The Changing Structure of Government Consumption Spending*

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Abstract

We document a secular change in the structure of government consumption spending: over time the government purchases relatively more private-sector goods, and relies less on its own production of value added. This process alters the transmission of government spending shocks, as the response of hours decreases – whereas the response of output remains constant – when government spending is more intensive in private-sector goods. We rationalize these facts with a general equilibrium model where the slowdown of public-sector relative productivity drives both the changing structure of government spending and the disconnect between the responses of hours and output to government spending shocks.

Key Words: Government Gross Output, Government Wage Bill, Fiscal Multiplier.

JEL Classification Codes: E62, H10, O41.

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1 Introduction

Macroeconomic models typically consider government consumption spending as consisting only of purchases of goods produced by the private sector (e.g., Baxter and King, 1993; Christiano et al., 2011; Woodford, 2011). Instead, in national accounts, government consumption spending equals government gross output, which sums government value added to the purchase of private-sector goods. The first contribution of this paper is to document a novel stylized fact: the share of purchases from the private sector in total government consumption spending rises over time in advanced economies. For instance, in the U.S. this share rose from 23% in 1960 to 33% in 2019. Thus, government spending changes such that the government relies more on private-sector goods, and less on its own production of value added.

Although the rise of the relevance of private-sector goods in total government spending moves slowly over time, it alters the propagation of fiscal policy at the business cycle frequency. The second contribution of this paper is to show that the changing structure of government spending implies a disconnect between the responses of output and hours to government spending shocks: the response of hours decreases – whereas the response of output remains constant – when the government purchases more private-sector goods. We establish these facts by estimating the fiscal multipliers on U.S. quarterly data using local projection methods, as in Ramey and Zubairy (2018). More specifically, we identify government spending shocks by assuming that the government cannot react to output changes within a quarter (Blanchard and Perotti, 2002). To address the concern that the shocks could be anticipated, we also instrument government spending with Ramey's (2011a) military news.

To rationalize these facts, we build a quantitative theory for the changing structure of government spending. Our theory grounds on the premise that although government gross output evolves exogenously, the production of this amount is

achieved optimally by means of a constant-returns-to-scale production function in capital, labor, and intermediate goods, with the latter consisting of purchases from the private sector. In this way, the government chooses the combination of inputs that minimizes the total cost of production given factor prices and the desired level of gross output.

To generate endogenously the secular change in the structure of government spending, we focus on a main determinant of long-run growth in the U.S.: investment-specific technological change (ISTC). Following Greenwood et al. (1997, 2000) and Ngai and Samaniego (2009), we model ISTC as an exogenous drop in the relative price of investment in terms of the price of consumption. In the model, ISTC induces the government to increase the share of intermediate inputs and reduce that of capital and labor when (*i*) private-sector value added is more intense in capital than government value added, and (*ii*) government value added and intermediate inputs are imperfect substitutes. The first condition implies that ISTC raises the relative productivity of private firms vis-à-vis the government. When the second condition holds, as the private sector becomes more efficient, the government optimally switches its input choice from the increasingly expensive own production of value added to the cheaper intermediate goods produced by the private sector.

We then show that the conditions that allow ISTC to affect the structure of government spending hold in the data. First, we measure the capital share in private and government value added using data of the U.S. Bureau of Economic Analysis. We explicitly take into consideration the fact that national accounts measure differently private and government value added, as the latter is derived by assuming a zero-return on capital. Accordingly, we build a series of private value added which abstracts from proprietors' income and corporate profits. This approach yields a capital share in private-sector value added which roughly doubles the one in government value added.[1] Second, we provide evidence for an elasticity

[1]This finding is further empirically supported by the fact that (*i*) public firms are more labor intensive than

of substitution between government value added and intermediate inputs well above one.

In the quantitative analysis, we calibrate the model to match the share of intermediate inputs in government spending for the U.S. economy in 1960. Then, we compare the structure of government spending in 1960 and 2019. When we feed the model with the observed changes in the productivity of value added in the public and private sector between 1960 and 2019 – backed out from the observed variation in the ratio between the public-sector and private-sector value-added deflators – our proposed mechanism accounts entirely for the increase in government purchases of private-sector goods. Since the calibrated economy reproduces fairly well the changing structure of government spending, we use the model as a laboratory to study the effects of this secular trend on the transmission of government spending shocks. In particular, we compare fiscal multipliers around two steady-states – representing the years 1960 and 2019 – that differ in the exogenous level of the value-added productivities. This distinction makes the two equilibria to differ endogenously in the share of government purchases from the private sector, so that we can ask to what extent the rise of this share alters the transmission of fiscal shocks.

The model accounts for the process of disconnect between the responses of output and hours to government spending shocks. Our economy implies a total value added multiplier which equals 0.83 and 0.82 in the 1960 and 2019 steady-states, respectively. However, the total hours multiplier drops from 0.50 to 0.15 across the two steady-states. Thus, the model accounts for 71% of the estimated relationship between the rising relevance of private-sector goods in government consumption and the decrease in the response of hours to government spending shocks.

What drives the disconnect in the response of hours and output to government spending in the model? We highlight the existence of the channels. First, the higher

private firms even within sectors, and (*ii*) following a privatization the labor share of public firms shrinks by roughly 40% (e.g., La Porta and Lopez-de-Silanes, 1999; Dewenter and Malatesta, 2001).

productivity of the economy in 2019 allows to produce output with less hours than in 1960. Second, this pattern is amplified as government spending tilts towards the private sector, which is less intensive in labor. We disentangle the role of these two channels by evaluating two alternative specifications of the model, in which the productivities vary over time as in the baseline economy, but the structure of government spending is kept constant over time. In this setting, the response of employment drops from 0.50 to 0.31. Instead, the dampening of the employment response across steady states is entirely driven by the rise in productivity when there is no differences in the labor share across sectors. These two results indicate that – under the condition that the labor shares differ between the private and public sector – the endogenous changing structure of government spending accounts for 46% of the drop in the employment response implied by the model.

