response. Proposition 2.3 focuses on the GDP deflator, because this is the most common inflation target. Corollary 2.1 explicitly derives flex-price output, and inflation-output tradeoff for the GDP deflator.

Corollary 2.1. Flex-price output and Inflation-output tradeoff. *The flex-price output is given by*

$$y^{RBC} = \frac{1}{\gamma + \bar{\varphi}} \left[\gamma - \frac{Cov\left(\varphi, \beta_G\right)}{1 + \theta \bar{\varphi}} \right] \frac{ds_G}{1 - s_G^*}, \tag{13}$$

while the GDP deflator has inflation-output tradeoff

$$\bar{\pi}_t \mid_{y=0} = - \left(\frac{\hat{\delta}\gamma}{1 - \underline{\hat{\delta}}} - \frac{1}{1 - \underline{\hat{\delta}}} \frac{Cov\left(\hat{\delta}\varphi, \beta_G\right)}{1 + \theta \overline{\delta\varphi}} \right) \frac{ds_{Gt}}{1 - s_G^*}. \tag{14}$$

Like in conventional models, government spending raises flex-price output and improves the inflation-output tradeoff through wealth effects in labor supply (first term in equations (13) and (14)). With segmented factor markets, reallocation effects (captured by the covariance terms) further increase the flex-price output and improve the inflation-output tradeoff if and only if government spending increases the demand for elastically supplied factors, or for factors employed by industries with stickier prices.

Figure 4 illustrates the aggregate response to an increase in government spending, depending on the industry composition of the government bundle. Aggregate supply is computed using the same price index as the Taylor rule (in our example, the GDP deflator), keeping future prices constant. The solid lines describe initial demand and supply curves, generating the equilibrium point A. The blue dashed line plots the wealth effect component of the supply shift, which by itself would imply equilibrium point B. The dotted blue line describes the full supply shift, including both wealth and reallocation effects, yielding the new equilibrium point C. The reallocation effect – captured by the difference between dashed and dotted lines – arises only with segmented factor markets. It depends on the spending composition, and is much larger than the wealth effect. Due to this reallocation effect, the aggregate multiplier is smaller when the government has a larger expenditure share on the industry with more flexible prices ($\delta_1 > \delta_2$) and/or less elastically supplied labor ($\varphi_1 > \varphi_2$) – and vice versa.

Following equation (12), aggregate multipliers crucially depend on how government spending reallocates demand across primary factors. The next paragraph examines the effect of government spending on relative factor demand in greater detail.

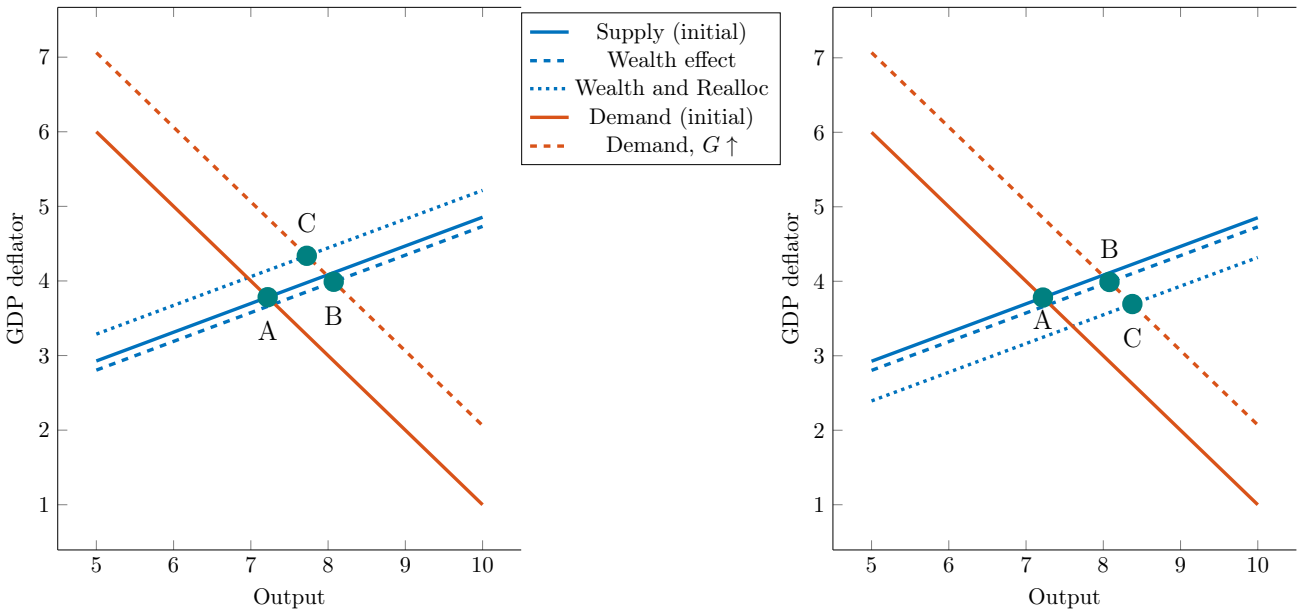


Figure 4: Reallocation effects of raising government spending. Left: Spending on steep supply industry shifts aggregate supply inward. Right: Spending on flat supply industry shifts aggregate supply outward. Blue dots denote equilibrium outcomes (A: initial; B: wealth effects only; C: full model).

Direct demand incidence and cross-sectional crowding out. Proposition 2.4 decomposes the response of relative factor demand to spending into a direct effect and an offsetting general equilibrium effect, which I refer to as cross-sectional crowding out of private demand.

Proposition 2.4. Cross-sectional crowding out. *Increasing government spending changes relative factor demand by*[9]

$$\frac{\partial\left(\ell_{it}-y_t\right)}{\partial s_G}=\left[1-\frac{\theta\hat{\delta\varphi}}{1+\theta\hat{\delta\varphi}}\right]\frac{\beta_{Gi}-\frac{1}{2}}{1-s_G^*}. \tag{15}$$

In equation (15) government spending has a direct effect on relative demand, equal to the difference between household and government consumption shares $\beta_{Gi}-\frac{1}{2}$. The cross-sectional crowding out effect $-\frac{\theta\hat{\delta\varphi}}{1+\theta\hat{\delta\varphi}}$ captures how rising relative prices (according to the supply slope $\hat{\delta\varphi}$) cause consumers to substitute toward good j (according to the substitution elasticity θ), partially offsetting the initial demand shift.[10]

General equilibrium forces counteract market segmentation: even when factors cannot be physically reallocated, there are offsetting demand spillovers through expenditure switching. This general equilibrium effect is represented

[9]Partial derivatives are taken for constant aggregate prices and future variables, while letting current relative prices and aggregate output adjust.

[10]I denoted $\hat{\delta\varphi}\equiv\overline{\delta\varphi}\left[1-\frac{\delta_i\varphi_i-\overline{\delta\varphi}}{\delta\varphi}\frac{\delta_i(\gamma+\varphi_i)-\overline{\delta(\gamma+\varphi)}}{\delta(\gamma+\varphi)}\right]$.

by the purple bar in figure 3. The offsetting is stronger when factors are better substitutes (higher θ), but the spending composition continues to matter as long as factors are not perfect substitutes.

2.3 Taking Stock

Main results. The simplified model establishes three key results. First, multiple heterogeneous primary factors traded on segmented markets are necessary for the spending composition to affect aggregate multipliers; second, aggregate outcomes depend on the covariance between spending shares and factor-specific supply slopes; third, cross-sectional crowding out partially offsets the direct incidence of government spending on relative factor demand. These three results extend to the general model, presented in sections 3 and 4.

What's missing in the simplified model? While capturing all fundamental economic mechanisms, the two-factor model presented in this section misses important realistic elements.

For concreteness, the simplified model labels the two primary factors as distinct labor types. In reality there are many different primary factors – not only labor, but also land, equipment, structures, raw materials, intellectual property, etc. The general model establishes that identical economic mechanisms apply whenever multiple differentiated factors cannot be freely repurposed – workers cannot switch occupations, land cannot become labor, and so on. Modeling the supply of non-labor factors is important. These factors have a different supply elasticity compared to labor, thereby making spending multipliers dependent on the labor intensity of the spending bundle. Moreover, the presence of non-labor factors drives a wedge between employment and output multipliers.

In addition, factor market boundaries typically do not coincide with industry boundaries. For example, the same labor occupations or equipment types could be used by multiple industries. On top of this, input-output linkages drive a wedge between direct and total factor contents. These elements do not change the core economic mechanisms, but they do change the way we compute factor supply slopes and relative demand elasticities from micro-level primitives. In particular, the effective supply slope for each factor depends not just on its own Frisch elasticity and price adjustment frequency, but on the stickiness and factor intensities of all industries that use it as an input. Likewise, relative demand slopes depend on substitution in both final consumption and intermediate inputs.

Beside accounting for realistic production features, the general model also distinguishes between government goods – defense, infrastructure, public administration, unavailable for private purchase – and government-provided market goods, such as healthcare and education.

Finally, to fully account for the redistributive implications of government spending, the general model abandons the representative household assumption. Households are differentially exposed to government spending because of their different labor occupations, ownership of non-labor assets, and consumption bundles. In response to spending shocks, they can smooth consumption through asset trades.

3 General Environment

This section introduces a general environment with multiple heterogeneous industries, primary factors, and final users. The general model extends the simple two-industry framework of section 2, while preserving analytical tractability and key insights. First and foremost, its value added consists in providing correct measures of demand incidences and factor supply slopes given real-world input shares and labor market boundaries.

Framework Overview. Industries $i, j \in \mathcal{N}$ produce goods using different combinations of primary factors and intermediate inputs. Primary factors $f \in \mathcal{F}$ include differentiated labor occupations $f \in \mathcal{L}$ and semi-fixed assets $f \in \mathcal{K}$ (land, equipment, structures). The crucial feature of the simple model is preserved: factor markets are segmented, meaning that different factor types cannot be repurposed interchangeably. Final users $z \in \mathcal{Z}$ comprise households $z \in \mathcal{H}$, asset utilization producers $z \in \mathcal{U}$, and the government G. Households supply different labor occupations, own shares in firms and primary factors, and optimally allocate returns from semi-fixed assets between consumption and utilization. Government spending takes two forms: provision of non-market goods and provision of market goods free of charge.

3.1 Production

Industry i firms produce differentiated varieties x using constant returns to scale technologies:

$$Y_{ixt} = G_i(\{L_{ifxt}\}_{f\in\mathcal{F}}, \{X_{ijxt}\}_{j=1}^{N})$$

where L_{ifxt} is primary factor f usage and X_{ijxt} is intermediate input j usage.

Customers purchase CES bundles of varieties Y_i with industry-specific elasticity of substitution ϵ_i and price index P_i:

$$Y_i = \left(\int Y_{ix}^{\frac{\epsilon_i-1}{\epsilon_i}} dx\right)^{\frac{\epsilon_i}{\epsilon_i-1}}, \quad P_i = \left(\int P_{ix}^{1-\epsilon_i} dx\right)^{\frac{1}{1-\epsilon_i}}.$$

All firms minimize costs given input prices. With constant returns to scale they all face the same industry-level marginal cost

$$MC_i = \min_{\{X_{ij}\},\{L_{if}\}} \sum_{f\in\mathcal{F}} W_f L_{if} + \sum_{j\in\mathcal{N}} P_j X_{ij} \text{ s.t. } G_i(\{L_{if}\},\{X_{ij}\}) = 1 \tag{16}$$

The elasticity of substitution between inputs j and k in production of good i is

$$\theta_{jk}^i \equiv -\frac{d\log\frac{X_{ij}}{X_{ik}}}{d\log\frac{P_j}{P_k}}.$$

Firms are subject to Calvo frictions, so that only a fraction δ_i can adjust prices each period, setting:

$$P^*_{ixt} = \frac{\epsilon_{it}}{\epsilon_{it}-1}\frac{\mathbb{E}\sum_s[SDF_{t+s}(1-\delta_i)^s Y_{ixt+s}(1-\tau_{it+s})MC_{it+s}]}{\mathbb{E}\sum_s[SDF_{t+s}(1-\delta_i)^s Y_{ixt+s}]} \tag{17}$$

where SDF_{t+s} is the stochastic discount factor between periods t and $t+s$.

Assumption 3.1 is standard in the literature, and it guarantees that the initial equilibrium is efficient.

Assumption 3.1. Input subsidies are in place, such that in the initial equilibrium all producers charge unit markups on pre-subsidy marginal costs.

Non-labor primary factors. Industries use as inputs labor occupations and non-labor primary factors, such as land, equipment, structures, intellectual property, etc. Accounting for non-labor factors is important, because non-labor shares in value added vary widely across industries, and non-labor factors tend to be inelastically supplied in the short run. I model them through a stylized asset utilization framework, which accounts for non-labor shares in value added and heterogeneous supply elasticities in a tractable way. See appendix A for a detailed description.

3.2 Heterogeneous Households and Segmented Labor Markets

Household $z \in \mathcal{H}$ has preferences represented by the utility function

$$\sum_{t=0}^{\infty} e^{-\rho t}\left[\frac{C_{zt}^{1-\gamma}}{1-\gamma} - \sum_{f\in\mathcal{L}}\frac{L_{zft}^{1+\varphi_f}}{1+\varphi_f} + \mathcal{G}_{zt}\right], \tag{18}$$

where C_{zt} denotes a homothetic consumption aggregator $C_{zt} \equiv \mathcal{C}_{zt}\left(\{c_{zit}\}_{i\in\mathcal{N}\setminus\mathcal{N}_G}\right)$ over *market goods*, and $\mathcal{G}_z$ is utility from *government goods*. The parameter γ governs both intertemporal substitution and wealth effects in labor supply. The households supply differentiated labor occupations f, with inverse Frisch elasticity φ_f.

Household z's total consumption of market good i is $c_{zi} = c_{zi}^{mkt} + G_{zi}^{mkt}$, where c_{zi}^{mkt} represents household purchases and G_{zi}^{mkt} represents government-provided quantities. For simplicity, I assume that all households consume strictly more market goods than the government provides them with ($c_{zi} > G_{zi}^{mkt}$ for all households z and all market goods i with $G_{zi}^{mkt} > 0$). The elasticity of substitution between goods i and j in the consumption of household z is

$$\theta_{ij}^C \equiv -\frac{d\log\frac{c_i}{c_j}}{d\log\frac{P_i}{P_j}}.$$

Given government provision, interest rates, and market prices, households maximize lifetime utility subject to the intertemporal budget constraint:

$$\sum_{t=0}^{\infty} e^{-\rho t} P_{zt}^C C_{zt} \leq \sum_{t=0}^{\infty} e^{-\rho t}\left[\sum_{f\in\mathcal{F}}\hat{\Xi}_{zf}W_f L_f + \sum_{i\in\mathcal{N}}\hat{\Xi}_{zi}\Pi_{it} + \sum_{i\in\mathcal{N}} P_i G_{zi}^{mkt} - T_{zt}\right], \tag{19}$$

where $P_{zt}^{\mathcal{C}}$ is the price index implied by the consumption aggregator $\mathcal{C}_z$, W_{ft} is the nominal wage earned by factor f, $\hat{\Xi}_{zf}$ and $\hat{\Xi}_{zi}$ are the ownership shares of household z in primary factor f and industry i, Π_{it} are profits in industry i, and T_{zt} is a lump-sum tax paid by household z to the government. I use the same notation W_f and L_f for the prices and quantities of labor and non-labor factors, to emphasize that both are primary factors of production. For labor occupations $f \in \mathcal{L}$, $\hat{\Xi}_{zf}$ simply represents the share of household z in the headcount of occupation f.

Households make labor supply decisions across multiple occupations, determined by the consumption-leisure tradeoff

$$C_{zt}^{\gamma} L_{zft}^{\varphi_f} = \frac{W_{ft}}{P_{zt}^{\mathcal{C}}}, \ \forall z \in \mathcal{H}, f \in \mathcal{L}. \tag{20}$$

Labor markets are fully segmented, hence wages differ across occupations. I account for wage rigidities by including occupation-specific labor unions, facing Calvo-style price rigidities, who hire workers and sell their services to firms.[11]

Households also trade a risk-free asset – in zero net supply, with nominal interest rate i_t – and shares in firms and semi-fixed assets. The optimal consumption-saving choice follows a standard Euler equation

$$\frac{C_{zt+1}}{C_{zt}} = \left[\frac{1 + i_{t+1}}{e^{-\rho}} \frac{P_{zt}^{\mathcal{C}}}{P_{zt+1}^{\mathcal{C}}} \right]^{\frac{1}{\gamma}}, \ \forall z \in \mathcal{H}. \tag{21}$$

The rates of return on firm shares and non-labor factors satisfy analogous Euler equations. Optimal asset trades determine the households' net borrowing.

3.3 Policy Instruments

Monetary policy. The central bank sets the nominal interest rate i_t following a conventional Taylor rule:

$$i_t - \log \rho = \boldsymbol{\phi}_{\pi} \boldsymbol{\pi}_t + \phi_y y_t, \tag{22}$$

where $\boldsymbol{\phi}_{\pi} \boldsymbol{\pi}_t$ is an aggregate inflation target and y_t denotes the log-deviation of real GDP from steady state.

Government spending. The government chooses the share of nominal GDP devoted to the provision of government goods (like defense, infrastructure, and public administration), the industry composition of government goods, and the value of market goods (like education and healthcare) allocated to each household. To formalize these decisions, I introduce the following notation.

Definition 3.1. The share of spending on government goods relative to nominal GDP is denoted $s_G^{\mathcal{G}}$. The government's expenditure share on industry $i \in \mathcal{N}_G$ relative to total expenditure on government goods is denoted

[11] Due to the Calvo friction, different unions hiring the same occupation $f \in \mathcal{L}$ might charge different prices. For simplicity I assume that ownership of each f-specific union is shared among households proportionately to their headcount in occupation f. This guarantees that all units of f-type labor are paid the same price, equal to the average price charged by f-specific unions.

$\Omega^{\mathcal{G}}_{Gi}$. The value of market goods received free of charge by household h as a share of total GDP is denoted $\left(s^{\mathcal{C}}_G\right)_h$. The overall share of spending on market goods relative to GDP is $\bar{s}^{\mathcal{C}}_G \equiv \sum_{h\in\mathcal{H}} \left(s^{\mathcal{C}}_G\right)_h$.

Government spending is financed through lump-sum taxes, proportional to the households' income shares relative to total household income $\bar{s}_{\mathcal{H}} \equiv \sum_{z\in\mathcal{H}} s_z$:

$$\frac{T_{ht}}{GDP} = \frac{s_h}{\bar{s}_{\mathcal{H}}}\left(s^{\mathcal{G}}_G + \bar{s}^{\mathcal{C}}_G\right), \ \forall h \in \mathcal{H}.$$

3.4 General Equilibrium and Aggregation

The model's equilibrium concept builds on Baqaee and Farhi (2020), extended to account for endogenous markups under pricing frictions. Given sectoral markups, all markets must clear; and the evolution of markups must be consistent with realized cost changes and Calvo price setting. This equilibrium definition encompasses flexible prices as a special case, when $\delta_i = 1$ for all industries.

Definition 3.2. At each period t, for given sectoral probabilities of price adjustment δ_i, and given monetary and fiscal policies, the general equilibrium is given by a vector of firm-level markups $\mathcal{M}_{ixt}$, a vector of sectoral prices P_{it}, a vector of factor-specific nominal wages W_{ft} for all primary factors, a vector of factor supplies L_{ft}, a vector of sectoral outputs Y_{it}, a matrix of intermediate input quantities X_{ijt}, and a matrix of final demands C_{izt}, such that: (i) a fraction δ_i of firms in each sector i charges the profit-maximizing price given by (17); (ii) the markup charged by adjusting firms is given by the ratio of the profit-maximizing price and marginal costs, while the markups of non-adjusting firms are such that their price remains constant; (iii) agents maximize utility subject to their budget constraint; (iv) producers in each sector i minimize costs and charge the relevant markup; and (v) markets for all goods and primary factors clear.

Aggregation. To analyze individual and aggregate outcomes, I define measures of GDP, the GDP deflator, and income shares of primary factors and final users. Throughout, I denote steady-state variables with a star.

Definition 3.3. Aggregate *nominal GDP* equals total final expenditure, $GDP = \sum_{z\in\mathcal{Z}} P^C_z C_z$. The *income shares* of final users are given by $s_z \equiv \frac{P^C_z C_z}{GDP}$ for $z \in \mathcal{Z}$, while the income shares of primary factors are given by $\bar{\Psi}_f \equiv \frac{W_f L_f}{GDP}$ for $f \in \mathcal{F}$. Infinitesimal changes in *real GDP* are defined as $d\log Y_t = \sum_{z\in\mathcal{Z}} s^*_z d\log C_{zt}$, while changes in the *GDP deflator* are defined as $d\log P^Y_t = \sum_{z\in\mathcal{Z}} s^*_z d\log P^C_{zt}$.

Remark 3.1. Around an efficient equilibrium, and for constant industry-level productivity, changes in real GDP equal the income-weighted sum of changes in primary factor quantities:

$$d\log Y_t = \sum_{f\in\mathcal{F}} \bar{\Psi}^*_f d\log L_{ft}.$$

3.5 Log-Linearized Model Notation

For analytical tractability, I work with a log-linearized version of the model. Table 1 introduces the model variables. The log-linear approximation is fully described by steady-state expenditure shares and elasticities, introduced in tables 2 and 3. All throughout, I use lower case letters to denote log-deviations from the initial steady state.

Endogenous variables and shocks. In order to obtain interpretable formulas, with a clear counterpart in the simple model of section 2, I collect the variables pertaining to each group of agents (primary factors, industries, and final users) into vectors, whose components correspond to individual agents. To better distinguish them from individual components, vectors are boldfaced. Using this notation, table 1 summarizes the model variables.

Variable	**Definition**
Aggregate output	$\bar{y}_t \equiv \log \frac{Y_t}{Y^*}$
Employment of primary factors	$\boldsymbol{\ell}_t = (\ell_{1t}, ..., \ell_{Ft})^T$ where $\ell_{ft} \equiv \log \frac{L_{f,t}}{L_f^*}$
Final users consumption	$\boldsymbol{c}_t = (c_{1t}, ..., c_{Zt})^T$ where $c_{zt} \equiv \log \frac{C_{zt}}{C_z^*}$
Industry-level prices	$\boldsymbol{p}_t = (p_{1t}, ..., p_{Nt})^T$ where $p_{it} \equiv \log \frac{P_{i,t}}{P_i^*}$
Industry-level inflation	$\boldsymbol{\pi}_t = (\pi_{1t}, ..., \pi_{Nt})^T$ where $\pi_{it} \equiv p_{it} - p_{i,t-1}$
Nominal interest rate	i_{t+1}
Spending shares in GDP	$s_G^{\mathcal{G}}$ (government goods), $\boldsymbol{s}_G^{\mathcal{C}}$ (market goods)
Spending composition	$\boldsymbol{\Omega}_G^{\mathcal{G}}$ (government goods)

Table 1: Model variables

Income flows and expenditure shares. Section 2 relied on simplifying assumptions about the income flows and expenditure shares in the economy (each industry uses a single primary factor, all households own equal shares in all industries and primary factors). Section 4 shows that the same economic mechanisms hold in a general setting. To describe this general setting, table 2 introduces a flexible notation for the industries' expenditures on primary factors and intermediate inputs, and for the final users' expenditures and ownership shares in industries and primary factors.

Importantly, I encode direct expenditure shares in the matrix Ω, whose ij-th element corresponds to the expenditure share of agent i on j. I define Ω to include factor marketplaces and final users as well, and extend the set $\mathcal{N}$ accordingly. I instead encode total expenditures (direct and through intermediate inputs) of i on j in the matrix $\Psi_{ij} \equiv (I - \Omega)^{-1}_{ij}$. As a convention, I denote by $\Omega_{\mathcal{Z}:}$ and $\Psi_{\mathcal{Z}:}$ the rows corresponding to final users, and by $\Omega_{:\mathcal{F}}$ and $\Psi_{:\mathcal{F}}$ the columns corresponding to labor unions and asset marketplaces. In particular, the block $\Psi_{\mathcal{Z}\mathcal{F}}$ represents the total content of primary factors in final uses. I adopt the same notation to indicate the rows and columns corresponding to final users and primary factors in all other matrices as well.

Parameter	Notation	Definition
Expenditure shares	$\Omega \in \mathbb{R}^{\lvert\mathcal{N}\rvert\times\lvert\mathcal{N}\rvert}$	$\Omega_{ij} = \frac{P_j^* X_{ij}^*}{P_i^* Y_i^*}$
Leontief inverse	Ψ	$\Psi \equiv (I - \Omega)^{-1}$
Final users' income shares	$\mathbf{s} \in \mathbb{R}^{\lvert\mathcal{Z}\rvert}$	$s_h \equiv \frac{P_h^C C_h}{GDP}$
Primary factors' income shares	$\bar{\mathbf{\Psi}}_{\mathcal{F}} \in \mathbb{R}^{\lvert\mathcal{F}\rvert}$	$\bar{\Psi}_f \equiv \frac{W_f L_f}{GDP}$
Ownership shares	$\Xi \in \mathbb{R}^{\lvert\mathcal{Z}\rvert\times\lvert\mathcal{N}\rvert}$	See Appendix A
GDP deflator	$\bar{p}$	$\boldsymbol{s}^T \Omega_{\mathcal{Z}:} \boldsymbol{p}$

Table 2: Expenditure and ownership shares

Elasticities. Table 3 introduces a compact matrix notation for demand, supply, and pricing elasticities, which generalize the scalar elasticities from section 2. Elasticity matrices describe supply and demand relations between the vector variables in Table 1, capturing both own-effects and cross-effects among different agents. The table reports notation for elasticity matrices in the general model, alongside the corresponding scalar notation from the two-sector model. Formal definitions are reported in Appendix A.

Parameter	Notation	Simple model
Wealth effects in factor supply	$\Gamma \in \mathbb{R}^{\lvert\mathcal{F}\rvert\times\lvert\mathcal{Z}\rvert}$	γ
Factor supply elasticities	$\Phi \in \mathbb{R}^{\lvert\mathcal{F}\rvert\times\lvert\mathcal{F}\rvert}$	φ_i
Factor price deflators	$\beta^T \boldsymbol{p}$, $\beta \in \mathbb{R}^{\lvert\mathcal{N}\rvert\times\lvert\mathcal{F}\rvert}$	$\bar{p}$
Nominal rate deflator	$\pi^R \in \mathbb{R}$	$\bar{\pi}$
Price pass-through	$\mathcal{P} \in \mathbb{R}^{\lvert\mathcal{N}\rvert\times\lvert\mathcal{N}\rvert}$	$\hat{\delta}_i$
Demand elasticity	$\Theta \in \mathbb{R}^{\lvert\mathcal{F}\rvert\times\lvert\mathcal{N}\rvert}$	θ

Table 3: Elasticities

4 Aggregate and Cross-Sectional Spending Multipliers

This section extends the two-factor example from section 2 to analyze aggregate spending multipliers and income redistribution in a general setting with any number of industries, heterogeneous primary factors, and households.

The general framework extends the simpler model in section 2 by allowing a more flexible representation of factor market boundaries, without imposing a one-for-one mapping between industries and factor markets. This requires rethinking the definition of factor supply slopes and the incidence of government spending on factor demand.

The key insights remain unchanged: government spending reallocates demand across primary factors (proposition 4.1), which have different supply slopes (proposition 4.2). This results in an expansionary aggregate supply shift whenever government spending targets factors with flatter supply curves, and vice versa (proposition 4.3). Cross-sectional crowding out of private expenditure partially offsets the direct impact of government spending on relative factor demand in general equilibrium (proposition 4.4). Corollary 4.1 formally establishes that factor

market segmentation and heterogeneous supply slopes are necessary and sufficient for the industry composition of government spending to affect aggregate multipliers. Moreover, supply slopes are heterogeneous if and only if factors have different supply elasticities or face different network-adjusted nominal rigidities.

Section 4.1 introduces the log-linearized equilibrium. The following subsections analyze how the economy responds to government spending shocks. As in conventional models, the economy exhibits rich dynamics because of forward-looking pricing, consumption, and monetary policy decisions. In addition, relative permanent income changes across households $\boldsymbol{\xi}$ depend on the entire future path of prices and employment. To analyze this complex dynamic system, I rearrange the equilibrium equations in three groups. The first describes aggregate demand and relative permanent income shifts (section 4.2). The second consists in industry-level supply curves, which get shifted by government spending and its industry composition (section 4.3). These two sets of equations are sufficient to characterize the dynamics of industry-level prices and aggregate output (section 4.4). The last set of equations (section 4.5) solves for cross-sectional employment given price and output dynamics.

4.1 Log-linearized Equilibrium

Proposition 4.1 extends proposition 2.1. The equilibrium system (23) generalizes equations (1) - (5) from the two-factor model, using the vector-matrix notation introduced in section 3.5. This notation transparently extends the simple model, by maintaining a similar structure while capturing all interconnections among disaggregated units.

The equilibrium system is expressed in terms of disaggregated variables (factor-specific employment, industry-specific prices), while aggregate outcomes are given by appropriately weighted averages.

Proposition 4.1. Log-linearized equilibrium. *Defining variables as in table 1 and elasticities as in table 3, the log-linearized equilibrium is characterized by the following five equations.*

$$\begin{cases} \boldsymbol{w}_t = & \Phi\boldsymbol{\ell}_t + \beta^T\boldsymbol{p}_t + \Gamma\left(\boldsymbol{\xi} - \mathbf{1}\frac{ds^{\mathcal{G}}_{Gt}}{\bar{s}_{\mathcal{H}}}\right) \\ \boldsymbol{p}_t = & \mathcal{P}_{:\mathcal{F}}\boldsymbol{w}_t + \left(I - \mathcal{P}\Psi^{-1}\right)\left(\boldsymbol{p}_{t-1} + \rho\mathbb{E}\boldsymbol{\pi}_{t+1}\right) \\ \boldsymbol{\ell}_t = & \mathbf{1}y_t - \Theta\boldsymbol{p}_t + \boldsymbol{\mathcal{D}}_{Gt} \\ \boldsymbol{c}_{\mathcal{H},t+1} = & \boldsymbol{c}_{\mathcal{H},t} + \frac{1}{\gamma}\left(\mathbf{1}i_t - \log\rho - \Omega_{\mathcal{H}:}\boldsymbol{\pi}_{t+1}\right) \\ i_t - \log\rho = & \phi_y\bar{y}_t + \boldsymbol{\phi}_\pi\boldsymbol{\pi}_t + \epsilon_t. \end{cases} \tag{23}$$

The vector $\boldsymbol{\xi}$ captures differential changes in the present value of income across households, with $\sum_{h\in\mathcal{H}} s_h\xi_h = 0$ and $\boldsymbol{\xi}_{\mathcal{U}} = \mathbf{0}$ for utilization producers.

Proof. The system (23) is obtained by log-linearizing the equilibrium conditions (16), (17), (19), (20), (21), optimal utilization of non-labor factors, and solving for consumption using the final users' budget constraints. Changes in relative present values of income $\boldsymbol{\xi}$ are derived in section 4.2. Complete derivations are reported in appendix A. □

The equilibrium consists of five conditions: factor supply decisions (first line), firms' pricing behavior (second line), relative factor demand (third line), households' consumption-saving decisions (fourth line), and monetary policy rule (fifth line). All equations are direct extensions of the two-industry model – just allowing for any number of agents and unrestricted expenditure shares.

The factor supply equation generalizes the consumption-leisure tradeoff (9), describing how factor prices (wages for different occupations and returns to different types of semi-fixed assets) respond to employment, final goods prices, and wealth effects. The pricing equation extends the real marginal cost Phillips curves (11) to account for input-output linkages. The relative factor demand equation extends (3) to relate changes in factor demand with relative prices and the composition of government spending.

The elasticity matrices (see table 3 and Appendix A) directly generalize their scalar counterparts from section 2. The matrix Φ generalizes the inverse Frisch elasticity φ, capturing how much each factor's price increases with its own employment and the employment of all other primary factors. The matrix Γ describes wealth effects in labor supply, while β defines the relevant price deflators for each factor. The pricing elasticity $\mathcal{P}$ generalizes real marginal cost Phillips curve slopes $\hat{\delta}$, describing the pass-through of cost shocks across the production network. The substitution elasticity Θ extends the scalar θ, capturing how the relative demand for each factor pair depends on relative prices across all industry pairs, without imposing that factor market boundaries match industry boundaries. Finally, the elasticity $\boldsymbol{\mathcal{D}}_G$, derived in section 4.1.1, describes how government spending reallocates demand across industries with different factor intensities, and how this gets translated into relative factor demand.

4.1.1 Direct Incidence of Spending on Relative Factor Demand

Lemma 4.1 characterizes how government spending affects the relative demand for heterogeneous labor occupations and non-labor factors. Crucially, provision of pure government goods generates very different redistributive patterns than provision of market goods. Both affect relative factor demand by redistributing income across final users with different factor contents in consumption. Government good provision however shifts resources from households to the government, while market good provision redistributes resources across households.

Lemma 4.1. *Denote factor contents in the average household's consumption by* $\bar{\boldsymbol{\Psi}}_{\mathcal{HF}} \equiv \frac{\boldsymbol{s}_{\mathcal{H}}^T}{\boldsymbol{s}_{\mathcal{H}}^T \mathbf{1}} \Psi_{\mathcal{HF}}$. *The direct incidence of government spending on relative factor demand is*

$$\begin{aligned} \boldsymbol{\mathcal{D}}_{Gt} \equiv \mathcal{D}_\ell \Big[\left(\boldsymbol{\Psi}_{G\mathcal{F}}^T - \bar{\boldsymbol{\Psi}}_{\mathcal{HF}}^T \right) ds_{Gt}^{\mathcal{G}} + s_G^{\mathcal{G}} Cov_{\boldsymbol{\Omega}_{G:}^{\mathcal{G}}} \left(\Psi_{:\mathcal{F}}, d\log \bar{\boldsymbol{\Omega}}_{Gt}^{\mathcal{G}} \right) \Big] \\ + \bar{s}_{\mathcal{H}} \mathcal{D}_\ell Cov_{\boldsymbol{s}_{\mathcal{H}}} \left(\Psi_{\mathcal{HF}}^T, \boldsymbol{\xi} \right), \end{aligned} \tag{24}$$

where $\mathcal{D}_\ell$ *(derived in Appendix A) captures feedback effects between factor demand changes and the income of final users with different factor contents in consumption.*

Proof. See appendix A. □

Government Good vs Market Good Provision. The first line in (24) describes the provision of pure government goods. Both changing the spending share $s_G^{\mathcal{G}}$ and changing the input composition of government goods $\bar{\mathbf{\Omega}}_G^{\mathcal{G}}$ directly affect relative factor demand. Spending on government goods is financed by taxing households as a group, thereby reallocating expenditure from factors used more intensively in private consumption toward factors used in government consumption.

The term in $s_G^{\mathcal{G}}$ generalizes the direct demand effect from equation (3), replacing the expenditure share difference $(2\beta - 1)$ in the simple model with the difference in factor contents $\mathbf{\Psi}_{G\mathcal{F}}^T - \bar{\mathbf{\Psi}}_{\mathcal{H}\mathcal{F}}^T$ between government and household consumption. When government goods use primary factors in different proportions than the average household, increasing the share of government goods in GDP reallocates demand toward factors used more intensively in the government bundle. Changes in the industry composition of government goods similarly reallocate demand toward factors used more intensively by the targeted industries, as captured by the covariance between factor contents $(\Psi_{:\mathcal{F}})$ and changes in expenditure shares $(d \log \bar{\mathbf{\Omega}}_G^{\mathcal{G}})$.

The second line in (24) describes the response to permanent income changes $\boldsymbol{\xi}$. As derived in lemma 4.3, $\boldsymbol{\xi}$ depends directly on market good provision, and indirectly on all spending functions through equilibrium employment and price changes. Market good provision ultimately redistributes income from households who are taxed to households who receive the goods. Accordingly, equation (24) shows that this type of spending increases demand for the factors consumed more intensively by households who receive a positive transfer, operating only through the households' relative permanent incomes. The relative demand incidence depends on relative factor contents $\Psi_{\mathcal{H}\mathcal{F}}$ in the consumption bundles of households who are taxed vs households who receive goods. Notably, the effect is the same regardless of the actual factor contents of government-provided market goods: only the net transfer matters, not the goods in units of which transfers are denominated.

These distinct mechanisms highlight why the spending type matters as much as its industry composition: government goods reallocate factor demand through production requirements, while market goods operate purely through income redistribution across households with heterogeneous consumption shares.

4.2 Consumption-Saving and Aggregate Demand

Lemma 4.2 characterizes how government spending shifts aggregate demand. As the lemma shows, aggregate demand resembles standard models, and it depends only minimally on the spending composition.

Lemma 4.2. *The economy admits an aggregate Euler equation*

$$\mathbb{E}y_{t+1} - y_t = \frac{1}{\gamma}\left(i_t - \mathbb{E}\bar{\pi}_{t+1}^R\right) + \frac{\mathbb{E}ds_{G,t+1}^{\mathcal{G}} - ds_{Gt}^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}} - \bar{\mathbf{\Xi}}_{\mathcal{H},\mathcal{F}}\left(\mathbb{E}\boldsymbol{\mathcal{D}}_{G,t+1} - \boldsymbol{\mathcal{D}}_{G,t}\right), \tag{25}$$

where $\bar{\pi}^R$ is a nominal rate deflator defined in Table 3.

Proof. Equation (25) is obtained by combining the households' Euler equations and budget constraints with the relative factor demand equation from (23). Complete proof is in Appendix A. □

The first two terms on the right hand side of (25) are the same as in aggregated models, capturing standard New Keynesian mechanisms. Monetary policy affects aggregate demand by setting nominal interest rates, while government spending shifts aggregate demand by creating a wedge between output and consumption. The third term is new to multi-factor models, and it captures a further wedge between consumption and output, arising when government spending reallocates income between consumption and utilization. For a given real rate – which pins down consumption growth – output growth is higher when government spending reallocates income from consumption toward asset utilization.

Lemma 4.2 states that the economy admits an aggregate Euler equation. This happens because all households are on their individual Euler equations, therefore their consumption growth is equalized (up to changes in relative prices).[12] Households however cannot insure ex-ante against spending shocks, resulting in endogenous changes in relative permanent income $\boldsymbol{\xi}$, derived in Lemma 4.3.

Lemma 4.3. *Changes in the relative present values of income across households are given by*

$$\boldsymbol{\xi} = (1-\rho)\sum_{t=0}^{\infty}\rho^t\left[\left(\Xi_{\mathcal{HF}} - \mathbf{1}\bar{\boldsymbol{\Xi}}_{\mathcal{HF}}\right)\boldsymbol{\ell}_t + \frac{1}{\gamma}\left[\gamma\left(\Xi_{\mathcal{H}:} - \mathbf{1}\bar{\boldsymbol{\Xi}}_{\mathcal{H}:}\right)\Psi^{-1} + (1-\gamma)\left(\Omega_{\mathcal{H}:} - \mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{H},:}\right)\right]\boldsymbol{p}_t + \frac{d\boldsymbol{s}_G^{\mathcal{C}} - d\bar{s}_G^{\mathcal{C}}}{\boldsymbol{s}_{\mathcal{H}}}\right]. \quad (26)$$

Proof. Equation (26) is derived by combining the intertemporal budget constraints (19) with the households' Euler equations (21). See Appendix A for the full derivation. □

The permanent income changes $\boldsymbol{\xi}$ capture three channels through which government spending affects households' lifetime wealth: direct transfers through market goods provision, factor income changes due to relative factor demand shifts, and real income changes due to relative price movements.