Moreover, the changing structure of government consumption shifts the stimulative effects of government spending shocks towards private economic activity. We identify the changes through the lenses of the government production function in the model, which allows us to disentangle the overall output effect in the private value-added and government value-added multipliers. We show that although the response of total value added is constant across the two steady-states, the responses of private and government value added depend crucially on the share of government purchases from the private sector. In the 1960 steady-state the level of the output fiscal multiplier hinges almost entirely on a positive government value-added multiplier, which is 0.76, while the private value-added multiplier is 0.07. Instead, in the 2019 steady-state the government value-added multiplier decreases to 0.62, but the private value-added multiplier becomes positive and equals 0.20. Also these implications are consistent with our empirical evidence.

Overall, our results highlight that the changing structure of government spending and the disconnect between the responses of output and hours to government spending are two interlinked processes. We show that this phenomenon leads to a

substantially variation in the way the additional income generated in response to a government spending shock is allocated between workers and capitalists: although the response of the labor share is positive in both steady states, the 2019 response of the labor share is half the response of the labor share in the 1960 steady state. Although our model features a representative agent and cannot properly evaluate the implications of this distributional effect, the drop in the responsiveness of the labor share could suggest a shift in the pool of winners and losers of stimulus packages. This finding together with the implication that accommodative fiscal policies may become less effective in boosting hours worked casts shadow on the future capability of stimulus packages to affect the labor market.

1.1 Related Literature

This paper adds to the literature on causes and business-cycle implications of the secular changes in the production structure of advanced economies.[2] We contribute to this literature by highlighting that advanced economies are also experiencing a change in the way the government operates and supplies public goods. Da-Rocha and Restuccia (2006), Moro (2012, 2015) and Galesi and Rachedi (2019) show that changes in the sectoral composition have first-order effects on business cycle fluctuations. Similarly, we emphasize how the changes in the government gross-output production function shapes the propagation of government spending shocks.

This paper also builds on the literature on ISTC. Greenwood et al. (1997, 2000) and Ngai and Samaniego (2009) show that the decline in the relative price of investment goods in terms of consumption goods is a primary source of long-run growth and business cycles. Debortoli and Gomes (2015) show that ISTC generates a downward trend in government public investment. Although also Debortoli and Gomes (2015) study a secular change in the government behavior, associate it to changes

[2]Karabarnounis and Neiman (2014) show the decline in the labor share in private value added, and Duarte and Restuccia (2010) and Herrendorf et al. (2013) document the reallocation of economic activity to services.

the relative price of investment goods, and uncover the implications for fiscal policy, our focus is different. First, Debortoli and Gomes (2015) document a decline in government public investment. Instead, our emphasis is only on government consumption spending - and its production function - as we abstract entirely from public investment. Second, Debortoli and Gomes (2015) study the implications for labor and corporate income taxation, whereas we mainly focus on fiscal multipliers.

The literature on fiscal multipliers tend to study the output effect of government spending shocks intended as exogenous hikes in purchases of private-sector goods (e.g., Barro, 1981; Baxter and King, 1993; Christiano et al., 2011; Woodford, 2011; Ramey, 2011a). Starting from Rotemberg and Woodford (1992), a strand of the literature has incorporated the role of changes in the government wage bill (e.g., Finn, 1998; Cavallo, 2005; Pappa, 2009; Ramey, 2012; Bermperoglou et al., 2017; Bandeira et al., 2018).[3] We contribute to this literature by showing that the response of private economic activity to government spending depends crucially on the government intermediate inputs share. Finally, this paper adds to the literature on the determinants of government spending multipliers,[4] by providing a novel channel that generates low-frequency movements in the effectiveness of fiscal policy.

2 Empirical Evidence

2.1 Government Spending in the National Accounts

In the National Income and Product Accounts (NIPAs) of the U.S. Bureau of Economic Analysis, government consumption spending[5] equals the nominal value of

[3]There is also a strand of the literature that studies how public employment affects private employment and the business cycle (e.g., Quadrini and Trigari, 2007; Gomes, 2015).

[4]E.g., slack in the economy in Auerbach and Gorodnichenko (2012), the level of government debt in Ilzetki et al. (2013), and the age structure of the population in Basso and Rachedi (2021)

[5]In the NIPAs, the contribution of the government sector to total GDP is measured as the sum of government investment expenditure (i.e, the value of investment in structures, equipment, and software carried out by both the federal and the local government) and government consumption expenditure. Throughout this paper, we focus solely on government consumption expenditure and abstract from government investment expenditure.

government gross output $P_{G,t}G_t$, which sums the nominal values of government value added $P_{Y_g,t}Y_{g,t}$ and government purchases of private-sector goods $P_{M_g,t}M_{g,t}$[6]

$$P_{G,t}G_t = P_{Y_g,t}Y_{g,t} + P_{M_g,t}M_{g,t}. \tag{1}$$

The NIPAs treat government spending slightly differently from the private economic activity for the fact that government gross output is measured on the cost side, by valuing output in terms of the input costs incurred in production. This approach implies that the value of gross output equals the sum of the wage bill of employees (both military and civilians), capital services, and the purchase from the private sector.[7] Moreover, the NIPAs posit that the contribution of capital services to the government value added consists only in the depreciation of the government-owned fixed capital. This condition implicitly assumes that the net return for the fixed assets of the government is zero, which creates a discrepancy with the definition of private value added, as in the latter the capital services yield a positive net return.[8]

Then, the definition of the total GDP of the economy in the NIPAs sums the contribution of the nominal values of nominal values of consumption $P_{C,t}C_t$ and investment $P_{I,t}I_t$ to government gross output $P_{G,t}G_t$, such as

$$GDP_t = P_{Y_p,t}Y_{p,t} + P_{Y_g,t}Y_{g,t} = P_{C,t}C_t + P_{I,t}I_t + P_{G,t}G_t. \tag{2}$$

This equation yields two different ways to define the GDP of the economy. On the one hand, nominal GDP equals the sum of the nominal values of private-sector

[6]In the NIPAs, government consumption spending equals government gross output *minus* sales to other sectors and own-account investment. Yet, sales to other sectors refer to the transfer of resources within the federal and local governments. Instead, own-account investment accounts for only 2.8% of government gross output. For these reasons, we consider that government consumption spending equals government gross output.