When targeted to specific household groups, $d\boldsymbol{s}_G^{\mathcal{C}} - d\bar{s}_G^{\mathcal{C}} \neq \mathbf{0}$, government-provided market goods have a direct redistributive impact. The term $\left(\Xi_{\mathcal{HF}} - \mathbf{1}\bar{\boldsymbol{\Xi}}_{\mathcal{HF}}\right)\boldsymbol{\ell_t}$ instead represents how employment changes differentially benefit households based on their factor ownership relative to the average household. The term $\gamma\left(\Xi_{\mathcal{H}:} - \mathbf{1}\bar{\boldsymbol{\Xi}}_{\mathcal{H}:}\right)\Psi^{-1}$ describes how price changes affect relative profit income, while $(1-\gamma)\left(\Omega_{\mathcal{H}:} - \mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{H}:}\right)$ captures relative consumption prices.

The zero-sum constraint reflects that $\boldsymbol{\xi}$ denotes differential changes – when relative permanent income increases for one household, others become relatively worse off. The aggregate income change is encoded in y.

These redistributive effects feed back into current labor supply decisions through wealth effects, and into current labor demand through heterogeneous consumption bundles. Below we will temporarily set aside the indirect effects

[12] Consumption growth is exactly equalized only if $\gamma = 1$.

of spending on employment and price dynamics through $\boldsymbol{\xi}$, to focus on contemporaneous factor demand. The full equilibrium dynamics are examined in Section 4.4.

4.3 Factor-Specific Supply Slopes: A Key Sufficient Statistic

Proposition 4.2 derives industry-by-factor supply slopes, generalizing proposition 2.2. Factor-specific supply slopes describe the heterogeneous incidence of primary factors on industry-level prices. As established in corollary 4.1 below, this heterogeneity is what enables the spending composition to affect aggregate outcomes.

Proposition 4.2. Factor supply curves. *Industry-level prices are given by*

$$\boldsymbol{\pi}_t - \boldsymbol{\kappa}\Phi^{-1}\mathbf{1}\bar{\pi}_t = \kappa\left[\mathbf{1}y_t - \Phi^{-1}\Gamma\left(\mathbf{1}\frac{ds^{\mathcal{G}}_{Gt}}{\bar{s}_{\mathcal{H}}} - \boldsymbol{\xi}\right) + \boldsymbol{\mathcal{D}}_{Gt}\right] + \boldsymbol{\Upsilon}_t, \tag{27}$$

where

$$\begin{aligned}
\kappa &\equiv \mathcal{W}^{-1}\mathcal{P}_{:\mathcal{F}}\Phi,\ \mathcal{W} \equiv I + \mathcal{P}_{:\mathcal{F}}\left(\Phi\Theta - \left(\beta^T - \mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}:}\right)\right) \\
\boldsymbol{\Upsilon}_t &= \rho\left(I - \mathcal{V}\right)\mathbb{E}\boldsymbol{\pi}_{t+1} - \mathcal{V}\boldsymbol{p}_{-1} \\
\mathcal{V} &= \mathcal{W}^{-1}\mathcal{P}\Psi^{-1}\left[I - \Psi_{:\mathcal{F}}\left(\left(\beta^T - \mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}\right) - \Phi\Theta\right)\right].
\end{aligned} \tag{28}$$

Prices are fully flexible if and only if $\boldsymbol{\kappa}\Phi^{-1}\mathbf{1} = \mathbf{1}$ *and* $\boldsymbol{\Upsilon}_t \equiv \mathbf{0}\ \forall t$. *Otherwise,* $\boldsymbol{\kappa}\Phi^{-1}\mathbf{1} \leq \mathbf{1}$.

Proof. See appendix A. □

The matrix $\kappa \in \mathbb{R}^{N\times F}$ represents factor-specific supply slopes – how prices in each industry respond to changes in the employment of each primary factor. Unlike the simple model from section 2, prices in all industries now depend on the employment of all primary factors – either directly, through input-output linkages, or through additional general equilibrium effects. Nonetheless, it remains true that inelastically supplied factors, or factors used by industries with more flexible prices (or whose customers have flexible prices, etc.) have a larger average price incidence. The term $\mathcal{P}_{:\mathcal{F}}\Phi$ generalizes $\hat{\delta}\varphi$ in the simple model, accounting for input-output linkages and non-labor factors. The multiplier $\mathcal{W}$ captures equilibrium adjustments, generalizing the denominator $\frac{1}{1+\theta\hat{\delta}\varphi}$ to allow for expenditure switching at each node of the production network ($\Phi\Theta$). It also accounts for asymmetric exposure of factor price deflators to the employment of different factors ($\beta^T - \mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}:}$), which result in differential supply responses.

4.4 Equilibrium Dynamics

The previous results illustrated how government spending shifts aggregate demand (25) and industry-level supply curves (27). These equations allow us to express equilibrium dynamics as a function of industry-level prices and

aggregate output, without keeping track of cross-sectional employment. Cross-sectional employment can be solved out for because it is not forward looking, which greatly simplifies the analysis.

If all prices are flexible ($\bar{\kappa}\Phi^{-1}\mathbf{1} = 1$), aggregate output y, industry prices $\boldsymbol{p}$, and relative permanent incomes $\boldsymbol{\xi}$ are determined by industry-level supply equations (27) and permanent income shifts (26). Cross-sectional employment is then given by the relative demand equation in (23).

If some prices are sticky ($\bar{\kappa}\Phi^{-1}\mathbf{1} < 1$), the dynamic system given by aggregate demand (25), Taylor rule, industry-level supply curves (27), and permanent income shifts (26) jointly determines aggregate output y, industry prices $\boldsymbol{p}$, and relative permanent incomes $\boldsymbol{\xi}$. Given aggregate output and price dynamics, cross-sectional employment follows from the relative demand equation in (23).

Overall, the economy features two dynamic feedback effects. The first operates through permanent income changes $\boldsymbol{\xi}$. Permanent income changes affect current factor supply through wealth effects, and current factor demand by redistributing income across households with different consumption preferences. Changes in factor demand and supply in turn feed back into permanent incomes, which depend on the entire equilibrium path of prices and employment through equation (26). The second dynamic feedback is active only with nominal rigidities, and it operates through forward-looking price setting (as in standard New Keynesian models).

4.4.1 Demand Reallocation, Supply Slopes, and Aggregate Multipliers

This section addresses the central question: under which circumstances does the industry composition of government spending matter for aggregate multipliers? Even though the full equilibrium depends on several dynamic feedback effects, looking at per-period supply shifts is very informative. Proposition 4.3 and corollary 4.1 establish that factor market segmentation, paired with heterogeneous supply slopes, are necessary for the composition of government spending to affect aggregate supply. Proposition 4.3 also highlights that supply slopes are heterogeneous whenever primary factors face different supply elasticities or network-adjusted nominal rigidities.

In principle one can construct many aggregate supply curves, depending on how industries are weighted in the reference price index. With flexible prices, all supply curves are shifted by the same amount. Given permanent incomes $\boldsymbol{\xi}$, the aggregate supply shift pins down aggregate output. Permanent income changes matter only if income is redistributed across households with different consumption bundles.

With sticky prices, different price indices yield different supply shifts. Of particular interest is the inflation target in the Taylor rule. While this index is not a sufficient statistic – equilibrium dynamics depend on the full price distribution – it does determine the inflation-output tradeoff faced by monetary policy, which shapes the monetary response.

Proposition 4.3 derives the aggregate supply shift under flexible prices, and the inflation-output tradeoff for the GDP deflator under nominal rigidities. The spending composition affects both flex-price shift and inflation-output tradeoff through $\boldsymbol{\mathcal{D}}_G$, by changing the aggregate expenditure shares on primary factors facing different supply

elasticities or nominal rigidities.

Before stating the main results, I introduce useful notation for cross-sectional mean and covariance operators.

Definition 4.1. Given a unit-sum vector of weights $\boldsymbol{w} \in \mathbb{R}^N \geq \mathbf{0}$, and a vector $\boldsymbol{x} \in \mathbb{R}^N$, I denote the weighted average by $\mathbb{E}_{\boldsymbol{w}}(\boldsymbol{x}) \equiv \sum_i w_i x_i$. Given matrices X with M rows and N columns and Y with N rows and Q columns, their covariance has dimension $M \times Q$ and is defined as $Cov_{\boldsymbol{w}}(X, Y) \equiv \sum_i w_i X_{:i} Y_{i:} - [\sum_i w_i X_{:i}][\sum_i w_i Y_{i:}]$.

Proposition 4.3. Aggregate supply shift. *Denote aggregate wealth effects by $\bar{\boldsymbol{\Gamma}} \equiv \bar{\boldsymbol{\Psi}}_{\mathcal{F}}^T \Gamma$ and the aggregate factor price deflator by $\bar{\boldsymbol{\beta}}^T \equiv \bar{\boldsymbol{\Psi}}_{\mathcal{F}}^T \beta$. The direct incidence of government spending on aggregate factor employment is $\bar{\mathcal{L}}_G \equiv \bar{\boldsymbol{\Gamma}}\left(\mathbf{1}\frac{ds_{Gt}^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}} - \boldsymbol{\xi}\right)$, while the direct incidence on relative factor employment is $\boldsymbol{\mathcal{L}}_G \equiv \boldsymbol{\mathcal{D}}_{Gt} - \Phi^{-1}\left(\Gamma - \mathbf{1}\bar{\boldsymbol{\Gamma}}\right)\left(\mathbf{1}\frac{ds_{Gt}^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}} - \boldsymbol{\xi}\right)$. With flexible prices, the aggregate supply shift is given by*

$$dy^{RBC} \propto \bar{\mathcal{L}}_G - Cov_{\bar{\boldsymbol{\Psi}}_{\mathcal{F}}}\left(\Phi, \left(I - \Theta\kappa^{RBC}\right)\boldsymbol{\mathcal{L}}_G\right) - Cov_{\bar{\boldsymbol{\Psi}}_{\mathcal{F}}}\left(\frac{\bar{\boldsymbol{\beta}}^T - \bar{\boldsymbol{\Omega}}_{\mathcal{Z}}}{\bar{\boldsymbol{\Psi}}_{\mathcal{F}}}, \kappa^{RBC}\boldsymbol{\mathcal{L}}_G\right). \tag{29}$$

Denoting the pass-through of factor prices into the GDP deflator $\boldsymbol{\mathcal{P}}_{\mathcal{F}} \equiv \bar{\boldsymbol{\Omega}}_{\mathcal{Z}}\mathcal{P}_{:\mathcal{F}}$ and the average pass-through $\underline{\mathcal{P}_{\mathcal{F}}} \equiv \bar{\boldsymbol{\Omega}}_{\mathcal{Z}}\kappa\Phi^{-1}\mathbf{1}$, the inflation-output tradeoff for the GDP deflator $\bar{\pi}$ under nominal rigidities is given by

$$\bar{\pi}\,|_{y=0} = -\frac{\mathcal{P}_{\mathcal{F}}}{1 - \underline{\mathcal{P}_{\mathcal{F}}}}\bar{\mathcal{L}}_G + \frac{1}{1 - \underline{\mathcal{P}_{\mathcal{F}}}}\left[Cov_{\bar{\boldsymbol{\Psi}}_{\mathcal{F}}}\left(\frac{\boldsymbol{\mathcal{P}}_{\mathcal{F}}\Phi}{\bar{\boldsymbol{\Psi}}_{\mathcal{F}}}, \left(I - \Theta\kappa\right)\boldsymbol{\mathcal{L}}_G\right) + Cov_{\bar{\boldsymbol{\Psi}}_{\mathcal{F}}}\left(\frac{\boldsymbol{\mathcal{P}}_{\mathcal{F}}\left(\beta^T - \mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}\right)}{\bar{\boldsymbol{\Psi}}_{\mathcal{F}}}, \kappa\boldsymbol{\mathcal{L}}_G\right)\right]. \tag{30}$$

Proof. Both decompositions follow directly from proposition 4.2. □

Equations (29) and (30) directly generalize (13) and (14) from section 2. The terms in $\bar{\mathcal{L}}_G$ capture wealth effects in factor supply. The first covariances generalize the reallocation effect $Cov\left(\hat{\delta}\varphi, d\beta_G\right)$. These more general expressions correlate factor-specific supply elasticities (Φ) and wage pass-through into final prices ($\boldsymbol{\mathcal{P}}_{\mathcal{F}}$) – which govern factor-specific supply slopes – with relative employment incidences, adjusted for cross-sectional crowding out of private demand ($-\Theta\kappa$, discussed in detail in section 4.5 below). Flex-price output is lower, and the inflation-output tradeoff is worse, when spending raises demand for factors with steeper supply curves. The second covariance terms are new to the general model, and state that government spending is less expansionary when it targets factors with higher incidence on the average factor price deflator relative to the GDP deflator, because this reduces overall factor supply.

Corollary 4.1 emphasizes that reallocation effects arise only when primary factors cannot be freely reallocated across uses, and factor supply slopes are heterogeneous. Changing the spending share affects relative demand for goods and factors only if the composition of government spending is different from private consumption.

Corollary 4.1. *The industry composition of government spending matters for aggregate supply only if both: (a) there are multiple primary factors, traded on segmented markets ($\Psi_{:\mathcal{F}} \neq \mathbf{1}\bar{\boldsymbol{\Psi}}_{\mathcal{F}}^T$), and (b) primary factors have differential incidences on prices, through heterogeneous factor-specific supply slopes. In turn, supply slopes are heterogeneous*

whenever factors face different nominal rigidities ($\bar{\mathbf{\Omega}}_{\mathcal{Z}}\mathcal{P}_{:\mathcal{F}}$ is not proportional to $\bar{\mathbf{\Psi}}_F^T$), have different supply elasticities ($\bar{\mathbf{\Psi}}_F^T\Phi$ is not proportional to $\bar{\mathbf{\Psi}}_F^T$), or have different incidences on the average factor price deflator ($\bar{\boldsymbol{\beta}}^T \neq \bar{\mathbf{\Omega}}_{\mathcal{Z}}$).

Changing the spending share $s_G^{\mathcal{G}}$ on government goods causes reallocation effects in aggregate supply only if the industry composition of government goods is different from average private consumption ($\mathbf{\Psi}_{G\mathcal{F}}^T - \bar{\mathbf{\Psi}}_{\mathcal{H}\mathcal{F}}^T$). Government provision of market goods causes reallocation effects only if it redistributes income across households with different factor contents in consumption.

4.4.2 Employment and Consumption Multipliers

Employment and consumption multipliers can be derived following the same method as output multipliers, appropriately re-normalizing the relative demand equation in (23). Appendix A reports detailed derivations.

4.5 Direct Demand Incidences and Cross-Sectional Crowding Out

Proposition 4.4 zooms in on the heterogeneous incidence of government spending on factor employment. Changes in relative employment across primary factors are the core reason why the industry composition of government purchases affects both aggregate multipliers and income redistribution. They are a distinguishing feature of economies with segmented markets, and cannot arise in benchmark input-output models with a single labor factor. The proposition highlights a direct effect and a general equilibrium effect, which I refer to as cross-sectional crowding out of private demand.

Proposition 4.4. Cross-sectional crowding out of private demand. *Denote cross-sectional factor employment by $\boldsymbol{\ell}^{XS} \equiv \boldsymbol{\ell} - \mathbf{1}y$. Then:*

$$\boldsymbol{\ell}_t^{XS} = \left(I - \hat{\Theta}\kappa\right)\boldsymbol{\mathcal{D}}_{Gt} + \hat{\Theta}\kappa\Phi^{-1}\Gamma\left(\mathbf{1}\frac{ds_{Gt}^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}} - \boldsymbol{\xi}\right) + \hat{\Theta}\left(\kappa\Phi^{-1}\mathbf{1} - \mathbf{1}\right)\bar{\pi}_t + \boldsymbol{\mathcal{X}}_t^{\mathcal{F}} \tag{31}$$

where $\boldsymbol{\mathcal{X}}^{\mathcal{F}}$ depends on lagged prices and expected inflation.

Proof. Equation (31) combines the factor supply, pricing, and relative factor demand equations in (23). The demand elasticity $\hat{\Theta}$ is rescaled to net out changes in aggregate output. Full derivation is reported in Appendix A. □

Proposition 4.4 decomposes the incidence of government spending on relative factor demand into direct effects $\boldsymbol{\mathcal{D}}_{Gt}$, and offsetting general equilibrium adjustments $-\hat{\Theta}\kappa\boldsymbol{\mathcal{D}}_{Gt}$.

The general equilibrium effects extend equation (3) from the simple model, resembling the term $-\frac{\theta\hat{\delta}\varphi}{1+\theta\hat{\delta}\varphi}$. They capture a cross-sectional crowding out of private expenditure: as demand increases for factors used intensively in the government bundle, their relative prices rise according to factor-specific supply slopes (κ), triggering private expenditure switching across the entire production network (governed by $\hat{\Theta}$). This partially offsets the initial change

in government demand. The economic intuition remains identical to section 2.2: even when factors cannot be physically reallocated, expenditure switching generates offsetting demand spillovers.

Additionally, in equation (31) increasing the share of government goods in GDP ($s_G^{\mathcal{G}}$) raises relative labor supply compared to non-labor factors – due to wealth effects (Γ) – causing substitution toward labor-intensive goods. The price level $\bar{\pi}$ is a measure of aggregate demand, which affects cross-sectional employment when prices are sticky and factor price pass-through is heterogeneous, shifting expenditure toward factors with smaller pass-through. With flexible prices ($\kappa\Phi^{-1}\mathbf{1} = \mathbf{1}$) this effect disappears. The $\boldsymbol{\xi}$ term captures how income redistribution induced by government spending affects relative labor supply across occupations through wealth effects.

4.6 Taking Stock: Value Added of the General Model

All three key insights from the two-factor example continue to hold in the general model: factor market segmentation and heterogeneity are necessary for the spending composition to affect aggregate multipliers; aggregate outcomes depend on the covariance between demand reallocation and factor-specific supply slopes; and cross-sectional crowding out of private demand partially offsets the direct incidence of government spending on relative factor demand.

The vector-matrix notation introduced in section 3.5 allows us to preserve analytical tractability, while flexibly matching real-world input shares across multiple industries and primary factors.

While governed by the same economic mechanisms, in complex economies it is challenging to measure factor demand incidences and factor supply slopes correctly. Providing these measures is the main value added of the general framework. Appendix C presents two illustrative examples. Example C.1 shows how vertical linkages affect supply slopes, while example C.2 illustrates how to compute relative factor demand when labor market boundaries do not coincide with industry boundaries. In both instances, the simplified model would provide inaccurate results.

Furthermore, the full model features three additional general equilibrium effects. Two of them are related with differences in expenditure shares across final users. First, factors whose price deflator is more exposed to other steep-supply factors tend to have steeper supply curves themselves (see equation (28)). Second, changes in factor demand affect the relative income of final users, feeding back into higher demand for factors consumed more intensively by final users whose income increased (see lemma 4.1).

The third feedback effect is dynamic in nature. Government spending redistributes permanent income across households, and this in turn raises demand for the factors consumed more intensively by households whose income increased. Moreover, these same households reduce their labor supply through a wealth effect. The resulting changes in factor income feed back into permanent incomes (see lemma 4.3).

5 Quantitative and Empirical Results

This section presents results from the model calibration and an empirical validation of the theory. I begin in Section 5.1 by describing the data sources. Section 5.2 documents how the industry composition of government spending has evolved over time. In Section 5.3 I estimate industry-level price and output responses to changes in government spending, confirming that prices respond by more, and quantities respond by less, in industries with more flexible prices and smaller labor shares in value added. Sections 5.4 and 5.5 present calibration results, showing that the spending composition substantially affects aggregate multipliers, and government spending has widely heterogeneous incidences on labor demand and income across different households.