[7]While this cost-side methodology requires some caution in the interpretation of an aggregate defined gross output, similar measurement issues (i.e., the absence of a well defined quantity of output) arise in the measurement of several type of market services. Moreover, in this paper we only use nominal aggregates when dealing with the components of government spending in the data. All predictions about real aggregates and prices are derived from the model.

[8]The definitions of government gross output, value added, and intermediate inputs can be explained in the following example. The government gross output associated with the provision of education consists of the wage and non-wage benefits accruing to the employees of public educational institutions, the depreciation of the capital stock, such as offices, buildings, and computers, and the purchase from the private sector, such as stationery, chalks, and blackboards.

$P_{Y_p,t}Y_{p,t}$ and government value added. On the other hand, GDP equals the sum of the nominal values of consumption, investment, and government gross output.

Importantly, the definition of government consumption spending of the NIPAs differs from the one which is usually considered in the theoretical literature on fiscal policy, which tends to posit that government consumption spending consists only of purchases of goods produced by the private sector. In this case, the resource constraint of the economy posits that nominal private value added equals the sum of the nominal values of consumption, investment, and government purchases of private-sector goods, that is

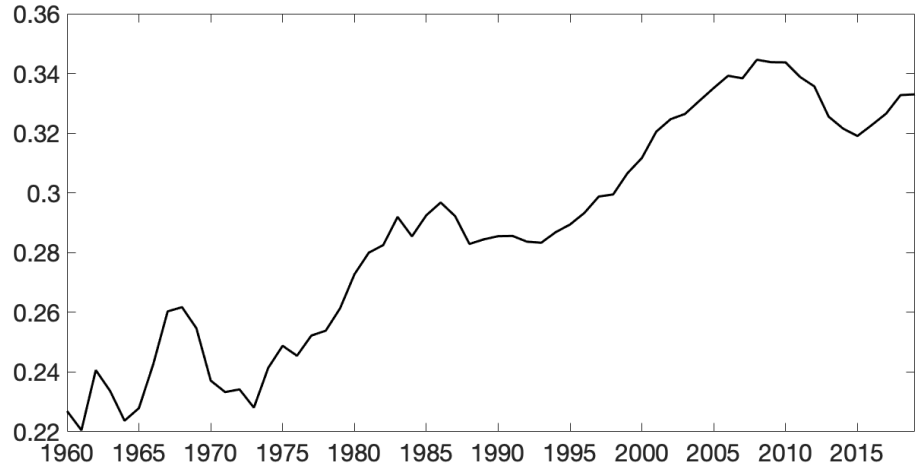
$$P_{Y_p,t}Y_{p,t} = P_{C,t}C_t + P_{I,t}I_t + P_{M_g,t}M_{g,t}. \tag{3}$$

2.2 The Government Intermediate Inputs Share

In this paper we document a novel stylized fact on government consumption spending, namely that the relative size of its two components $P_{Y_g,t}Y_{g,t}$ and $P_{M_g,t}M_{g,t}$ changes dramatically over time in industrialized economies. In particular, governments purchase relatively more goods and services from the private sector, and rely less on the in-house production of value added. In Section 3 we interpret these purchases from the private sector as intermediate goods entering the gross-output production of the government, so that the ratio $(P_{M_g,t}M_{g,t})/(P_{G,t}G_t)$ defines the share of intermediate inputs in gross output. Figure 1 reports the share of intermediate inputs in the gross output of the general government in the U.S. from 1960 to 2019, which rises from a value of 22.7% in 1960 up to 33.3% in 2019. We refer to this new stylized fact as *the changing structure of government spending.*

The share of intermediate inputs rises even when we disaggregate the gross output of the general government in either the gross output of the federal government or the gross output of the local government. Figure 2 reports the share of intermediate inputs at these different government levels, and shows that the intermediate

Figure 1: Share of Government Intermediate Inputs.

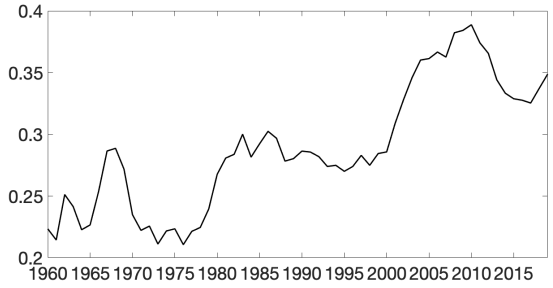


Note: This graph reports the share of intermediate inputs in the gross output of general government. The data is annual from 1960 until 2019. Source: Bureau of Economic Analysis.

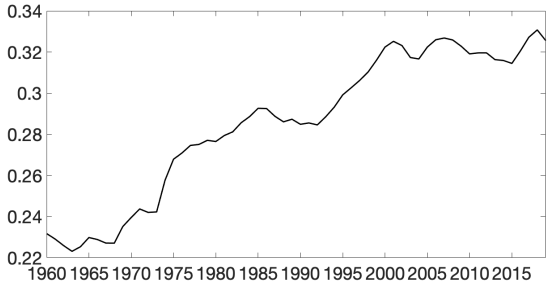
inputs share of the federal government increased from 22.4% to 34.9%, whereas the intermediate inputs share of the local government rose from 23.2% to 32.6%. Hence, the rise of the government intermediate inputs share is not driven by the behavior of one specific level (or function) of the U.S. government.

Figure 2: Share of Government Intermediate Inputs - Different Government Levels.

(a) Federal Government



(b) Local Government



Note: These graphs report the share of intermediate inputs in the gross output of the federal government (Panel a) and the share of intermediate inputs in the gross output of the local government (Panel b). The data is annual from 1960 until 2019. Source: Bureau of Economic Analysis.

The observed changing structure of government spending could be only an accounting phenomenon driven by the variation in the contribution of capital depreciation to government gross output. Figure A.1 in Appendix A shows that this is not the case. Indeed, the share of government intermediate inputs of the general,

federal, and state and local government rises by the same amount even when we exclude capital depreciation from the definition of government gross output.

In addition, the rise in the government intermediate inputs share could be driven by an outsourcing process through which public workers are displaced and then hired back by private companies, even though they do not change their job tasks. To rule out this hypothesis, we compute the government intermediate inputs share by excluding each time a key sector in the provision of goods and services to the government. Figure A.2 in Appendix A shows that even when we exclude either the finance and real estate sector, or the professional and business services sector, or the educational services sector, or the health care services sector, the government intermediate inputs share always displays an upward trend. Thus, the changing structure of government spending does not hinge on a simple outsourcing of labor, but it is rather the result of a complex reallocation of resources from the public sector to the private sector.[9]

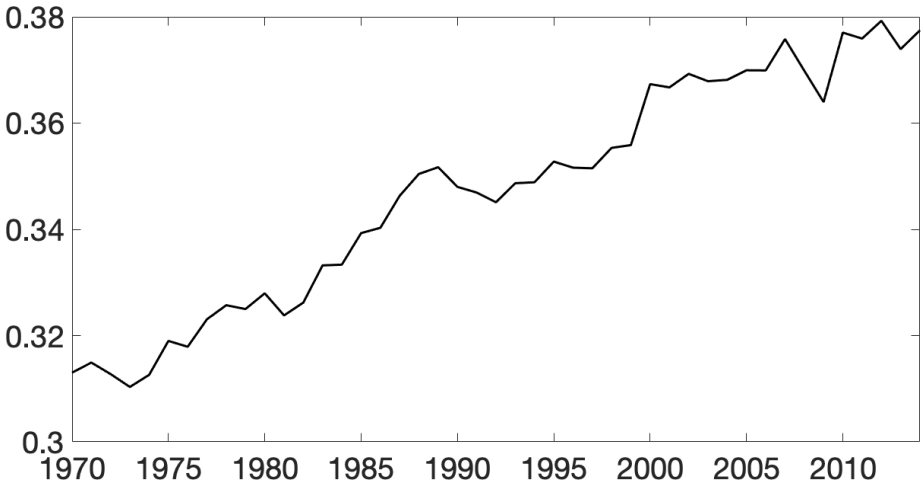
The rise of the government intermediate inputs share is not mirrored by an analogous trend in the private sector. Ngai and Samaniego (2009), Moro (2012, 2015), Duarte and Restuccia (2020) have documented that the intermediate inputs shares in private gross output across sectors are constant over time. The evidence of this strand of the literature confirms that the changes in the intermediate inputs share of the government gross-output production function were not accompanied by similar systematic dynamics in the private sector.

Importantly, the rise of the government intermediate inputs share does not characterize only the U.S. economy. Using data from the World KLEMS initiative on an unbalanced panel of twenty countries over the years 1970 - 2014, we uncover the global dimension of the changing structure of government spending.[10] In a similar

[9]The hypothesis of a simple process of outsourcing of labor from the public to the private sector would generate a raise in the value-added labor share of the private sector, which is inconsistent with the secular decline documented by Karabarbounis and Neiman (2014).

[10]The countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom, United

Figure 3: The Global Rise of the Government Intermediate Inputs Share.



Note: The graph plots the estimated coefficient of year fixed effects in a panel regression across twenty countries in which the government intermediate inputs share is regressed on country and year fixed effects. Source: World KLEMS Initiative.

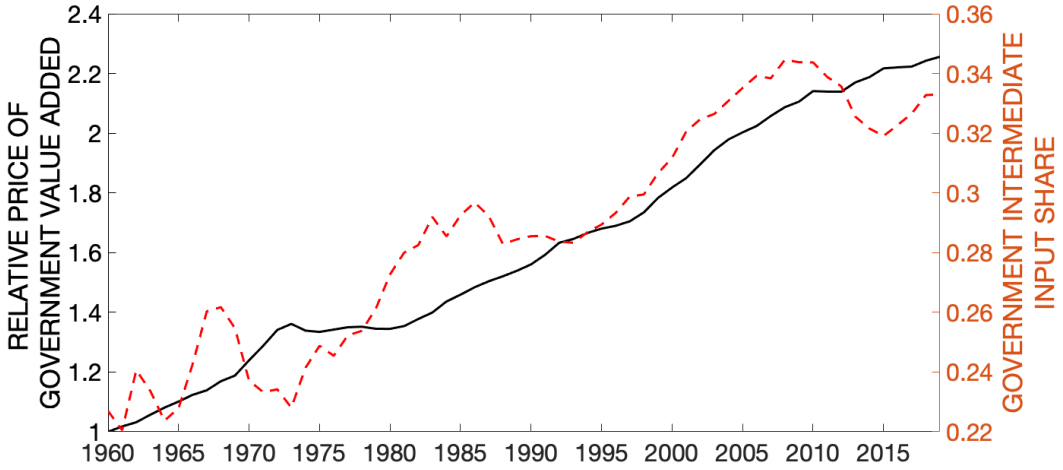
vein as the analysis of Karabarbounis and Neiman (2014) on the labor share, we estimate a panel regression in which the intermediate inputs share is regressed on country fixed effects and year fixed effects. Figure 3 reports the estimated coefficients on the year fixed effects, which inform on the global dimension of the change in the government intermediate inputs share. The rise in the government intermediate inputs share is indeed a global phenomenon: the average share has been rising from 31% to 38%.