5.1 Data Sources and Calibration

Government and private expenditure shares are computed from the Bureau of economic Analysis (BEA) input-output tables. Preference and production parameters are set to conventional values. Appendix D presents full detail.

5.2 Government Spending Composition Over Time

Government spending comprises purchases of goods, labor services, and non-labor factors. Figure 11 in appendix D shows how the composition of government purchases has changed between 1963 and 2023. The figure reveals a notable shift away from construction and durable manufacturing toward professional services, and from low-skill labor to high-skill labor, mirroring similar changes in private expenditure patterns. Section 5.3 exploits variation in the industry composition of government spending over time, to provide an empirical validation of the theory.

5.3 Empirical Evidence

Table 4 validates the core economic mechanism of the model, by looking at industry-level price and output responses to changes in the industry composition of government spending. As implied by the model, prices respond more to changes in government spending, and output responds less, in industries with relatively flexible prices or low labor shares in value added. Appendix D reports detailed empirical specifications and robustness checks.

Table 4: Effect of Government Spending on Prices and Output: Heterogeneity by Price Flexibility and Non Labor Value Added

	Price Growth		Output Growth	
	(1)	(2)	(3)	(4)
Intercept	1.260***	1.349***	0.449***	-1.851***
	(0.079)	(0.106)	(0.033)	(0.141)
$\Delta\Omega_G\times$ Price Flexibility	0.327***		-0.203**	
	(0.059)		(0.079)	
$\Delta\Omega_G\times$ Non Labor Value Added		0.340***		-0.252**
		(0.093)		(0.123)
Time Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	No	No	No	No
Observations	3720	3720	3720	3720
R-squared	0.773	0.772	0.706	0.707
Number of Industries	62	62	62	62

Notes: Standard errors in parentheses, clustered at the industry level. *** p<0.01, ** p<0.05, * p<0.1. Quarterly data, over the sample period 2006Q4 to 2022Q3. Price and Output are year-over-year growth rates. Government Demand and Private Demand are year-over-year first differences. The controls include change in government expenditure shares, changes in expenditure shares of private households, four lags of the dependent variable, dummies for industry-level size, industry-level durability, and average government expenditure share interacted with the change in government expenditure shares.

5.4 Calibration Results

This section computes model-predicted aggregate and cross-sectional multipliers. Aggregate multipliers are standard in the literature. Thanks to its modeling of multiple segmented factor markets, this paper is the first to compute relative employment and income responses across households.

The calibrated model reveals very different multiplier ranges, depending on which dimension of heterogeneity one considers. Focusing on aggregate multipliers, the largest differences arise between government good and market good provision, followed by differences across target industries. Variation among government functions or among market functions remains small. Aggregate multipliers, however, mask significant differences among occupation-level responses. The range of occupation-level responses for any given industry composition is one order of magnitude larger than the range of aggregate multipliers across industry compositions.

5.4.1 Aggregate Multipliers

This section quantifies how the spending composition affects aggregate multipliers. I compute model-implied multipliers by government function and by target industry.

Multipliers by Government Function Figure 5 plots aggregate output multipliers (blue), employment multipliers (red) and consumption multipliers (yellow) for each government function. The horizontal lines represent benchmark multipliers when the spending composition equals private consumption, eliminating reallocation effects. Multipliers represent cumulative responses over a 20-quarter horizon to a 1% increase in government spending as a share of

GDP.

The results reveal a clear distinction between pure government goods and government provision of market goods. Government goods (defense, infrastructure, public administration) yield consistently larger multipliers than market goods (health and education). This is because the provision of market goods generates no wealth effects in aggregate labor supply, and only minimal reallocation effects. Within categories, however, differences are modest. Multipliers for pure government functions are not far from the benchmark value, due to offsetting differences between the industry composition of government spending and private consumption. The spending bundle has more flexible prices, implying a negative composition effect, but higher labor share in value added, implying a positive composition effect. The latter is especially important for employment multipliers.

Multipliers by Industry Figure 6 presents output, employment, and consumption multipliers when government spending is entirely concentrated on a given industry. Changing the target industry of government goods generates larger variation in aggregate multipliers than shifting resources between government functions. Output multipliers span from 0.3 to 0.7, reflecting industry-specific differences in price stickiness, labor intensity, and input-output linkages. These differences would remain masked when focusing on more aggregated government functions.

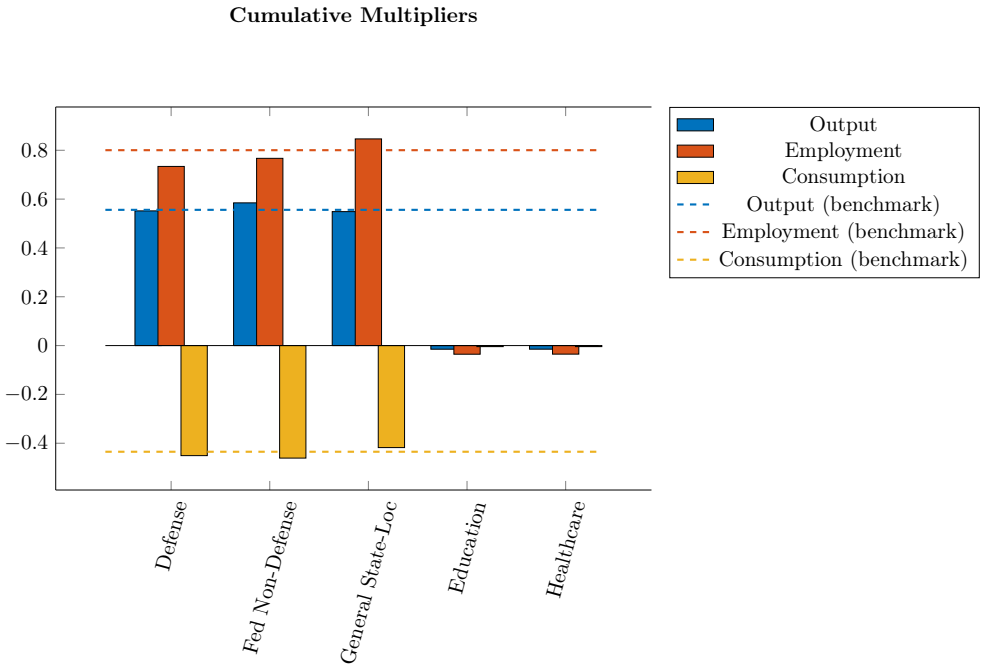


Figure 5: Aggregate multipliers by government function: output (blue bars), employment (red bars), and consumption (yellow bars). Dashed lines represent an aggregated model with only one primary factor.

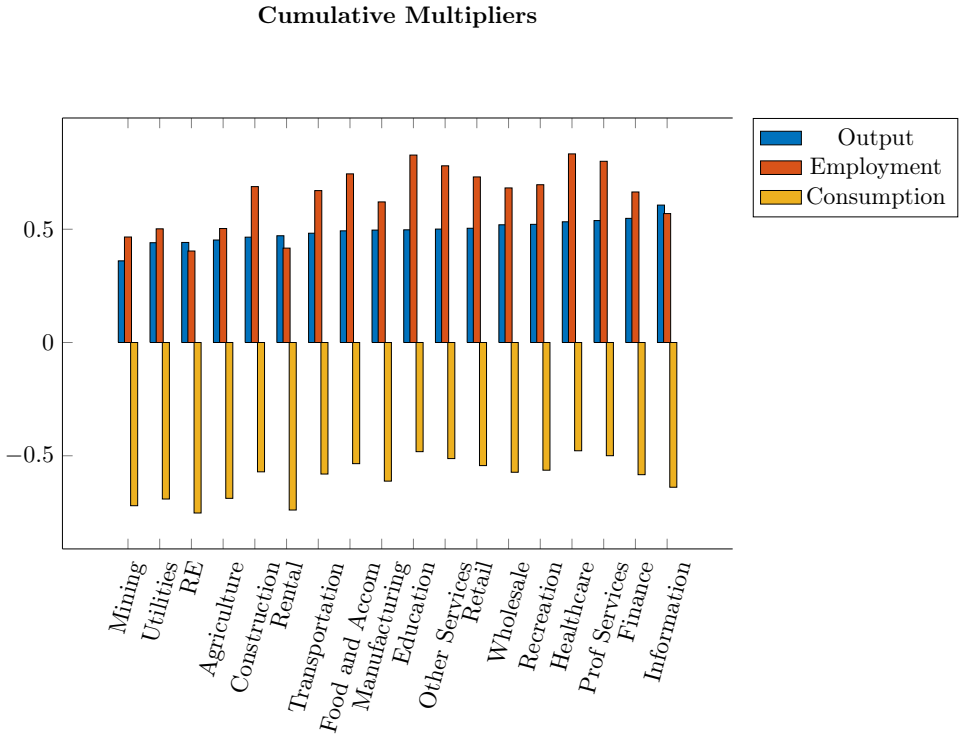


Figure 6: Aggregate multipliers, by industry where spending is targeted: output (blue bars), employment (red bars), and consumption (yellow bars).

Taking stock. Among aggregate multipliers, the largest differences are between government good provision and market good provision. This distinction mirrors a classic fiscal policy comparison between spending and transfer multipliers. Market good provision – like transfers – redistributes income across households, while government good provision fits the traditional view of government spending. The calibration results are consistent with the conventional wisdom that transfer multipliers are smaller.[13]

Focusing on government functions, defense spending exhibits a similar multiplier to non-defense and state and local spending. This is consistent with small differences found in the literature (Ramey, 2019).

Aggregate multipliers generated by targeting different industries exhibit substantially larger variation than among government functions or among market functions, even though the cross-industry range is smaller than the difference between government and market functions.

5.5 Redistributive Implications

Beyond aggregate effects, government spending has important redistributive consequences. Figures 7 through 10 illustrate its incidence across income groups and occupations. Notably, variation in employment and labor income multipliers among occupations is one order of magnitude larger than variation in aggregate multipliers across target

[13]My model omits heterogeneity in marginal propensities to consume, therefore this calibration is a lower bound on transfer multipliers.

industries. Even if the aggregate spending multiplier is small, some occupations may see large employment effects, suggesting that understanding household-level multipliers is as important as understanding aggregate multipliers.

Figure 7 shows the cumulative real income response by household income quintile to a 1% increase in government spending as a share of GDP, given the spending composition in 2019. Each bar decomposes the total response into labor income (blue), returns on non-labor factors of production (orange), consumption price changes (yellow), and tax incidence (purple). Households in the first four quintiles benefit through increased labor income, while the top quintile benefits primarily from higher returns on non-labor assets. Higher asset returns do not fully offset relatively smaller labor income gains, making the overall incidence mildly progressive. Figure 8 shows the same decomposition for market good provision (education and healthcare), highlighting that these functions operate essentially as income transfers, with minimal effects on labor and asset income.

Looking beyond quintiles, figure 9 shows cumulative labor income responses by occupation to a 1% increase in government spending as a share of GDP, decomposed into employment (blue) and wage (red) effects. Lower-income occupations are marked with darker-shaded bars. The comparison between figures 7 and 9 reveals that focusing on income quintiles masks significant variation across occupations, within quintiles.

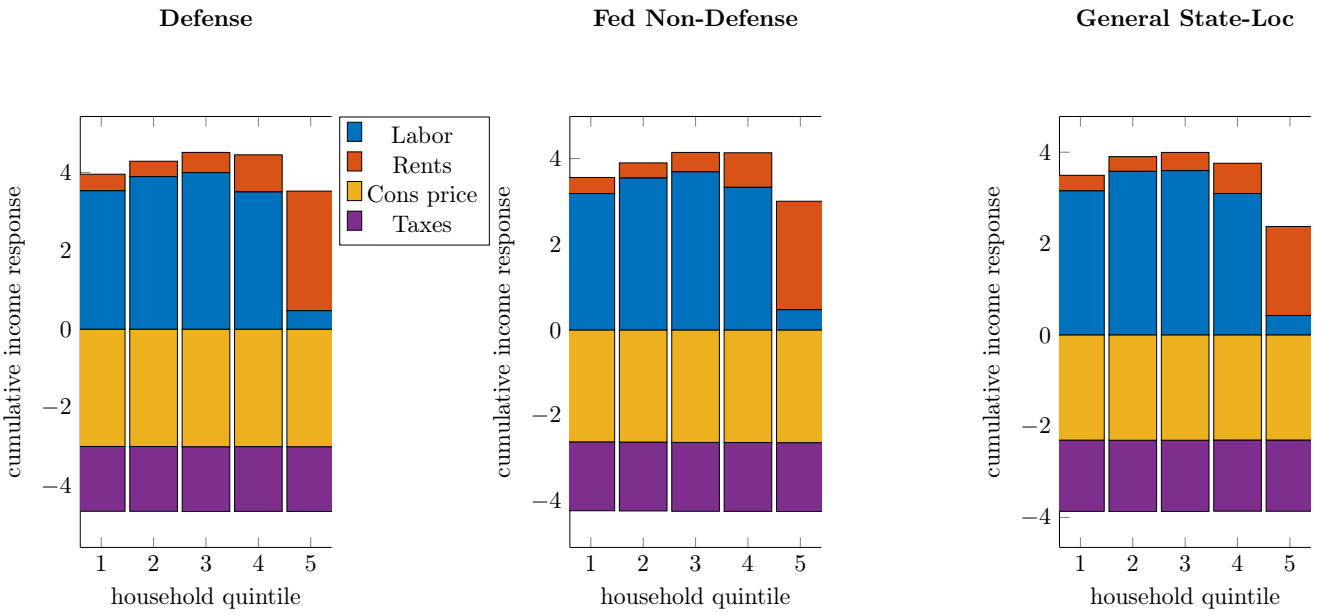


Figure 7: Cumulative real income response to a 1% increase in government spending share in total GDP, by household quintile and government function. Income responses are decomposed into labor (blue), asset and profit rents (red), consumer prices (yellow), and taxes (purple).

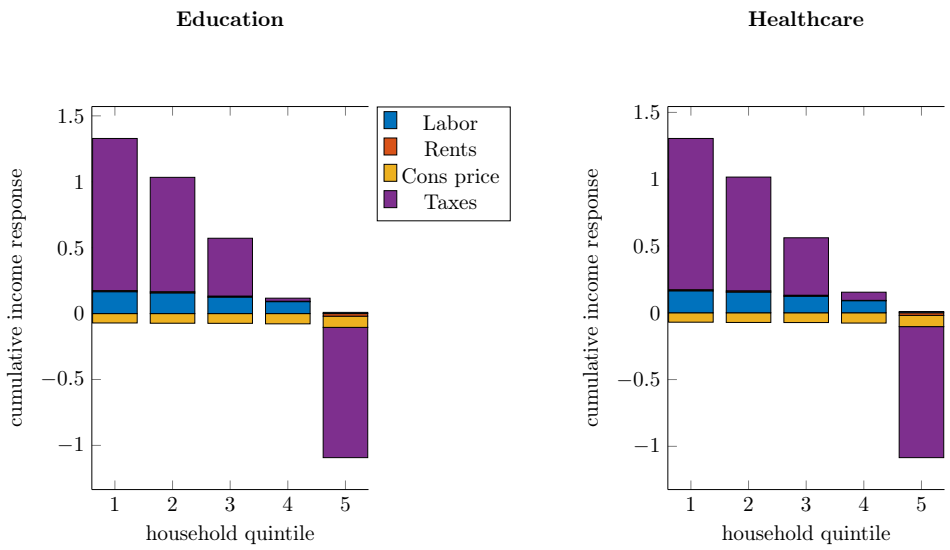


Figure 8: Cumulative real income response to a 1% increase in government spending share in total GDP, by household quintile and market function. Income responses are decomposed into labor (blue), asset and profit rents (red), consumer prices (yellow), and taxes (purple).

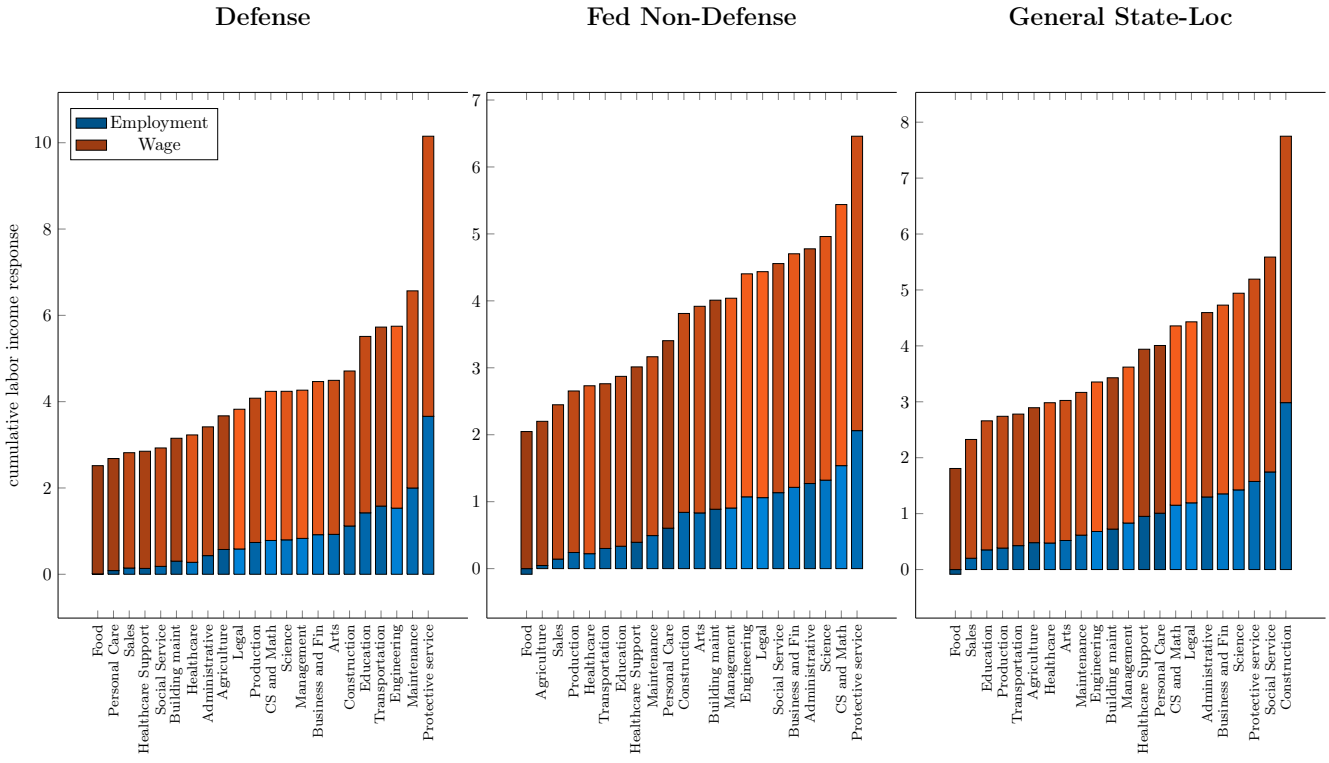


Figure 9: Cumulative percentage change in labor income by occupation, following a 1% increase in the share of government spending in total GDP. The blue bars represent employment changes, while the red bars represent wage changes. In each panel, the spending increase is allocated to a different government function.

Finally, figure 10 provides a heatmap of occupation-by-industry employment multipliers, representing employment responses across occupations (rows) to a 1% increase in government spending concentrated in a specific industry (columns). The results show wide variation in employment effects – ranging from multipliers near zero for some industry-occupation pairs to values exceeding 20 for others. Higher values along the diagonal indicate larger employment responses for workers directly hired by the target industry.