2.3 The Slowdown of the Public-Sector Value-Added Productivity

Annual growth rate of private productivity: 0.82% Annual growth rate of government productivity: 0.05% Correlation log changes in relative productivity of public-sector value added with the log changes in the relative price of public-sector value added is around .7

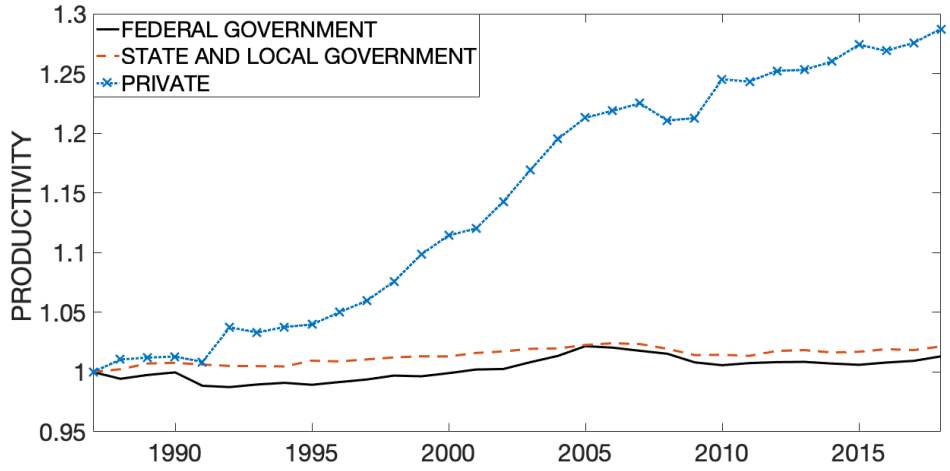
States.

Figure 4: The Relative Price of the Public-Sector Value Added.



Note: This graph reports the share of intermediate inputs in the gross output of general government (the red dashed line measured on the right y-axis) and the ratio between the price deflator of government value added and the price deflator of private value added (the black continuous line measured on the left y-axis). The data is annual from 1960 until 2019. Source: Bureau of Economic Analysis.

Figure 5: The Productivity of the Private Sector and the Government.



Note: This graph reports the productivity of the federal government (continuous line), the state and local government (dashed line), and the private non-farm sector (crossed line). All lines are normalized to one in 1987. The data is annual from 1987 until 2018. Source: Bureau of Labor Statistics.

2.4 Business Cycle Implications

We then evaluate how the changing structure of government spending alters the transmission of government spending shocks. Namely, we study if the government spending multipliers of total value added, government value added, and total hours depend on whether total government spending is more intensive in either the pur-

chase of private-sector goods or in the own production of government value added.

To perform this analysis, we follow Ramey and Zubairy (2018) and estimate the response of a set of key dependent variables to a government spending shocks using a times-series of U.S. quarterly data from 1960 to 2015. More specifically, we can the Jordà (2006)'s method to estimate the fiscal multiplier at any horizon h by directly estimating the following regression using instrumental variables:

$$\sum_{j=0}^{h} Y_{t+j} = \gamma_h + \mathbf{Z'_{t-1}}\gamma + m_{1,h} \sum_{j=0}^{h} G_{t+j} + \dots \tag{4}$$
$$\cdots + m_{2,h} \sum_{j=0}^{h} G_{t+j} \left(\frac{P_{t-1}M_{g,t-1}}{P_{G,t-1}G_{t-1}} - \frac{1}{T}\sum_{t=1}^{T} \frac{P_t M_{g,t}}{P_{G,t}G_t} \right) + \omega_{t+h} \qquad \text{for } h = 0, 1, 2, \dots,$$

where Y_t is the dependent variable of interest, γ_h is a constant term for each time-horizon period h, z is a vector of control variables, G_t is government spending, and $\frac{P_{t-1}M_{g,t-1}}{P_{G,t-1}G_{t-1}} - \frac{1}{T}\sum_{t=1}^{T} \frac{P_t M_{g,t}}{P_{G,t}G_t}$ is the demeaned lagged values of the government intermediate inputs share. Finally, since the Jordà's method induces serial-correlation in the error terms, we follow Ramey and Zubairy (2018) by deriving the Newey and West (1987) robust standard errors. In this specification, the estimate of the parameter $m_{1,h}$ captures the size of the government spending multiplier at the horizon h, whereas the estimate of the parameter $m_{2,h}$ informs on how the fiscal multiplier varies with a one percentage point increase in the government intermediate input share. To this end, our main parameter of interest is $m_{2,h}$ because it captures how the changing structure of government spending alters the transmission of fiscal policy.

Four comments are in order with the specification of the regression 4. First, we consider the demeaned government intermediate inputs share as in this way the parameter $m_{1,h}$ can be interpreted as the fiscal multiplier. Without the demeaning, $m_{1,h}$ would inform about the fiscal multiplier associated with the case in which the share of government intermediate inputs in total gross output is zero. It is important

to stress that the demeaning does not alter whatsoever the estimate of $m_{2,h}$, and its only used for the ease of the interpretation of $m_{1,h}$.[11] Second, we consider the lagged value of the share so that the interaction variable is predetermined to the contemporaneous realization of the government spending shock. Third, rather than using the variables in the logarithm, we follow Gordon and Krenn (2014) by dividing all variables by potential GDP, proxied by a polynomial estimate of real GDP. Ramey and Zubairy (2018) discuss how this transformation allows for a neat interpretation of the coefficient $m_{1,h}$ as the fiscal multiplier. Fourth, the set of controls $\mathbf{Z}$ includes some key variables that can alter the transmission of fiscal policy: (i) the ratio of tax revenues to total GDP (Leeper et al., 2010), (ii) the ratio of total transfers to total GDP (Oh and Reis, 2012), (iii) the ratio of government debt to GDP (Ilzetzki et al., 2013), (iv) the ratio of households' debt to GDP (Hagedorn et al., 2019), and (v) the unemployment rate (Auerbach and Gorodnichenko, 2012). In this way, we can estimate the effect of the changing structure of government spending on the fiscal multipliers which holds above and beyond the additional influence of all these key control variables.

To identify the government spending shocks we instrument G_t with two variables: the first one is the Blanchard and Perotti (2002) shock, which relies on the assumption that that current government consumption does not depend on the current realization of total value added; the second one is the military news variable of Ramey (2011a), which allows us to purge the estimate of the government spending shocks by controlling at each point in time for the forecast of future government consumption.

Table 1 reports the estimates of the government spending multipliers of total value added, total hours, and government value added, as well as their interaction with the structure of government spending of each country. Column (1) reports

[11] See Basso and Rachedi (2021) for a thorough discussion about the equivalence of the estimates of $m_{1,h}$ and $m_{2,h}$ in specifications with and without the demeaning of the interaction variable.

Table 1: 1-Year Cumulative Response of Output to Government Shocks

Dependent Variable	Value Added	Hours	Government Value Added
	(1)	(2)	(3)
G_t	0.733**	1.264***	0.630**
	(0.347)	(0.491)	(0.302)
$G_t \times \left(\frac{P_{t-1}M_{g,t-1}}{P_{G,t-1}G_{t-1}} - \frac{1}{T}\sum_{t=1}^{T}\frac{P_tM_{g,t}}{P_{G,t}G_t}\right)$	0.153	-0.058***	-0.012**
	(0.248)	(0.021)	(0.005)
Controls	YES	YES	YES
N. Observations	224	224	224

Note: The table reports the estimates of the one-year cumulative fiscal multiplier based on a local projection method applied to quarterly U.S. data from 1960 to 2015. In all regressions, the independent variables are the identified government spending shocks $\epsilon^G_{i,t}$, and the interaction of these shocks with the demeaned lagged share of government intermediate inputs in total government gross output. In Column (1), the dependent variable is real value added, in Column (2) the dependent variable is total hours worked, and in Column (3) the dependent variable is real government value added. Newey-West (1987) standard errors are reported in brackets. *, **, and *** indicate statistical significance at the 10%, 5% and 1%, respectively.

the results for total value added, and shows that the 1-year output multiplier is 0.73, and does not depend on the structure of government spending. Indeed, the coefficient associated with the interaction of government spending and the share of government intermediate inputs is not statistically different from zero.

However, the structure of government spending does affect the response of total hours. Indeed, Column (2) reports that the hours fiscal multiplier is 1.26, whereas the coefficient associated to the interaction term is negative and highly statistically significant: a one percentage point increase in the share of government intermediate inputs reduces the hours fiscal multiplier from 1.26 to 1.21. If we combine these estimates with the path of the share of government intermediate inputs of the U.S. economy, we find that in the United States the rising relevance of private-sector goods in government spending has reduced the hours fiscal multiplier from 1.26 in 1960 to 0.64 in 2019.

Although few papers have highlighted that the effectiveness of government spending in stimulating economy activity has been decreasing over the recent decades (e.g., Blanchard and Perotti, 2002; Bilbiie et al., 2008; Basso and Rachedi, 2021), our results point towards a disconnect in the response of output and hours to government spending. As government spending shifts towards the purchase of private-sector goods, fiscal policy maintains its effectiveness in stimulating total output, but loses the ability in triggering a large surge of employment. This novel prediction on the disconnect between the response of output and hours to government spending is very relevant for policy-makers, as usually job creation is considered one of the main goals of fiscal stimulus plans.

Finally, we find that although the rising relevance of private-sector goods in total government spending does not alter the total output fiscal multiplier, it implies a dramatic change in the composition of the transmission mechanism of fiscal policy: over time government spending becomes more effective in spurring the economic activity of the private sector. Indeed, Column (3) shows that the interaction term is negative and highly statistically significant. If we interpret again the relevance of the estimates in light of the U.S. experience, this result implies a drop in the government value-added multiplier from 0.63 in 1960 to 0.50 in 2019.

This result sheds a new light on the findings of Ramey (2012) on the contractionary effect of government spending on private activity. Namely, the response of private economic activity to government spending shocks depends crucially on the government intermediate inputs share: government spending shocks is more likely to trigger a negative response of private economic activity at low levels of the government intermediate inputs share.

Overall, we find that the shift of government spending from the own production of government value added towards the purchase of private-sector goods alters the transmission of fiscal policy at the business cycle frequency, by shifting the stimulus effects from the public sector towards the private sector, and by reducing the

responsiveness of total hours, while keeping intact that of total value added.

3 The Model

We build a model that can endogenously generate a changing structure of government consumption spending, and then we use it to evaluate the implications of this secular process on the size of fiscal multipliers.

The economy consists of a representative household, a final good private-sector firm, a continuum of monopolistically competitive private-sector firms, and the government. The government produces public goods using labor, capital, and intermediate inputs produced by the private-sector firm.

The model has a set of features that are intended to generate the long-run changes in the structure of government spending: the production function of government gross output with a non-unitary elasticity of substitution between value added and intermediate inputs, and the exogenous variation in the levels of public-sector and private-sector value-added productivities.

In addition, the model has a set of features which are intended to generate short-run dynamics following government spending shocks that are quantitatively in line with the empirical evidence on fiscal multipliers: the New Keynesian set up of the economy (i.e., monopolistic competition and Calvo (1983) staggered price setting in the private sector), and a GHH utility function.[12]

3.1 Household

The economy is populated by an infinitely-lived representative household that has preferences over consumption C_t and labor N_t, such that the lifetime utility is

[12]Section C of the Appendix studies the relevance of each of these two features on the effects of the changing structure of government spending on the size of fiscal multipliers.

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{1}{1-\sigma} \left(C_t - \theta \frac{N_t^{1+\eta}}{1+\eta} \right)^{1-\sigma} \right], \tag{5}$$

where β is the time discount factor, σ denotes the risk aversion, θ captures the disutility from working, and η is the inverse of the Frisch elasticity. We consider a GHH utility as in Greenwood et al. (1988) because CRRA preferences generate counterfactually low fiscal multipliers when government spending consists also of government value added.[13]

The household maximizes life-time utility (5) subject to the budget constraint

$$P_t C_t + P_{I,t} I_t + T_t + B_{t+1} = W_t N_t + R_{k,t} K_t + R_t B_t + \Pi_t. \tag{6}$$

The household buys the consumption goods C_t at the nominal price P_t, investment goods I_t at the nominal price $P_{I,t}$ and incur in lump-sum nominal taxes T_t. The household also invests in a one-period bond B_t which yields a nominal gross interest rate R_t. The household earns a nominal labor income $W_t N_t$, a nominal capital income $R_{k,t} K_t$, and receives the profits of private-sector firms Π_t. Physical capital accumulates following the law of motion

$$K_{t+1} = (1-\delta) K_t + I_t \left[1 - \frac{\Omega}{2} \left(\frac{I_t}{I_{t-1}} - 1 \right)^2 \right], \tag{7}$$

where δ is the depreciation rate and Ω captures investment adjustment costs.