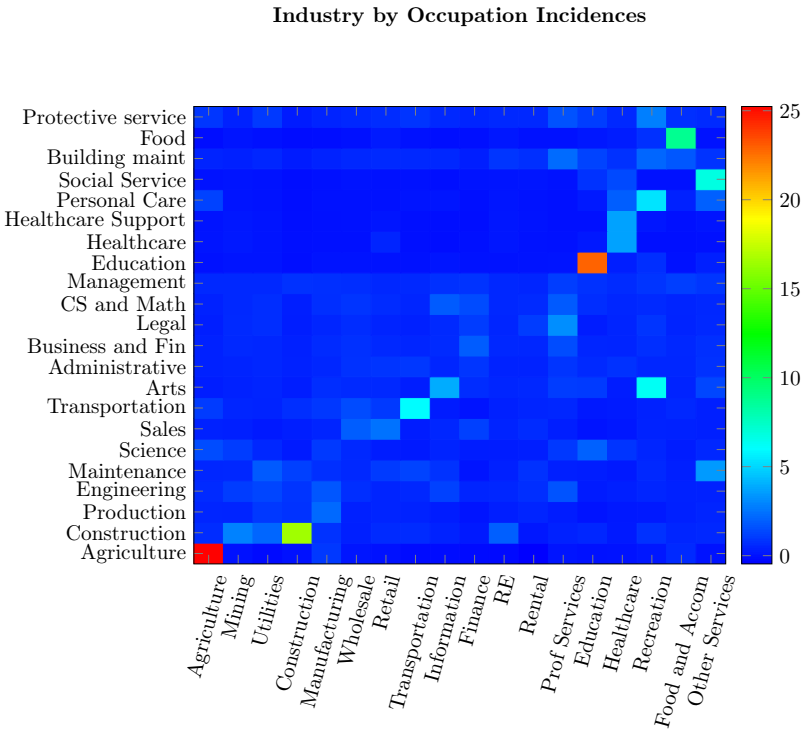


Figure 10: Percentage change in employment by occupation (row) following a 1% increase in government spending over GDP, concentrated in a single industry (column)

5.6 Which model features matter?

The calibrated model suggests that there is no single government spending multiplier, but several multipliers. Aggregate output depends on which goods the government purchases, and employment responses vary widely across occupations. Table 5 considers counterfactual model calibrations, to understand which features cause this variation. The first column reports the range of aggregate output multipliers across target industries (maximum minus minimum). The second column reports the cross-occupation variance of employment responses to an increase in the share of government spending in total GDP, given the 2019 industry composition.

Calibration	Aggreggate multiplier range	Variance of employment responses
Baseline	0.322	1.11
Unsegmented Labor Market	0.322	0.00
Omit Non-Labor Factors	0.063	0.95
Omit Input-Output Linkages	0.670	2.31
4 Aggregated Industries	0.176	0.16

Table 5: Aggregate and cross-sectional multiplier ranges under counterfactual calibrations

Adopting a coarser industry classification with four broad sectors substantially reduces the range of aggregate multipliers and cross-sectional responses. Eliminating labor market segmentation does not reduce the range of aggregate multipliers, but prevents us from studying redistributive implications through labor demand. Ignoring the presence of non-labor primary factors instead substantially reduces the range of aggregate multipliers and cross-sectional employment responses. By contrast, omitting input-output linkages significantly overstates the range of aggregate and cross-sectional responses. This is because total factor contents (accounting for input-output linkages) are less heterogeneous across industries than direct factor contents, therefore using direct contents overstates reallocation effects of government spending on relative factor demand.

6 Conclusion

This paper connects the industry composition of government spending with aggregate multipliers and income redistribution, using an analytically tractable, yet quantitatively realistic framework.

Analytical results prove that, whenever factor markets are segmented, government spending affects the relative demand for primary factors, and hence relative incomes across households. If moreover primary factors have different supply slopes, these redistributive effects create a connection between the industry composition of government spending and aggregate multipliers. Targeting factors with flatter supply curves yields a better inflation-output tradeoff, and larger output responses.

The calibrated model reveals substantial variation in spending multipliers across target industries and labor occupations. Empirical evidence confirms the theoretical predictions.

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Appendix to One Dollar, Many Multipliers

A Derivations

Non-labor primary factors. Non-labor factors have a fixed stock that can be utilized more or less intensively. Increasing utilization has a cost, in units of asset-specific input bundles. This creates an upward-sloping supply curve for effective asset services, even when the underlying asset stock is fixed. Utilization fully depreciates each period, meaning that building higher capacity today doesn't increase tomorrow's capacity. This simplifies the dynamics, at the cost of abstracting from realistic forward-looking investment decisions.

Formally, the supply of each asset $f \in \mathcal{K}$ is given by $L_{ft} = U_{ft}\bar{K}_f$, where $\bar{K}_f$ is a fixed endowment and U_{ft} is utilization intensity. Utilization is produced by asset retailers according to $U_{ft} \equiv \left[(1+\varphi_f)\, C_{ft}\right]^{\frac{1}{1+\varphi_f}}$, where C_{ft} is a constant-return-to-scale utilization bundle combining goods from various industries. The model allows these input mixes to vary across asset types, through asset-specific consumption aggregators $C_{ft} = \mathcal{C}_f(c_{f1,t}, ..., c_{fN,t})$.

I purposefully use a similar notation for household consumption and asset utilization, to underscore that both are final uses. The elasticity of substitution between goods i and j in the utilization bundle of factor f is denoted θ^f_{ij}.

The utilization function is chosen to generate supply curves with constant elasticity φ_f. Optimal utilization by asset retailers implies

$$U_f^{\varphi_f} = \frac{W_f}{P_f^C}\bar{K}_f, \ \forall f \in \mathcal{K}. \tag{32}$$

where P_f^C is the price index associated with the utilization bundle C_f, and φ_f is the inverse supply elasticity of factor f. Importantly, labor and non-labor production factors will have different supply elasticities.

Asset utilization is produced competitively – asset retailers take input prices as given and maximize profits from selling utilization services. Profit maximization by asset retailers implies that returns are split between operational costs (share $\frac{1}{1+\varphi_f}$) and pure rents to asset owners (share $\frac{\varphi_f}{1+\varphi_f}$). When supply is less elastic (higher φ_f), most returns accrue as rents to asset owners. Vice versa, rents are smaller when supply is more elastic (lower φ_f).

This utilization model implies a budget constraint for utilization producers $P^C_{ft}C_{ft} = \hat{\Xi}_{ff}W_{ft}L_{ft}$, where $\hat{\Xi}_{ff} = \frac{1}{1+\varphi_f}$ and $\hat{\Xi}_{ff'} = 0$ for $f \in \mathcal{U}, f' \in \mathcal{F}, f' \neq f$, similar to (19).

Notation. Table 6 reports the full notation for income flows and expenditure shares, while table 7 reports the definition of model elasticities.

Parameter	Notation	Definition
Expenditure shares	$\Omega \in \mathbb{R}^{\lvert\mathcal{N}\rvert\times\lvert\mathcal{N}\rvert}$	$\Omega_{ij} = \frac{P_j^* X_{ij}^*}{P_i^* Y_i^*}$
Leontief inverse	Ψ	$\Psi \equiv (I-\Omega)^{-1}$
Final user income shares	$\mathbf{s} \in \mathbb{R}^{\lvert\mathcal{Z}\rvert}$	$s_h \equiv \frac{P_h^{C*} C_h^*}{GDP^*}$
Primary factor income shares	$\bar{\mathbf{\Psi}}_{\mathcal{F}} \in \mathbb{R}^{\lvert\mathcal{F}\rvert}$	$\bar{\Psi}_f \equiv \frac{W_f^* L_f^*}{GDP^*}$
Domar weights	$\bar{\mathbf{\Psi}} \in \mathbb{R}^{\lvert\mathcal{N}\rvert}$	$\bar{\Psi}_i \equiv \frac{P_i^* Y_i^*}{GDP^*}$
Ownership shares	$\Xi \in \mathbb{R}^{\lvert\mathcal{Z}\rvert\times\lvert\mathcal{N}\rvert}$	$\Xi \equiv \mathcal{S}^{-1}\left(\hat{\Xi} + \boldsymbol{T}^* \mathbf{1}^T\right)\mathcal{T}$ $T_z^* \equiv \left(\frac{s_G^h}{s_G^{\mathcal{C}}} - \frac{s_h}{s_{\mathcal{H}}}\right) s_G^{\mathcal{C}} - s_G^{\mathcal{G}} \quad z \in \mathcal{H}$ $T_z^* = 0 \quad z \in \mathcal{U}$
Industries' weights in GDP deflator	$\bar{\mathbf{\Omega}}_{\mathcal{Z}} \in \mathbb{R}^{\lvert\mathcal{N}\rvert}$	$\bar{\mathbf{\Omega}}_{\mathcal{Z}} \equiv \boldsymbol{s}^T \Omega_{\mathcal{Z},:}$

Table 6: Expenditure and ownership shares

Parameter	Notation	Definition
Wealth effects in factor supply	$\Gamma \in \mathbb{R}^{\lvert\mathcal{F}\rvert\times\lvert\mathcal{Z}\rvert}$	$\Gamma = \hat{\Xi}^T_{:\mathcal{F}} diag(\boldsymbol{\gamma})$ $\boldsymbol{\gamma} \equiv \begin{pmatrix} \gamma\mathbf{1}_{\mathcal{H}} & \mathbf{0}_{\mathcal{U}} & 0 \end{pmatrix}$
Heterogeneous factor supply elasticities	$\Phi \in \mathbb{R}^{\lvert\mathcal{F}\rvert\times\lvert\mathcal{F}\rvert}$	$\Phi \equiv diag(\boldsymbol{\varphi}) +$ $\Gamma \begin{pmatrix} \mathbf{1}_{\mathcal{H}}\bar{\Xi}_{\mathcal{H}\mathcal{F}} & \Xi_{\mathcal{U}\mathcal{F}} & \mathbf{0} \end{pmatrix}^T$
Factor price deflators	$\beta \in \mathbb{R}^{\lvert\mathcal{N}\rvert\times\lvert\mathcal{F}\rvert}$	$\beta^T \equiv (I-\Gamma)\begin{pmatrix} \mathbf{1}\bar{\Omega}_{\mathcal{H}} & \Omega_{\mathcal{U}} \end{pmatrix}^T$ $+\Gamma \begin{pmatrix} \mathbf{1}_{\mathcal{H}}\bar{\Xi}_{\mathcal{H},:} & \Xi_{\mathcal{U},:} & \mathbf{0} \end{pmatrix}^T \Psi^{-1}$
Industry shares in nominal rate deflator	$\pi^R \equiv \hat{\boldsymbol{\beta}}^T \boldsymbol{\pi}$	$\hat{\boldsymbol{\beta}}^T \equiv (1-\gamma)\bar{\mathbf{\Omega}}_{\mathcal{H}:}$ $+\gamma\left[\bar{\mathbf{\Xi}}_{\mathcal{H}:}\Psi^{-1} - \bar{\mathbf{\Xi}}_{\mathcal{H}\mathcal{F}}\Theta\right]$
Substitution elasticities	θ_{jk}^i	$\theta_{jk}^i \equiv -\frac{d\log\frac{X_{ij}}{X_{ik}}}{d\log\frac{P_j}{P_k}}$
Real marginal cost Phillips curve slopes	$\Delta \equiv diag\left(\hat{\delta}_1, ..., \hat{\delta}_{\bar{N}}\right)$	$\hat{\delta}_i \equiv \frac{\delta_i(1-\rho(1-\delta_i))}{1-\rho\delta_i(1-\delta_i)}$
Price pass-through	$\mathcal{P} \in \mathbb{R}^{\lvert\mathcal{N}\rvert\times\lvert\mathcal{N}\rvert}$	$\mathcal{P} \equiv \Delta(I-\Omega\Delta)^{-1}$
Demand elasticity	$\Theta \in \mathbb{R}^{\lvert\mathcal{F}\rvert\times\lvert\mathcal{N}\rvert}$	See proof of proposition 4.1 *A*

Table 7: Elasticities

Proof of proposition 4.1. Industry-level Phillips curves and household-level Euler equations follow from standard derivations (see Gali (2015), Rubbo (2023)). Below I derive factor supply and relative factor demand equations.

When households can freely trade a risk-free asset, their Euler equations imply

$$\boldsymbol{c}_{\mathcal{H}t} = \boldsymbol{\xi} + \mathbf{1}\bar{c}_{\mathcal{H}t} - \Gamma^{-1}\left(\boldsymbol{p}_{\mathcal{H}t} - \mathbf{1}\bar{p}_{\mathcal{H}t}\right) \ \forall t > 0, \tag{33}$$

where $\boldsymbol{\xi} = (\xi_1, ..., \xi_H)^T$ is a vector of level shifts in the households' consumption, that are constant over time and satisfy $\sum_{h\in\mathcal{H}} s_h\xi_h = 0$. Combining the log-linearized consumption-leisure tradeoff with the definition of $\boldsymbol{\xi}$ in (33)

gives the factor supply equations

$$\boldsymbol{w} = \Phi\boldsymbol{\ell} + \Gamma\left(\boldsymbol{\xi} - \mathbf{1}\frac{ds_G^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}}\right) + \beta^T\boldsymbol{p}.$$

To derive the relative demand equation, start by approximating the accounting relation

$$\bar{\boldsymbol{\Psi}}_{\mathcal{F}} = \Psi_{\mathcal{Z}\mathcal{F}}^T\mathbf{s},$$

to obtain

$$d\bar{\boldsymbol{\Psi}}_{\mathcal{F}} = d\left(\Psi_{\mathcal{Z}\mathcal{F}}^T\right)\mathbf{s} + \Psi_{\mathcal{Z}\mathcal{F}}^T d\boldsymbol{s}.$$

Next denote by $\boldsymbol{\mu}$ the vector of log-changes in industry-level markups, and use the definition of $\Psi \equiv (I-\Omega)^{-1}$ to solve

$$d\left(\Psi_{\mathcal{Z}\mathcal{F}}^T\right)\mathbf{s} = \Psi_{:\mathcal{F}}^T d\Omega^T\,|_{Sub}\;\bar{\boldsymbol{\Psi}} - \Psi_{:\mathcal{F}}^T\mathcal{T}\boldsymbol{\mu} + s_G^{\mathcal{G}}Cov_{\boldsymbol{\Omega}_G^{\mathcal{G}}}\left(\Psi_{:\mathcal{F}}^T, d\log\boldsymbol{\Omega}_G^{\mathcal{G}}\right),$$

where

$$\begin{aligned}
\Psi_{:\mathcal{F}}^T d\Omega^T\,|_{Sub}\;\bar{\boldsymbol{\Psi}} &\equiv \sum_{i,j,k}\bar{\Psi}_i\omega_{ij}\omega_{ik}\left(1-\theta_{jk}^i\right)\left(\Psi_{:\mathcal{F}}\right)_{j,:}(p_j-p_k)\\
&= \sum_{i,j,k}\bar{\Psi}_i\omega_{ij}\omega_{ik}\left(\Psi_{:\mathcal{F}}\right)_{j,:}(p_j-p_k) - \Theta\left(\Psi_{:\mathcal{F}},\mathbf{p}\right)\\
&= \left[\Psi_{:\mathcal{F}}^T\left(I-\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}\mathbf{1}^T\right)\mathcal{T}\Psi^{-1} - Cov_{\boldsymbol{s}}\left(\Psi_{\mathcal{Z}\mathcal{F}},\Omega_{\mathcal{Z}:}\right) - \Theta\left(\Psi_{:\mathcal{F}},I\right)\right]\mathbf{p}.
\end{aligned}$$

and we defined

$$\left[\Theta\left(X,Y\right)\right]_{fi} \equiv \sum_j\bar{\boldsymbol{\Psi}}_j\sum_{nq}\Omega_{jn}\Omega_{jq}\theta_{nq}^j\left(X_{fn}-X_{fq}\right)\left(Y_{nj}-Y_{qj}\right).$$

Solving for markups as a function of prices and wages,

$$\boldsymbol{\mu} = \Psi^{-1}\boldsymbol{p} - \Omega_{:\mathcal{F}}\boldsymbol{w},$$

yields

$$d\left(\Psi_{\mathcal{Z}\mathcal{F}}^T\right)\mathbf{s} = -\left[\bar{\boldsymbol{\Psi}}_{\mathcal{F}}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}} + Cov_{\boldsymbol{s}}\left(\Psi_{\mathcal{Z}\mathcal{F}},\Omega_{\mathcal{Z}:}\right) + \Theta\left(\Psi_{:\mathcal{F}},I\right)\right]\mathbf{p} - \mathcal{T}_{\mathcal{F}}\boldsymbol{w} + s_G^{\mathcal{G}}Cov_{\boldsymbol{\Omega}_G}^{\mathcal{G}}\left(\Psi_{:\mathcal{F}}^T, d\log\boldsymbol{\Omega}_G^{\mathcal{G}}\right)$$

and hence

$$\begin{aligned}
d\bar{\boldsymbol{\Psi}}_{\mathcal{F}} &= \mathcal{T}_{\mathcal{F}}\left(\boldsymbol{w}+\boldsymbol{\ell}-\mathbf{1}y\right) - \bar{\boldsymbol{\Psi}}_{\mathcal{F}}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}\boldsymbol{p}\\
&= -\left[\bar{\boldsymbol{\Psi}}_{\mathcal{F}}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}} + Cov_{\boldsymbol{s}}\left(\Psi_{\mathcal{Z}\mathcal{F}},\Omega_{\mathcal{Z}:}\right) + \Theta\left(\Psi_{:\mathcal{F}},I\right)\right]\mathbf{p} - \mathcal{T}_{\mathcal{F}}\boldsymbol{w} + \Psi_{\mathcal{Z}\mathcal{F}}^T d\boldsymbol{s} + s_G^{\mathcal{G}}Cov_{\boldsymbol{\Omega}_G}^{\mathcal{G}}\left(\Psi_{:\mathcal{F}}^T, d\log\boldsymbol{\Omega}_G^{\mathcal{G}}\right)
\end{aligned}$$

so that

$$\mathcal{T}_{\mathcal{F}}\left(\boldsymbol{\ell}-\mathbf{1}y\right)=-\left[Cov_{\boldsymbol{s}}\left(\Psi_{\mathcal{Z}\mathcal{F}},\Omega_{\mathcal{Z}:}\right)+\Theta\left(\Psi_{:\mathcal{F}},I\right)\right]\mathbf{p}+\Psi_{\mathcal{Z}\mathcal{F}}^{T}d\boldsymbol{s}+s_{G}^{\mathcal{G}}Cov_{\boldsymbol{\Omega}_{G}}^{\mathcal{G}}\left(\Psi_{:\mathcal{F}}^{T},d\log\boldsymbol{\Omega}_{G}^{\mathcal{G}}\right)$$

Moreover we have

$$\Psi_{\mathcal{Z}\mathcal{F}}^{T}d\boldsymbol{s}=Cov_{\boldsymbol{s}}\left(\Psi_{\mathcal{Z}\mathcal{F}}^{T},d\log\boldsymbol{s}\right)$$

and

$$d\log\boldsymbol{s}=\Xi\left(\boldsymbol{\ell}-\mathbf{1}y\right)+\left[\Xi\Psi^{-1}-\mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}-\begin{pmatrix}\left(\Gamma^{-1}-I\right)\left(\Omega_{\mathcal{H}:}-\mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{H}:}\right)\\ \mathbb{O}\end{pmatrix}\right]\boldsymbol{p}+\boldsymbol{\xi}-\begin{pmatrix}\mathbf{1}_{\mathcal{H}}\\ \mathbf{0}_{\mathcal{U}}\end{pmatrix}\frac{ds_{G}^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}}$$

which yields

$$\boldsymbol{\ell}-\mathbf{1}y=-\Theta\boldsymbol{p}+\boldsymbol{\mathcal{D}}_{G},$$

where

$$\Theta\equiv\mathcal{D}_{\ell}\left[\Theta(\Psi_{:\mathcal{F}}^{T},I)+Cov_{\boldsymbol{s}}\left(\Psi_{\mathcal{Z}\mathcal{F}}^{T},\begin{pmatrix}\mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{H}:}\\ \Omega_{\mathcal{U},:}\end{pmatrix}-\Xi\Psi^{-1}+\Gamma^{-1}\begin{pmatrix}\Omega_{\mathcal{H}:}-\mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{H}:}\\ \mathbb{O}\end{pmatrix}\right)\right]$$
$$\mathcal{D}_{\ell}\equiv\mathcal{T}_{\mathcal{F}}^{-1}\left(I-Cov_{\boldsymbol{s}}\left(\Psi_{\mathcal{Z}\mathcal{F}}^{T},\Xi_{:\mathcal{F}}\mathcal{T}_{\mathcal{F}}^{-1}\right)\right).$$

Proof of lemma 4.1. Within the proof of proposition 4.1.