The household provides labor and capital to both the private-sector firms and the government, such that

$$N_t = N_{p,t} + N_{g,t}, \qquad \text{and} \qquad K_t = K_{p,t} + K_{g,t}. \tag{8}$$

The perfect mobility of capital and labor across sectors implies that both the wage W_t and the rental rate of capital $R_{k,t}$ equalize across sectors in equilibrium.

[13] Bilbiie (2011) shows that the consumption-labor complementarities generated by GHH preferences can trigger a positive response of consumption to government spending where prices are not flexible. Gnocchi et al. (2016) study time use data to provide empirical evidence on the relevance on the consumption-labor complementarities in the transmission of government spending.

3.2 Government-Sector Firm

The total amount of public goods G_t produced by the government moves over time following the realizations of government consumption spending shocks, as

$$\log G_t = (1-\rho_g)\, G_{ss} + \rho_g \log G_{t-1} + \epsilon_{g,t}, \tag{9}$$

where the parameter ρ_g denotes the persistence of changes in government spending, $\epsilon_{g,t}$ is a spending shocks such that $\epsilon_{g,t} \sim N(0, \sigma_g)$, and G_{ss} is the steady-state level of public goods. In the quantitative analysis, we set the steady-state value of government spending, $P_{G,ss}G_{ss}$, where $P_{G,ss}$ is the steady-state price of government spending, to be a constant fraction of total GDP, as it is in the data. In this way, in the model there is no change in the total amount of government spending relative to GDP, but only in its composition.[14]

Although the total amount of public goods G_t moves exogenously over time, the inputs required to produce such a level of government consumption spending are endogenously determined according to the gross-output production function[15]

$$G_t = \left[\omega_g^{\frac{1}{\nu_g}} M_{g,t}^{\frac{\nu_g-1}{\nu_g}} + (1-\omega_g)^{\frac{1}{\nu_g}} Y_{g,t}^{\frac{\nu_g-1}{\nu_g}}\right]^{\frac{\nu_g}{\nu_g-1}}, \tag{10}$$

where $M_{g,t}$ denotes the intermediate inputs purchased from the private sector, $Y_{g,t}$ is the in-house production of government value added, ω_g is the weight of intermediate inputs in the government gross output, and ν_g denotes the elasticity of substitution between government value added and intermediate inputs. The production function (10) implies that the price of the government gross output is

$$P_{G,t} = \left[\omega_g P_t^{1-\nu_g} + (1-\omega_g)\, P_{Y_g,t}^{1-\nu_g}\right]^{\frac{1}{1-\nu_g}}, \tag{11}$$

where P_t is the price of the intermediate inputs provided by the private sector

[14] The model is calibrated to the observed slowdown of the public-sector productivity between 1960 and 2019. Over this period of time, the level the share of government gross output to total GDP has remained remarkably constant even amidst some business-cycle variation: the share of government gross output to total GDP was 16.98% in 1960, and 16.91% in 2019.

[15] This modeling approach is observationally equivalent to positing that the government chooses optimally both the production inputs *and* the level of gross output to meet an exogenously given households' demand for public goods.

and $P_{Y_g,t}$ is the price of government value added. The first-order condition on the optimal amount of government intermediate inputs implies that the government intermediate inputs share equals

$$\frac{P_t M_{g,t}}{P_{G,t} G_t} = \omega_g \left(\frac{P_t}{P_{G,t}} \right)^{1-\nu_g}. \tag{12}$$

This condition states that when government value added and intermediate inputs are imperfect substitutes (i.e., $\nu_g > 1$), an increase in the price of government value added relative to the price of private-sector goods induces the government to raise the share of intermediate inputs.

The government value added $Y_{g,t}$ is produced with a Cobb-Douglas function

$$Y_{g,t} = N_{g,t}^{\alpha_g} \, K_{g,t}^{1-\alpha_g}, \tag{13}$$

where α_g denotes the labor share of the government value added. The production function (13) implies that the price of government value added is

$$P_{Y_g,t} = \frac{W_t^{\alpha_g} \, R_{k,t}^{1-\alpha_g}}{{\alpha_g}^{\alpha_g} \left(1-\alpha_g\right)^{1-\alpha_g}}. \tag{14}$$

Finally, the balanced budget constraint of the government implies $P_{G,t} G_t = T_t$, such that

$$T_t = W_t N_{g,t} + R_{k,t} K_{g,t} + P_t M_{g,t}. \tag{15}$$

The government levies a lump-sum nominal tax T_t to finance its wage bill $W_t N_{g,t}$, the cost of renting capital $R_{k,t} K_{g,t}$, and the purchase of private-sector goods $P_t M_{g,t}$.

3.3 Monopolistically Competitive Private-Sector Firms

As in standard New Keynesian models, the production structure of the private sector is split in two levels: a continuum of monopolistically competitive producers indexed by $i \in [0,1]$ and a final goods firm.

Each monopolistically competitive firm i produces the value-added variety $Y_{p,t}^i$

with a Cobb-Douglas production function

$$Y_{p,t}^i = {N_{p,t}^i}^{\alpha_p} {K_{p,t}^i}^{1-\alpha_p}, \tag{16}$$

where $K_{p,t}^i$ and $N_{p,t}^i$ are the amounts of capital and labor hired by firm i. In equilibrium, the market clearing conditions imply that $\int_0^1 N_{p,t}^i \, di = N_{p,t}$ and $\int_0^1 K_{p,t}^i \, di = K_{p,t}$. Then, α_p is the labor share of the private-sector value added. Importantly, we allow the labor share in private value added α_p to differ from the labor share in government value added α_g. In the calibration, we set these parameters to match the shares observed in WorldKLEMS and BEA data.