Proof of Lemma 4.2. The budget constraint for households as a whole

$$\bar{c}_{\mathcal{H}}=\bar{\boldsymbol{\Xi}}_{\mathcal{H}\mathcal{F}}\boldsymbol{\ell}+\bar{\boldsymbol{\Xi}}_{\mathcal{H}:}\Psi^{-1}\boldsymbol{p}-\bar{p}_{\mathcal{H}}-\frac{ds_{Gt}^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}},\tag{34}$$

together with the households' Euler equations in (23), imply

$$\bar{\boldsymbol{\Xi}}_{\mathcal{H}\mathcal{F}}\boldsymbol{\ell}_{t+1}=\bar{\boldsymbol{\Xi}}_{\mathcal{H}\mathcal{F}}\boldsymbol{\ell}_{t}+\frac{1}{\gamma}\left[i_{t}-\log\rho-\left[\left(1-\gamma\right)\bar{\boldsymbol{\Psi}}_{\mathcal{H}:}+\gamma\bar{\boldsymbol{\Xi}}_{\mathcal{H}:}\right]\Psi^{-1}\mathbb{E}\boldsymbol{\pi}_{t+1}\right]+\frac{ds_{Gt+1}^{\mathcal{G}}-ds_{Gt}^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}}.$$

Combining with the relative demand equation then yields

$$y_{t+1}=y_{t}+\frac{1}{\gamma}\left[i_{t}-\log\rho-\hat{\boldsymbol{\beta}}^{T}\mathbb{E}\boldsymbol{\pi}_{t+1}\right]+\frac{ds_{Gt+1}^{\mathcal{G}}-ds_{Gt}^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}}-\bar{\boldsymbol{\Xi}}_{\mathcal{H}\mathcal{F}}\left(\boldsymbol{\mathcal{D}}_{Gt+1}-\boldsymbol{\mathcal{D}}_{Gt}\right)$$
$$\hat{\boldsymbol{\beta}}^{T}\equiv\left(1-\gamma\right)\bar{\boldsymbol{\Omega}}_{\mathcal{H}}+\gamma\left(\bar{\boldsymbol{\Xi}}_{\mathcal{H}:}\Psi^{-1}-\bar{\boldsymbol{\Xi}}_{\mathcal{H}\mathcal{F}}\Theta\right).$$

Proof of Lemma 4.3. The households' intertemporal budget constraints pin down the permanent income shifts $\boldsymbol{\xi}$, by imposing that the present value of consumption equals the present value of factor and profit income, adjusted

for taxes and subsidies:

$$\sum_{t=0}^{\infty}\rho^t\left(\boldsymbol{c}_{\mathcal{H}t}+\boldsymbol{p}_{\mathcal{H}t}-\Xi_{\mathcal{H}\mathcal{F}}\boldsymbol{\ell}-\Xi_{\mathcal{H}:}\Psi^{-1}\boldsymbol{p}\right)=$$
$$\sum_{t=0}^{\infty}\rho^t\left(\boldsymbol{\xi}+\mathbf{1}\left(\bar{c}_{\mathcal{H}t}+\bar{p}_{\mathcal{H}t}\right)+\left(I-\Gamma^{-1}\right)\left(\boldsymbol{p}_{\mathcal{H}t}-\bar{p}_{\mathcal{H}t}\right)-\Xi_{\mathcal{H}\mathcal{F}}\boldsymbol{\ell}-\Xi_{\mathcal{H}:}\Psi^{-1}\boldsymbol{p}\right)=$$
$$\sum_{t=0}^{\infty}\rho^t\left[\left(\frac{\boldsymbol{s}_G^{\mathcal{H}}}{\boldsymbol{s}_{\mathcal{H}}}-\mathbf{1}\frac{s_G^{\mathcal{C}}}{\bar{s}^{\mathcal{H}}}\right)d\log s_{Gt}^{\mathcal{C}}-\mathbf{1}\frac{ds_{Gt}^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}}\right].$$

Therefore we have

$$\boldsymbol{\xi}=(1-\rho)\sum_{t=0}^{\infty}\rho^t\left(I-\frac{\mathbf{1}\boldsymbol{s}_{\mathcal{H}}^T}{\boldsymbol{s}_{\mathcal{H}}^T\mathbf{1}}\right)\boldsymbol{\varsigma}_t,$$

where

$$\boldsymbol{\varsigma}_t\equiv\Xi_{\mathcal{H}\mathcal{F}}\boldsymbol{\ell}_t+\frac{1}{\gamma}\left[\gamma\Xi_{\mathcal{H}:}\Psi^{-1}+(1-\gamma)\,\Omega_{\mathcal{H}:}\right]\boldsymbol{p}_t+\frac{\boldsymbol{s}_G^{\mathcal{H}}}{\boldsymbol{s}_{\mathcal{H}}}d\log s_{Gt}^{\mathcal{C}}.$$

Proof of proposition 4.2. Combining the factor supply and relative demand equations in (23) yields

$$\boldsymbol{w}_t=\Phi\left[\mathbf{1}y_t+\boldsymbol{\mathcal{D}}_{Gt}-\Phi^{-1}\Gamma\mathbf{1}\frac{ds_{Gt}^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}}\right]+\left(\beta^T-\Phi\Theta\right)\boldsymbol{p}_t.$$

Plugging into the pricing equation then gives

$$\left(I-\kappa\Phi^{-1}\mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}\right)\boldsymbol{p}=\kappa\left[\mathbf{1}y+\boldsymbol{\mathcal{D}}_G-\Phi^{-1}\Gamma\mathbf{1}\frac{ds_G^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}}\right]+(I-\mathcal{V})\left(\boldsymbol{p}_{-1}+\rho\mathbb{E}\boldsymbol{\pi}_{+1}\right)\tag{35}$$

where

$$\kappa\equiv\left(I+\mathcal{P}_{:\mathcal{F}}\left(\Phi\Theta-\left(\beta^T-\mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}:}\right)\right)\right)^{-1}\mathcal{P}_{:\mathcal{F}}\Phi$$
$$\mathcal{V}\equiv\left(I+\mathcal{P}_{:\mathcal{F}}\left(\Phi\Theta-\left(\beta^T-\mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}\right)\right)\right)^{-1}\mathcal{P}\Psi^{-1}\left[I-\Psi_{:\mathcal{F}}\left(\left(\beta^T-\mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}\right)-\Phi\Theta\right)\right].$$

Equation (27) is obtained from (35) noting that $\boldsymbol{p}=\boldsymbol{\pi}+\boldsymbol{p}_{-1}$.

Proof of Proposition 4.4. Aggregating both sides of equation (35) according to final use shares $\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}$ and solving for aggregate output yields

$$y=\frac{1-\boldsymbol{\kappa}^Y\Phi^{-1}\mathbf{1}}{\boldsymbol{\kappa}^Y\mathbf{1}}\bar{p}+\frac{\boldsymbol{\kappa}^Y}{\boldsymbol{\kappa}^Y\mathbf{1}}\left[\Phi^{-1}\boldsymbol{\mathcal{S}}_G ds_G^{\mathcal{G}}-\boldsymbol{\mathcal{D}}_G\right]-\frac{\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}}{\boldsymbol{\kappa}^Y\mathbf{1}}\left(I-\mathcal{V}\right)\left(p_{-1}-\rho\mathbb{E}\pi_{+1}\right).$$

Plugging the expression for y back into (35) then gives

$$\left(I-\kappa\Phi^{-1}\mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}\right)\boldsymbol{p}=\left(1-\boldsymbol{\kappa}^{Y}\Phi^{-1}\mathbf{1}\right)\frac{\kappa\mathbf{1}}{\boldsymbol{\kappa}^{Y}\mathbf{1}}\bar{p}+\left(I-\frac{\kappa\mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}}{\boldsymbol{\kappa}^{Y}\mathbf{1}}\right)\kappa\left[\mathcal{D}_{G}-\Phi^{-1}\mathcal{S}_{G}ds_{G}^{\mathcal{G}}\right]+\left(I-\frac{\kappa\mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}}{\boldsymbol{\kappa}^{Y}\mathbf{1}}\right)\left(I-\mathcal{V}\right)\left(p_{-1}-\rho\mathbb{E}\pi_{+1}\right).$$

Noting that $\Theta\mathbf{1}=\mathbf{0}$ then allows us to write

$$\Theta\boldsymbol{p}=\Theta\left(I-\frac{\kappa\mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}}{\boldsymbol{\kappa}^{Y}\mathbf{1}}\right)\left[\kappa\Phi^{-1}\mathbf{1}-\mathbf{1}\right]\bar{p}+\Theta\left(I-\frac{\kappa\mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}}{\boldsymbol{\kappa}^{Y}\mathbf{1}}\right)\left[\kappa\left[\mathcal{D}_{G}-\Phi^{-1}\mathcal{S}_{G}ds_{G}^{\mathcal{G}}\right]+\left(I-\mathcal{V}\right)\left(p_{-1}-\rho\mathbb{E}\pi_{+1}\right)\right],$$

Denoting $\hat{\Theta}\equiv\Theta\left(I-\frac{\kappa\mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}}{\boldsymbol{\kappa}^{Y}\mathbf{1}}\right)$, and combining with the relative demand equation, yields

$$\boldsymbol{\ell}-\mathbf{1}y=\left(I-\hat{\Theta}\kappa\right)\boldsymbol{\mathcal{D}}_{Gt}+\hat{\Theta}\kappa\Phi^{-1}\Gamma\mathbf{1}\frac{ds_{Gt}^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}}-\hat{\Theta}\left(\mathbf{1}-\kappa\Phi^{-1}\mathbf{1}\right)p_{t}^{Y}-\hat{\Theta}\left(I-\mathcal{V}\right)\left(p_{-1}-\rho\mathbb{E}\pi_{+1}\right).$$

B Employment and Consumption Multipliers

Lemmas B.1 and B.2 derive employment and consumption multipliers (proofs are at the end of this subsection).

Lemma B.1. *Rescale all demand elasticities relative to aggregate labor employment ($\mathcal{D}_{x}^{\mathcal{L}}\equiv\left(I-\frac{\mathbf{1}\bar{\boldsymbol{\Psi}}_{\mathcal{L}}^{T}}{\bar{\boldsymbol{\Psi}}_{\mathcal{L}}^{T}\mathbf{1}}\right)\mathcal{D}_{x}$, $x=p,G,\boldsymbol{\xi}$). Equilibrium dynamics can be expressed in terms of aggregate employment using modified aggregate demand and Phillips curves:*

$$\begin{cases}\boldsymbol{\pi}_{t}-\kappa^{\mathcal{L}}\Phi^{-1}\mathbf{1}\bar{\pi}_{t}=\kappa^{\mathcal{L}}\left[\mathbf{1}\bar{\ell}_{t}-\Phi^{-1}\Gamma\left(\mathbf{1}\frac{ds_{Gt}^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}}-\boldsymbol{\xi}\right)+\boldsymbol{\mathcal{D}}_{Gt}^{\mathcal{L}}\right]+\boldsymbol{\mathcal{X}}_{t}^{\mathcal{L}}\\ \bar{\ell}_{t+1}-\bar{\ell}_{t}=\frac{1}{\gamma}\left(i_{t}-\bar{\pi}_{t+1}^{R,\mathcal{L}}\right)+\frac{ds_{Gt+1}^{\mathcal{G}}-ds_{Gt}^{\mathcal{G}}}{s_{\mathcal{H}}}-\bar{\boldsymbol{\Xi}}_{\mathcal{H},\mathcal{F}}\left(\boldsymbol{\mathcal{D}}_{Gt+1}^{\mathcal{L}}-\boldsymbol{\mathcal{D}}_{Gt}^{\mathcal{L}}\right),\end{cases}$$

where $\kappa^{\mathcal{L}}$ and $\bar{\pi}^{R,\mathcal{L}}$ are computed using rescaled demand elasticities. Employment-based demand and supply curves both shift by more than their output-based counterparts when government spending targets labor-intensive goods, as measured respectively by $\left(\frac{\bar{\boldsymbol{\Psi}}_{\mathcal{L}}^{T}}{\bar{\Psi}_{\mathcal{L}}}-\frac{\bar{\boldsymbol{\Psi}}_{\mathcal{K}}^{T}}{\bar{\Psi}_{\mathcal{K}}}\right)\boldsymbol{\mathcal{D}}_{G}>0$ and $\left(\frac{\bar{\boldsymbol{\Psi}}_{\mathcal{L}}^{T}}{\bar{\Psi}_{\mathcal{L}}}-\frac{\bar{\boldsymbol{\Psi}}_{\mathcal{K}}^{T}}{\bar{\Psi}_{\mathcal{K}}}\right)\left(I-\Theta\kappa\right)\boldsymbol{\mathcal{D}}_{G}>0$.

Lemma B.2 derives a similar result for consumption multipliers.

Lemma B.2. *Equilibrium dynamics can be expressed in terms of aggregate consumption ($\bar{c}\equiv\frac{\boldsymbol{s}_{\mathcal{H}}^{T}\boldsymbol{c}}{\boldsymbol{s}_{\mathcal{H}}^{T}\mathbf{1}}$) using modified demand and Phillips curves:*

$$\begin{cases}\boldsymbol{\pi}_{t}-\kappa^{\mathcal{H}}\Phi^{-1}\mathbf{1}\bar{\pi}_{t}=\kappa^{\mathcal{H}}\left[\mathbf{1}\bar{c}_{t}+\left(I-\Phi^{-1}\Gamma\right)\left(\mathbf{1}\frac{ds_{Gt}^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}}-\boldsymbol{\xi}\right)+\boldsymbol{\mathcal{D}}_{Gt}^{\mathcal{H}}\right]+\boldsymbol{\mathcal{X}}^{\mathcal{H}}\\ \bar{c}_{t+1}=\bar{c}_{t}+\frac{1}{\gamma}\left(i_{t}-\pi_{t+1}^{CPI}\right),\end{cases}$$

where $\kappa^{\mathcal{H}}$, $\beta_{\mathcal{H}}$, and $\mathcal{D}_{\mathcal{H}}$ are defined in Appendix A. Reallocation effects in the consumption-based supply curve are larger than in the output-based one when $\frac{\bar{\boldsymbol{\Psi}}_{\mathcal{K}}^{T}}{1+\boldsymbol{\varphi}_{\mathcal{K}}}\left(I-\Theta\kappa\right)\boldsymbol{\mathcal{D}}_{G}<0$ and $\left(\bar{\boldsymbol{\Xi}}_{\mathcal{H}:}\Psi^{-1}-\bar{\boldsymbol{\Omega}}_{\mathcal{H}}\right)\kappa\boldsymbol{\mathcal{D}}_{G}>0$.

Like in aggregated models, consumption multipliers are smaller than output multipliers because government

spending doesn't shift the consumption-based Euler equation. Reallocation effects however can be larger in the consumption-based supply curve than in the output-based one, when spending targets labor-intensive industries and goods used more intensively in utilization than in consumption.

Example B.1 illustrates employment and output multipliers in a two-industry economy.

Example B.1. Output and Employment multipliers. Consider an economy with two industries, 1 and 2, each using its own industry-specific labor L and land K. Labor shares are α and $1-\alpha$ respectively. The inverse Frish elasticity of labor supply is φ_L, while inverse land supply elasticity is φ_K. For simplicity, consider the limit $\rho \to 0$.

Suppose a representative household has equal expenditure shares on goods 1 and 2, while the government has expenditure shares β_{G1} and β_{G2}. Let's consider the supply shifts caused by raising the spending share $s_G^{\mathcal{G}}$, in terms of aggregate output and aggregate (labor) employment:

$$\begin{aligned}\partial y &= \frac{\frac{1}{2}\gamma}{\frac{1}{2}\gamma+\bar{\varphi}}\frac{ds_G}{1-s_G^*} + \frac{1}{4}\frac{\varphi_K-\varphi_L}{\frac{1}{2}\gamma+\bar{\varphi}}\left(\bar{\ell}-\bar{k}\right)\\ \partial\bar{\ell} &= \frac{\frac{1}{2}\gamma}{\frac{1}{2}\gamma+\bar{\varphi}}\frac{ds_G}{1-s_G^*} + \frac{1}{4}\left(\gamma+2\varphi_K\right)\left(\bar{\ell}-\bar{k}\right).\end{aligned}$$

If labor is more elastically supplied than land ($\varphi_K > \varphi_L$), both output and employment shifts are larger when spending raises hours worked more than land utilization. The employment effect is purely mechanical, while output responds to the usual logic (shifting expenditure toward factors with flatter supply curves expands aggregate supply).

In turn, hours worked relative to land utilization depend on changes in demand and supply of the two factors:

$$\bar{\ell}-\bar{k} = \mathcal{C}_1\left[\left(\varphi_K-\varphi_L-\gamma\right)y + \gamma\frac{ds_G}{1-s_G^*}\right] + \mathcal{C}_2\left(2\alpha-1\right)\left(2\beta_{G1}-1\right)\frac{ds_G}{1-s_G^*},$$

where $\mathcal{C}_1$ and $\mathcal{C}_2$ are positive constants. Relative demand for labor is increasing in the spending share if and only if spending is targeted toward the labor intensive industry. Moreover, increasing government spending always raises the relative supply of labor, because of wealth effects.

Proof of Lemma B.1. The relative demand equation in (23) implies

$$\boldsymbol{\ell}-\mathbf{1}\bar{\ell} = \left(I - \frac{\mathbf{1}\bar{\boldsymbol{\Psi}}_{\mathcal{L}}^T}{\bar{\boldsymbol{\Psi}}_{\mathcal{L}}^T\mathbf{1}}\right)\left(\boldsymbol{\ell}-\mathbf{1}y\right) = -\Theta^{\mathcal{L}}\boldsymbol{p} + \boldsymbol{\mathcal{D}}_G^{\mathcal{L}}. \tag{36}$$

Combining equation (36) with the consumption-leisure tradeoff and the pricing equation yields

$$\begin{aligned}\left(1-\kappa^{\mathcal{L}}\Phi^{-1}\mathbf{1}\right)\boldsymbol{p}_t &= \kappa^{\mathcal{L}}\left[\mathbf{1}\bar{\ell}_t - \Phi^{-1}\Gamma\mathbf{1}\frac{ds_{Gt}^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}} + \boldsymbol{\mathcal{D}}_{Gt}^{\mathcal{L}}\right] + \left(I-\mathcal{V}^{\mathcal{L}}\right)\left(\boldsymbol{p}_{t-1}+\rho\mathbb{E}\boldsymbol{\pi}_{t+1}\right)\\ \mathcal{V}^{\mathcal{L}} &\equiv \left(I+\mathcal{P}_{:\mathcal{F}}\left(\Phi\Theta^{\mathcal{L}} - \left(\beta^T - \mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}\right)\right)\right)^{-1}\mathcal{P}\Psi^{-1}\left[I-\Psi_{:\mathcal{F}}\left(\left(\beta^T-\mathbf{1}\bar{\boldsymbol{\Omega}}_{\mathcal{Z}}\right)-\Phi\Theta^{\mathcal{L}}\right)\right].\end{aligned}$$

Let's now solve for aggregate demand. Aggregating the households' Euler equations yields

$$\bar{c}_{\mathcal{H},t+1} = \bar{c}_{\mathcal{H},t} + \frac{1}{\gamma}\left(i_t - \bar{\mathbf{\Omega}}_{\mathcal{H}:}\boldsymbol{\pi}_{t+1}\right),$$

while the households' budget constraints imply

$$\bar{c}_{\mathcal{H}t} = \bar{\ell} + \bar{\mathbf{\Xi}}_{\mathcal{H}\mathcal{F}}\boldsymbol{\mathcal{D}}^{\mathcal{L}}_{Gt} + \left(\bar{\mathbf{\Xi}}_{\mathcal{H}:}\Psi^{-1} - \bar{\mathbf{\Xi}}_{\mathcal{H}\mathcal{F}}\Theta^{\mathcal{L}} - \bar{\mathbf{\Omega}}_{\mathcal{H}:}\right)\boldsymbol{p} - \frac{ds^{\mathcal{G}}_{Gt}}{\bar{s}_{\mathcal{H}}}.$$

Therefore we have

$$\begin{aligned}
\bar{\ell}_{t+1} &= \bar{\ell}_t + \frac{1}{\gamma}\left(\mathbf{1}i_t - \bar{\boldsymbol{\beta}}^T_{\mathcal{L}}\boldsymbol{\pi}_{t+1}\right) + \frac{ds^{\mathcal{G}}_{Gt+1} - ds^{\mathcal{G}}_{Gt}}{\bar{s}_{\mathcal{H}}} - \bar{\mathbf{\Xi}}_{\mathcal{H}\mathcal{F}}\left(\boldsymbol{\mathcal{D}}^{\mathcal{L}}_{Gt+1} - \boldsymbol{\mathcal{D}}^{\mathcal{L}}_{Gt}\right)\\
\beta^T_{\mathcal{L}} &\equiv (1-\gamma)\,\Omega_{\mathcal{H}:} + \gamma\left(\Xi_{\mathcal{H}:}\Psi^{-1} - \Xi_{\mathcal{H}\mathcal{F}}\Theta^{\mathcal{L}}\right).
\end{aligned}$$

The reallocation effect on aggregate employment is larger than the reallocation effect on aggregate output whenever

$$\begin{aligned}
&\bar{\mathbf{\Omega}}_{\mathcal{Z}:}\left(I + \mathcal{P}_{:\mathcal{F}}\left(\Phi\left(I - \frac{\mathbf{1}\bar{\mathbf{\Psi}}^T_{\mathcal{L}}}{\bar{\mathbf{\Psi}}^T_{\mathcal{L}}\mathbf{1}}\right)\Theta - \left(\beta^T - \mathbf{1}\bar{\mathbf{\Omega}}_{\mathcal{Z}:}\right)\right)\right)^{-1}\mathcal{P}_{:\mathcal{F}}\Phi\left(I - \frac{\mathbf{1}\bar{\mathbf{\Psi}}^T_{\mathcal{L}}}{\bar{\mathbf{\Psi}}^T_{\mathcal{L}}\mathbf{1}}\right)\boldsymbol{\mathcal{D}}_{Gt}\\
&< \bar{\mathbf{\Omega}}_{\mathcal{Z}:}\left(I + \mathcal{P}_{:\mathcal{F}}\left(\Phi\left(I - \mathbf{1}\bar{\mathbf{\Psi}}^T_{\mathcal{F}}\right)\Theta - \left(\beta^T - \mathbf{1}\bar{\mathbf{\Omega}}_{\mathcal{Z}:}\right)\right)\right)^{-1}\mathcal{P}_{:\mathcal{F}}\Phi\left(I - \mathbf{1}\bar{\mathbf{\Psi}}^T_{\mathcal{F}}\right)\boldsymbol{\mathcal{D}}_{Gt} \iff\\
&\bar{\boldsymbol{\kappa}}^{\mathcal{L}}\mathbf{1}\left(\frac{\bar{\mathbf{\Psi}}^T_{\mathcal{L}}}{\bar{\mathbf{\Psi}}^T_{\mathcal{L}}\mathbf{1}} - \bar{\mathbf{\Psi}}^T_{\mathcal{F}}\right)(I - \Theta\kappa)\,\boldsymbol{\mathcal{D}}_{Gt} > 0 \iff \begin{pmatrix} \frac{1-\bar{\mathbf{\Psi}}^T_{\mathcal{L}}\mathbf{1}}{\bar{\mathbf{\Psi}}^T_{\mathcal{L}}\mathbf{1}}\bar{\mathbf{\Psi}}^T_{\mathcal{L}} & -\bar{\mathbf{\Psi}}^T_{\mathcal{K}} \end{pmatrix}(I - \Theta\kappa)\,\boldsymbol{\mathcal{D}}_{Gt} > 0
\end{aligned}$$

Similarly, the aggregate demand shift in terms of employment is larger than in terms of output whenever

$$\begin{aligned}
&\bar{\mathbf{\Xi}}_{\mathcal{H}\mathcal{F}}\left(I - \frac{\mathbf{1}\bar{\mathbf{\Psi}}^T_{\mathcal{L}}}{\bar{\mathbf{\Psi}}^T_{\mathcal{L}}\mathbf{1}}\right)\left(\boldsymbol{\mathcal{D}}_{Gt+1} - \boldsymbol{\mathcal{D}}_{Gt}\right) < \bar{\mathbf{\Xi}}_{\mathcal{H}\mathcal{F}}\left(I - \mathbf{1}\bar{\mathbf{\Psi}}^T_{\mathcal{F}}\right)\left(\boldsymbol{\mathcal{D}}_{Gt+1} - \boldsymbol{\mathcal{D}}_{Gt}\right) \iff\\
&\left(\frac{\bar{\mathbf{\Psi}}^T_{\mathcal{L}}}{\bar{\mathbf{\Psi}}^T_{\mathcal{L}}\mathbf{1}} - \bar{\mathbf{\Psi}}^T_{\mathcal{F}}\right)\left(\boldsymbol{\mathcal{D}}_{Gt+1} - \boldsymbol{\mathcal{D}}_{Gt}\right) > 0.
\end{aligned}$$

Proof of Lemma B.2. Define

$$\begin{aligned}
\mathcal{D}^{\mathcal{H}}_x &\equiv \left(I - \mathbf{1}\bar{\mathbf{\Xi}}_{\mathcal{H}\mathcal{F}}\right)\mathcal{D}_x,\ \ x = p, G \qquad (37)\\
\beta_{\mathcal{H}} &\equiv \beta + \Phi\mathbf{1}\left(\bar{\mathbf{\Omega}}_{\mathcal{H}} - \bar{\mathbf{\Xi}}_{\mathcal{H}:}\Psi^{-1}\right)\\
\kappa^{\mathcal{H}} &\equiv \left(I + \mathcal{P}_{:\mathcal{F}}\left(\Phi\Theta^{\mathcal{H}} - \left(\beta^T_{\mathcal{H}} - \mathbf{1}\bar{\mathbf{\Omega}}_{\mathcal{Z}:}\right)\right)\right)^{-1}\mathcal{P}_{:\mathcal{F}}\Phi
\end{aligned}$$

The relative demand equation in (23) implies

$$\begin{aligned}
\boldsymbol{\ell} - \mathbf{1}\bar{c} &= \left(I - \mathbf{1}\bar{\mathbf{\Xi}}_{\mathcal{H}\mathcal{F}}\right)(\boldsymbol{\ell} - \mathbf{1}y) + \mathbf{1}\left[\bar{\mathbf{\Omega}}_{\mathcal{H}} - \bar{\mathbf{\Xi}}_{\mathcal{H}:}\Psi^{-1}\right]\boldsymbol{p} + \mathbf{1}\frac{ds^{\mathcal{G}}_G}{\bar{s}_{\mathcal{H}}}\\
&= -\Theta^{\mathcal{H}}\boldsymbol{p} + \boldsymbol{\mathcal{D}}^{\mathcal{H}}_G + \mathbf{1}\left[\bar{\mathbf{\Omega}}_{\mathcal{H}} - \bar{\mathbf{\Xi}}_{\mathcal{H}:}\Psi^{-1}\right]\boldsymbol{p} + \mathbf{1}\frac{ds^{\mathcal{G}}_G}{\bar{s}_{\mathcal{H}}},
\end{aligned}$$

where we used the aggregated household budget constraint

$$\bar{c} = \bar{\mathbf{\Xi}}_{\mathcal{H}\mathcal{F}}\boldsymbol{\ell} + \left[\bar{\mathbf{\Xi}}_{\mathcal{H}:}\Psi^{-1} - \bar{\mathbf{\Omega}}_{\mathcal{H}}\right]\boldsymbol{p} - \frac{ds_G^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}}.$$

Plugging into the factor supply equation yields

$$\begin{aligned} w &= \Phi\mathbf{1}\bar{c} + \Phi\left[\boldsymbol{\mathcal{D}}_G^{\mathcal{H}} + \left(I - \Phi^{-1}\Gamma\right)\mathbf{1}\frac{ds_G^{\mathcal{G}}}{\bar{s}_{\mathcal{H}}}\right] + \left[\beta_{\mathcal{H}}^T - \Phi\Theta^{\mathcal{H}}\right]\boldsymbol{p} \\ \beta_{\mathcal{H}}^T &\equiv \beta^T + \Phi\mathbf{1}\left[\bar{\mathbf{\Omega}}_{\mathcal{H}} - \bar{\mathbf{\Xi}}_{\mathcal{H}:}\Psi^{-1}\right]. \end{aligned}$$

Further combining with the pricing equation yields the expression for the GDP deflator in proposition B.2. Following a similar argument as for proposition B.1, the reallocation effect on aggregate consumption is larger than on aggregate output whenever

$$\bar{\boldsymbol{\kappa}}^{\mathcal{H}}\boldsymbol{\mathcal{D}}_G^{\mathcal{H}} - \bar{\boldsymbol{\kappa}}\boldsymbol{\mathcal{D}}_G > 0 \iff$$

$$\begin{aligned} &\bar{\mathbf{\Omega}}_{\mathcal{Z}:}\left[\left(I + \mathcal{P}_{:\mathcal{F}}\left(\Phi\left(I - \mathbf{1}\bar{\mathbf{\Xi}}_{\mathcal{H}\mathcal{F}}\right)\Theta^{\mathcal{H}} - \left(\beta_{\mathcal{H}}^T - \mathbf{1}\bar{\mathbf{\Omega}}_{\mathcal{Z}:}\right)\right)\right)^{-1}\mathcal{P}_{:\mathcal{F}}\Phi\left(I - \mathbf{1}\bar{\mathbf{\Xi}}_{\mathcal{H}\mathcal{F}}\right)\right. \\ &\left. - \left(I + \mathcal{P}_{:\mathcal{F}}\left(\Phi\left(I - \mathbf{1}\bar{\mathbf{\Psi}}_{\mathcal{F}}^T\right)\Theta - \left(\beta^T - \mathbf{1}\bar{\mathbf{\Omega}}_{\mathcal{Z}:}\right)\right)\right)^{-1}\mathcal{P}_{:\mathcal{F}}\Phi\left(I - \mathbf{1}\bar{\mathbf{\Psi}}_{\mathcal{F}}^T\right)\right]\boldsymbol{\mathcal{D}}_{Gt} < 0 \iff \end{aligned}$$

$$\bar{\boldsymbol{\kappa}}^{\mathcal{H}}\mathbf{1}\left[\left(\bar{\mathbf{\Xi}}_{\mathcal{H}\mathcal{F}} - \bar{\mathbf{\Psi}}_{\mathcal{F}}^T\right)(I - \Theta\kappa) + \left(\bar{\mathbf{\Xi}}_{\mathcal{H}:}\Psi^{-1} - \bar{\mathbf{\Omega}}_{\mathcal{H}}\right)\kappa\right]\boldsymbol{\mathcal{D}}_{Gt} > 0,$$

and profit maximization by utilization producers implies $\bar{\mathbf{\Xi}}_{\mathcal{H}\mathcal{F}} - \bar{\mathbf{\Psi}}_{\mathcal{F}}^T = -\frac{\bar{\mathbf{\Psi}}_{\mathcal{K}}^T}{1+\boldsymbol{\varphi}_K}$.

C General Model vs Stylized Setting – Examples

Example C.1. Vertical linkages. Consider an economy with an intermediate good industry I and a final good industry F. The two industries hire labor L_I and L_F from two segmented markets, and industry F uses good I as input with expenditure share $1-\alpha$. Both industries have the same price adjustment probability δ. Both labor types are supplied by a representative household, with the same inverse Frish elasticity φ. Households only purchase the final good, while the government can purchase any combination of intermediate and final goods.

Following the intuition from our simplified model in section 2, one would be tempted to conclude that the spending composition doesn't matter, because both industries face the same price adjustment probability and labor supply elasticity. The simplified model, however, is misleading, because it ignores the vertical linkage between industries I and F. As a result, changes in the labor cost of industry I are subject to two layers of nominal rigidity (in industry I selling to industry F, and in industry F selling to final consumers), while L_F faces only one layer. This mutes the pass-through of upstream wages into consumption prices, so that L_I has a smaller incidence on final

good prices:[14]

$$\left(1-\bar{\delta}\right)p_F = \bar{\delta}\left[\left(\gamma+\varphi\right)y - \gamma\frac{ds_G}{1-s_G^*}\right] + \alpha\left(1-\alpha\right)\left(\tilde{\delta}_F - \tilde{\delta}_I\right)\left(\ell_F - \ell_I\right)$$

where $\tilde{\delta}_F = \delta$, $\tilde{\delta}_I = \delta^2$, and $\bar{\delta} = \alpha\tilde{\delta}_F + \left(1-\alpha\right)\tilde{\delta}_I$.

As a result, intermediate good workers have a flatter supply slope. Solving for $\ell_F - \ell_I$ from the relative demand equation, we find that spending on intermediate goods results in a larger supply shift:[15]

$$\partial y = \frac{\delta\gamma}{\underline{\delta\gamma} + \underline{\delta\varphi}}\left[1 + \frac{\alpha\left(1-\alpha\right)}{\underline{\delta\gamma}}\frac{\tilde{\delta}_F - \tilde{\delta}_I}{\bar{\delta}}\alpha\beta_{GI}\right]\frac{\partial s_G}{1-s_G^*}.$$

Example C.2. Labor market boundaries versus industry boundaries. Consider an economy with two industries, 1 and 2, and two segmented labor markets L_1 and L_2. Both industries use both labor types, but industry 1 has expenditure share $\alpha > \frac{1}{2}$ on L_1 and vice versa. The elasticity of substitution between L_1 and L_2 is σ in both industries, while the elasticity of substitution between goods 1 and 2 in consumption is θ. Both industries have the same price adjustment probability δ.

Both labor types are supplied by a representative household, with inverse Frish elasticities φ_1 and φ_2. The representative household has equal expenditure shares on goods 1 and 2, while the government has expenditure shares β_{G1} and β_{G2}.

This setup is very similar to section 2, except that labor markets are not fully segmented by industry. Both industries use both labor types, although in different proportions. How to compute the relevant macro-level substitution elasticity between L_1 and L_2 in this setting?

To compute the relative demand for L_1 and L_2, we can directly apply the definition of Θ (reported in appendix A). The relative demand equation takes a similar form as in section 2, except that the substitution elasticity θ is replaced by an average of substitution elasticities in production and consumption:

$$\Theta \equiv \sigma\left(1 - \frac{\bar{\beta}_1\bar{\beta}_2\left(\alpha_1-\alpha_2\right)^2}{s_1 s_2}\right) + \theta\delta\frac{\bar{\beta}_1\bar{\beta}_2\left(\alpha_1-\alpha_2\right)^2}{s_1 s_2}.$$

When labor markets are fully segmented across industries, as in section 2, the relevant elasticity of substitution is θ (consumption). If instead industries use the two factors in the same proportions, the relevant substitution elasticity is σ (production). The simplified model would erroneously leads us to ignore the substitution elasticity in production, and the general framework is essential to compute the correct average depending on industry-level input

[14] The result holds in an even stronger form: L_I always has a smaller incidence on final good prices, regardless of price adjustment probabilities.

[15] The averages $\underline{\delta\gamma}$ and $\underline{\delta\varphi}$ are defined as

$$\underline{\delta\gamma} \equiv \gamma\left[\bar{\delta} + \alpha\left(1-\alpha\right)\left(\tilde{\delta}_F - \tilde{\delta}_I\right)\right]$$
$$\underline{\delta\varphi} \equiv \varphi\left[\bar{\delta} - \frac{\theta}{\bar{\delta}}\alpha\left(1-\alpha\right)\left(\tilde{\delta}_F - \tilde{\delta}_I\right)^2\right].$$

shares.

Using the generalized demand elasticity Θ, we can compute the counterparts of aggregate and relative employment shifts (12) and (15) in an economy where labor market boundaries do not coincide with industry boundaries:

$$\partial(\ell_1 - \ell_2) = \frac{\Psi_{G1} - \Psi_{H1}}{1 + \Theta\bar{\varphi}} \frac{s_G}{1 - s_G^*}, \ \Psi_{G1} - \Psi_{H1} = (\beta_{G1} - \beta_{H1})(\alpha_1 - \alpha_2)$$
$$\partial y_t \propto -\frac{Cov(\varphi, \Psi_G - \Psi_H)}{1 + \Theta\bar{\varphi}} \frac{s_G}{1 - s_G^*}.$$

The main economic mechanism remains the same: targeting spending toward elastically supplied factors implies a larger aggregate supply shift. However, expenditure switching effects and cross-sectional crowding out of private demand are now governed by the generalized substitution elasticity Θ. Moreover, changes in relative demand now depend on the difference between total labor contents $\boldsymbol{\Psi}$ in household versus government consumption – not just direct expenditure shares $\boldsymbol{\beta}$.

D Quantitative analysis

Data Sources and Calibration. Table 8 presents the data sources used to measure government spending in the model calibration and in the empirical analysis.

Data	**Source**
Government expenditure shares on intermediate inputs	Bureau of Economic Analysis input-output tables (1963-2023, 71 NAICS 2-digit industries)
Government expenditure shares on labor occupations	BEA IO tables, American Community Survey (22 occupations)
Government expenditure shares on semi-fixed assets	NIPA tables (1963-2023, 31 semi-fixed assets)

Table 8: Data sources for government expenditure analysis.

Tables 9 and 10 present the data sources for private expenditure shares and the calibrated values of key elasticities.

Data	**Source**
Industries' expenditure on intermediate inputs	BEA input-output tables
Industries' expenditure on labor occupations	BEA IO tables, American Community Survey
Industries' expenditure on semi-fixed assets	NIPA tables
Expenditure shares in asset utilization bundles	Capital Flow Tables
Expenditure shares in consumption	BEA IO tables, Consumer Expenditure Survey
Ownership shares in industries and semi-fixed assets	American Community Survey

Table 9: Data sources for income flow calibration.

Parameter	Calibrated Value
Inverse Frish elasticity	$\varphi_o = 2$ for all occupations $o \in \mathcal{L}$
Inverse supply elasticity of semi-fixed assets	Heavy equipment: 10 Light equipment: 2 Structures: 20 Intellectual products: 5
Wealth effects in labor supply, intertemporal elasticity of substitution	$\gamma = 1$
Substitution elasticities	Consumption: 0.9 Intermediates vs. labor: 0.5 Intermediates vs. semi-fixed assets: 0.5 Labor vs. semi-fixed assets: 0.5 Across intermediate inputs: 0.1 Across labor types: 0.1 Across asset types: 0.1
Price adjustment frequencies	From Pasten et al. (2019)

Table 10: Calibrated model elasticities.

Composition of government purchases. Figure 11 illustrates the composition of government purchases, including direct hiring of labor occupations and non-labor factors (red and orange bars). Mirroring trends in private consumption, the figure highlights a shift from low-skill labor (dark red) to high-skill labor (light red), and from manufacturing (dark green) to high-skill services (blue).

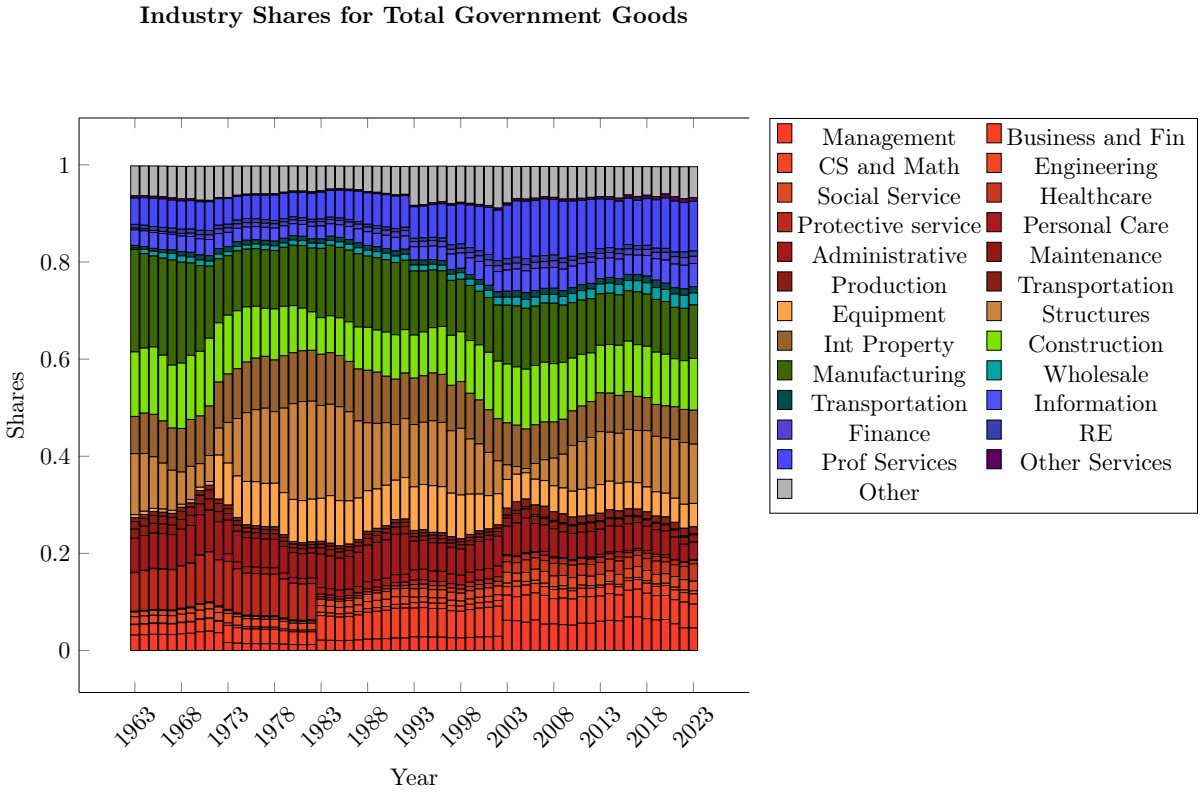


Figure 11: Industry Shares for Total Government Goods

Panel regressions: additional detail. Table 11 presents full results for the panel regressions of industry-level relative prices and output on industry-specific government expenditure shares. The regression specifications are

$$\pi_{i,t} = \text{const.} + \beta(\Delta\Omega_{G_{i,t}} * X_i) + \xi_1 \Delta\Omega_{G_{i,t}} + \xi_2 X_i + \text{controls} + \varsigma_i + \varsigma_t + \varepsilon_{i,t}$$

$$\Delta y_{i,t} = \text{const.} + \beta(\Delta\Omega_{G_{i,t}} * X_i) + \xi_1 \Delta\Omega_{G_{i,t}} + \xi_2 * X_i \text{controls} + \gamma_i + \gamma_t + \varepsilon_{i,t}$$

where X_i are either industry-level non-labor shares in value added or industry-level price adjustment probabilities. Both are centered around the mean. The controls include changes in expenditure shares of private households ($\Delta\bar{\Omega}_{H_{i,t}}$), changes in government expenditure shares ($\Delta\Omega_{G_{i,t}}$), four lags of the dependent variable, dummies for industry-level, size, durability and average government expenditure share interacted with the change in government expenditure shares, industry fixed effects, and time fixed effects.

For robustness, tables 12 - 13 present specifications replacing industry fixed effects with direct controls for industry size, durability, and average spending share, and omitting lags of the dependent variable.

Table 11: Effect of Government Spending on Prices and Output: Heterogeneity by Price Flexibility and Non Labor Value Added

	Price Growth		Output Growth	
	(1)	(2)	(3)	(4)
Intercept	1.260***	1.349***	0.449***	-1.851***
	(0.079)	(0.106)	(0.033)	(0.141)
Private Spending Share by Industry ($\Delta\bar{\Omega}_H$)	7.216*	7.581**	6.566***	6.246***
	(3.827)	(3.791)	(2.330)	(2.324)
Goverment Spending Share by Industry ($\Delta\Omega_G$)	0.050	0.065	0.227**	0.220**
	(0.046)	(0.050)	(0.112)	(0.106)
$\Delta\Omega_G\times$ Price Flexibility	0.327***		-0.203**	
	(0.059)		(0.079)	
$\Delta\Omega_G\times$ Non Labor Value Added		0.340***		-0.252**
		(0.093)		(0.123)
Time Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Observations	3720	3720	3720	3720
R-squared	0.773	0.772	0.706	0.707
Number of Industries	62	62	62	62

Notes: Standard errors in parentheses, clustered at the industry level. *** p<0.01, ** p<0.05, * p<0.1. Quarterly data, over the sample period 2006Q4 to 2022Q3. Price and Output are year-over-year growth rates. Government Demand and Private Demand are year-over-year first differences. The controls include changes in expenditure shares of private households, four lags of the dependent variable, dummies for industry-level size, industry-level durability, and average government expenditure share interacted with the change in government expenditure shares.

Table 12: Effect of Government Spending on Prices and Output: Heterogeneity by Price Flexibility and Non Labor Value Added

	Price Growth		Output Growth	
	(1)	(2)	(3)	(4)
Intercept	3.133***	1.709***	2.467***	-1.767***
	(0.142)	(0.143)	(0.234)	(0.244)
Private Spending Share by Industry ($\Delta\bar{\Omega}_H$)	6.938*	7.139**	6.087**	5.927**
	(3.556)	(3.377)	(2.365)	(2.417)
Goverment Spending Share by Industry ($\Delta\Omega_G$)	0.047	0.062	0.211**	0.203**
	(0.041)	(0.045)	(0.104)	(0.100)
Price Flexibility	0.749*		-0.021	
	(0.387)		(0.732)	
$\Delta\Omega_G\times$ Price Flexibility	0.322***		-0.191**	
	(0.059)		(0.077)	
Non Labor Value Added		0.023		0.700***
		(0.197)		(0.257)
$\Delta\Omega_G\times$ Non Labor Value Added		0.327***		-0.228*
		(0.099)		(0.123)
Time Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	No	No	No	No
Observations	3720	3720	3720	3720
R-squared	0.773	0.770	0.701	0.701
Number of Industries	62	62	62	62

Notes: Standard errors in parentheses, clustered at the industry level. *** p<0.01, ** p<0.05, * p<0.1.Price and Output are year-over-year growth rates. Government Demand and Private Demand are year-over-year first differences. The controls include changes in expenditure shares of private households, four lags of the dependent variable, dummies for industry-level size, industry-level durability, and average government expenditure share both directly and in interaction with the change in government expenditure shares.

Table 13: Effect of Government Spending on Prices and Output: Heterogeneity by Price Flexibility and Non Labor Value Added

	Price Growth		Output Growth	
	(1)	(2)	(3)	(4)
Intercept	2.751***	0.234	1.616***	-1.067**
	(0.222)	(0.240)	(0.437)	(0.450)
Private Spending Share by Industry ($\Delta\bar{\Omega}_H$)	16.077*	17.141**	11.327**	11.022**
	(8.384)	(7.904)	(5.140)	(5.176)
Goverment Spending Share by Industry ($\Delta\Omega_G$)	0.147	0.197	0.430**	0.413**
	(0.119)	(0.127)	(0.173)	(0.163)
Price Flexibility	1.954**		-0.169	
	(0.875)		(1.348)	
$\Delta\Omega_G\times$ Price Flexibility	0.976***		-0.344**	
	(0.117)		(0.132)	
Non Labor Value Added		0.149		1.221**
		(0.514)		(0.512)
$\Delta\Omega_G\times$ Non Labor Value Added		1.007***		-0.385**
		(0.214)		(0.188)
Time Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	No	No	No	No
Observations	3720	3720	3720	3720
R-squared	0.367	0.346	0.281	0.283
Number of Industries	62	62	62	62

Notes: Standard errors in parentheses, clustered at the industry level. *** p<0.01, ** p<0.05, * p<0.1. Price and Output are year-over-year growth rates. Government Demand and Private Demand are year-over-year first differences. The controls include changes in expenditure shares of private households, dummies for industry-level size, industry-level durability, and average government expenditure share both directly and in interaction with the change in government expenditure shares.

Figure D illustrates industry-level responses in more detail, using a two-step procedure. The first step estimates a panel regression of industry-specific inflation and output growth on changes in government expenditure shares. In the second step, estimated industry-specific responses are regressed on industry-level price adjustment probabilities and non-labor shares in value added, weighting observations according to inverse standard errors $1/(SE(\beta_i))^2$. The panel regression specification is

$$Z_{i,t} = \text{const.} + \beta_i \Delta\Omega_{G_{i,t}} + \varepsilon_t$$

where the outcome variable Z_{it} is either industry-level inflation (π_{it}) or industry-level output growth (y_{it}). Both dependent and independent variable are residualized on four lags of the dependent variable, industry fixed effects, time fixed effects, industry size, average spending share, and durability dummy.

The figure plots industry-level coefficients – computed in the first step – against non-labor shares in value added and price adjustment probabilities, along with the regression line and 5% confidence bands estimated in the second step.

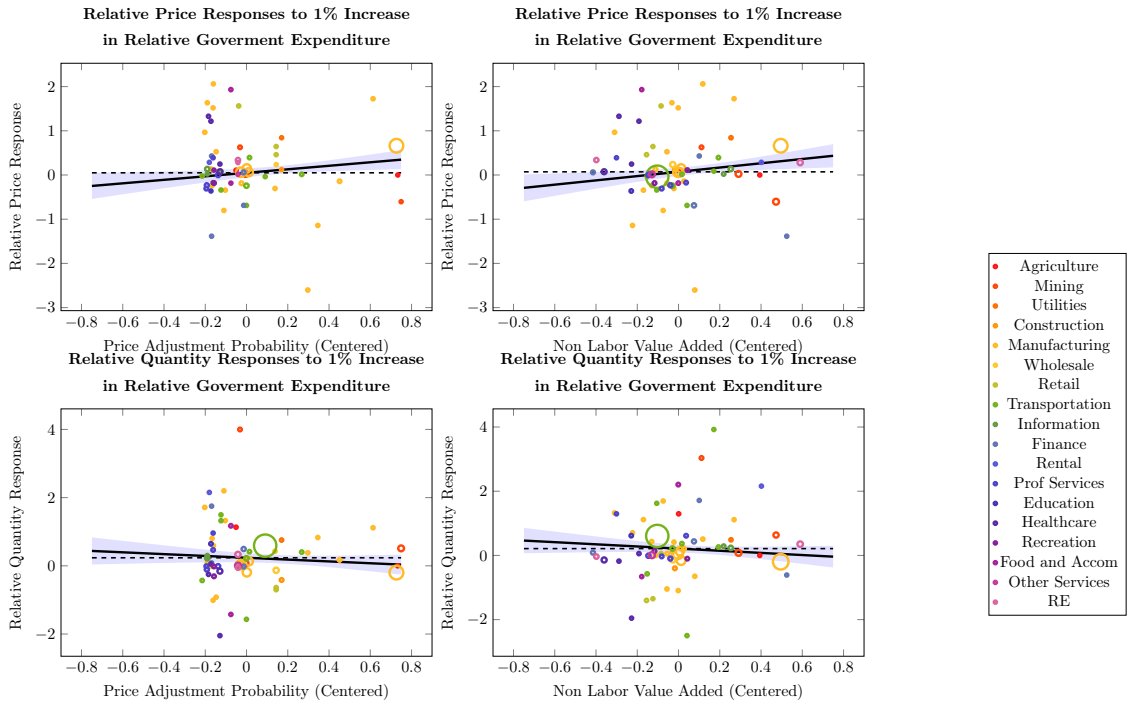


Figure 12: Responses of relative prices and output to changes in industry-level government expenditure shares. Quarterly data, over the sample period 2006Q4 to 2022Q3. Price and Output are year-over-year growth rates. Government Demand is year-over-year first difference.

Additional calibration figures. Figure 13 plots employment and wage responses to government provision of market goods. Labor income responses are much smaller than for government good purchases, consistent with the fact that market good provision is akin to a pure lump-sum transfer (see figure 8).

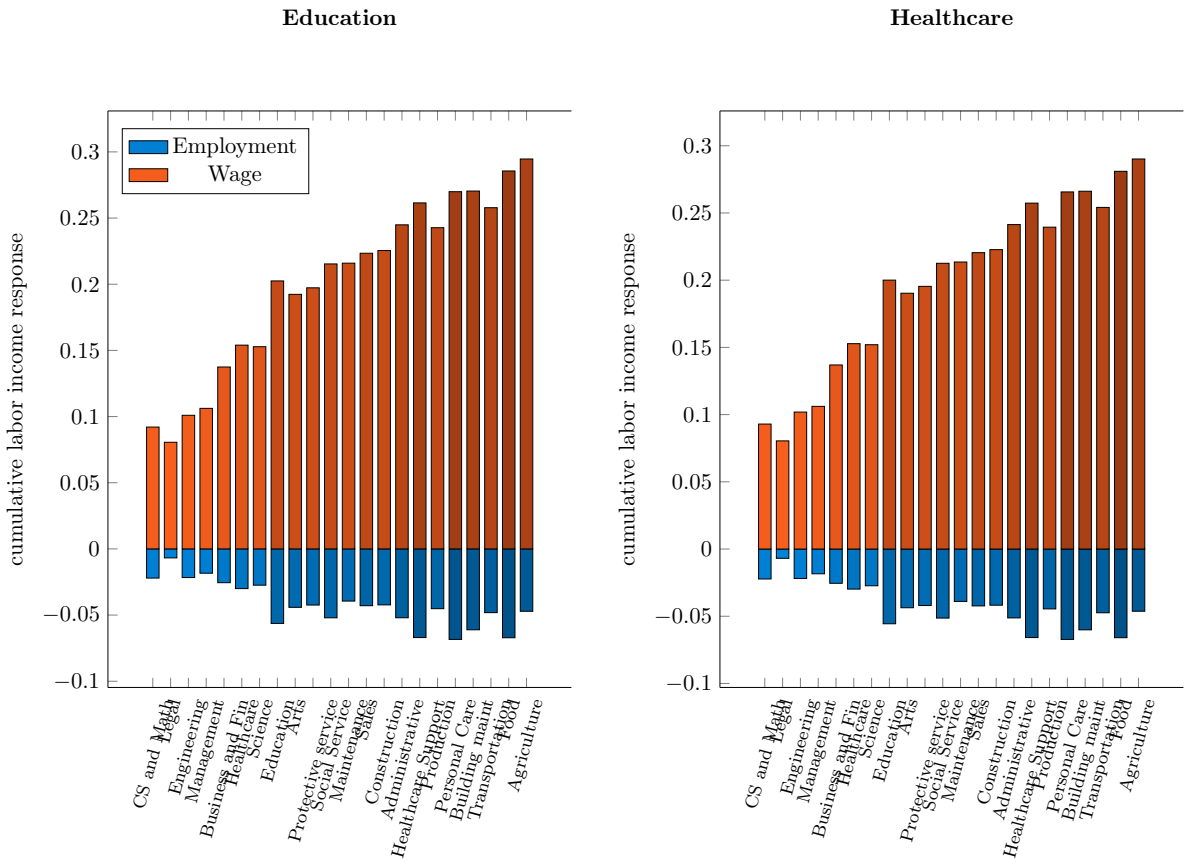


Figure 13: Cumulative labor income responses by occupation, education and healthcare (employment and wages).

Figure 14 instead plots occupation-level employment responses by broad function (defense, non-defense, state and local, education, healthcare). Consistent with figures 7 and 8, employment responses are large for government functions and close to zero for market functions. Within government functions, there is wide variation in employment responses across occupations. Different functions use different combinations of labor occupations. As a result, defense spending raises employment for protective service, maintenance and transportation occupations the most, while state and local spending predominantly raises employment for construction workers.

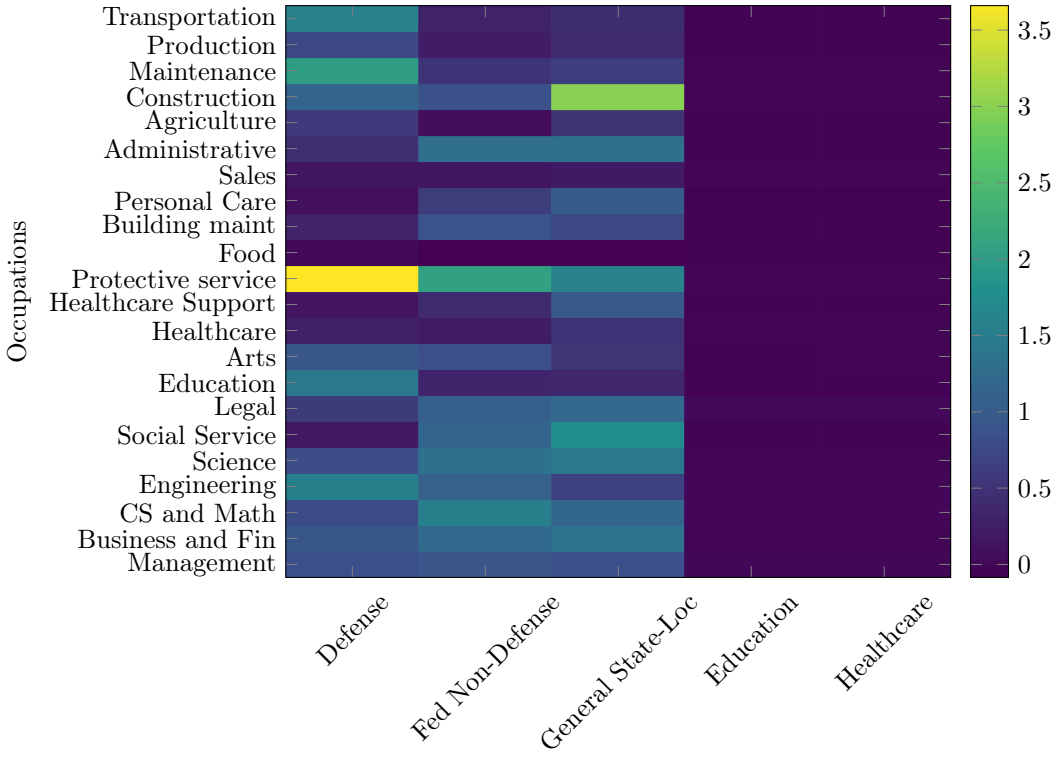


Figure 14: Labor Demand Incidences by Function