Finally, firms face a Calvo staggered price setting mechanism such that prices can be reset with a probability $1 - \phi$. This probability is independent and identically distributed across firms, and constant over time. As a result, in each period a fraction ϕ of firms cannot change their prices and maintain the prices of the previous period, whereas the remaining fraction $1-\phi$ of firms can set freely their prices. The optimal reset price $P_t^{i,\star}$ is chosen to maximize the expected discounted stream of real dividends

$$\max_{P_t^{i,\star}} \mathbb{E}_t \sum_{s=t}^{\infty} (\beta\phi)^s \, \Lambda_{t,s} \left[\frac{P_t^i}{P_s} - \varphi_s \right] Y_{p,s}^i,$$

where φ_t denotes the real marginal cost, and $\Lambda_{t,s}$ is the stochastic discount factor of the household between period t and s.

3.4 Final Goods Private-Sector Firm

The perfectly competitive final goods firm aggregates the different value-added varieties $Y_{p,t}^i$ produced by the continuum of monopolistically competitive firms using the CES function

$$Y_{p,t} = \left(\int_0^1 {Y_{p,t}^i}^{\frac{\epsilon-1}{\epsilon}} \, di \right)^{\frac{\epsilon}{\epsilon-1}}, \tag{17}$$

where ϵ denotes the elasticity of substitution across varieties.

The market clearing condition of the private sector posits that the production

of final goods is split into the consumption goods and investment goods demanded by the households, and the intermediate inputs demanded by the government:

$$Y_{p,t} = C_t + I_t + M_{g,t}. \tag{18}$$

3.5 Closing the Model

We consider the consumption price as the numeraire of the economy. Accordingly, we can define the real aggregate GDP as the sum of the real values of private-sector and public-sector value added, defined as the ratios with respect to the consumption price, that is

$$Y_t = Y_{p,t} + \frac{P_{Y_g,t}}{P_t} Y_{g,t}. \tag{19}$$

In the economy there is a monetary authority that sets the nominal interest rate R_t following the Taylor rule

$$\frac{R_t}{R_{ss}} = \left(\frac{R_{t-1}}{R_{ss}}\right)^{\rho_r} \left[(1+\pi_t)^{\phi_\pi}\, x_t^{\phi_y}\right]^{1-\rho_r}, \tag{20}$$

where $1 + \pi_t = \frac{P_t}{P_{t-1}}$ is the consumer price inflation, and $x_t = \frac{Y_t}{Y_t^{FLEX}}$ defines the output gap, that is, the ratio between the log real GDP of the economy Y_t and the corresponding variable Y_t^{FLEX} for an economy with fully flexible prices. R_{ss} is the steady-state interest rate, ρ_r denotes the degree of interest rate inertia, ϕ_π and ϕ_y capture the elasticities at which the monetary authority moves the nominal interest rate following a change in inflation and the output gap, respectively.

3.6 The Structure of Government Spending

This section characterizes analytically the equilibrium steady-state structure of government spending. We provide a closed-form formula that highlights the conditions through which the slowdown of the public-sector value-added productivity with respect to the private-sector value-added productivity induces a switch of the gov-

ernment production function towards the purchase of intermediate inputs.

In the steady-state the equilibrium government intermediate inputs share equals

$$\frac{P_{ss}M_{g,ss}}{P_{G,ss}G_{ss}} = \omega_g \left(\frac{P_{ss}}{P_{G,ss}}\right)^{1-\nu_g} = \frac{\omega_g}{\omega_g + (1-\omega_g)\,\Phi \left(Z \times A_p^{\frac{\alpha_p-\alpha_g}{\alpha_p}}\right)^{\nu-1}} \tag{21}$$

where $Z \equiv \frac{A_g}{A_p}$ denotes the relative productivity of the public-sector value added with respect to the private-sector value added, and

$$\Phi = \left(\frac{\epsilon-1}{\epsilon}\right)^{\frac{\alpha_g}{\alpha_p}} \frac{\left[\alpha_p^{\alpha_p}\left(1-\alpha_p\right)^{(1-\alpha_p)}\right]^{\frac{\alpha_g}{\alpha_p}}}{\alpha_g^{\alpha_g}\left(1-\alpha_g\right)^{(1-\alpha_g)}} \left[\frac{1-\beta\left(1-\delta\right)}{\beta}\right]^{\left[(1-\alpha_g)-(1-\alpha_p)\frac{\alpha_g}{\alpha_p}\right]} > 0.$$

How does the level of the relative public-sector productivity Z affect the equilibrium government intermediate inputs share? Equation (22) defines the derivative of the government intermediate inputs share with respect to Z:

$$\frac{\partial \frac{P_{ss}M_{g,ss}}{P_{G,ss}G_{ss}}}{\partial Z} = -\left(\nu_g - 1\right) \frac{\omega_g\left(1-\omega_g\right)\Phi \left(A_p^{\frac{\alpha_p-\alpha_g}{\alpha_p}}\right)^{\nu-1} Z^{\nu-2}}{\left[\omega_g + \left(1-\omega_g\right)\Phi \left(Z \times A_p^{\frac{\alpha_p-\alpha_g}{\alpha_p}}\right)^{\nu-1}\right]^2}. \tag{22}$$

For any given level of the private-sector productivity A_p, the sign of the derivative depends on the sign of the numerator, as the denominator is always positive. Since $\Phi > 0$ and $0 < \omega_g < 1$, the numerator is negative as long as $\nu_g > 1$, such that government value added and intermediate inputs are imperfect substitutes within the government gross-output production function.

Under the condition that $\nu_g > 1$, then a slowdown in the relative productivity of public-sector value added leads to the changing structure of government spending towards a larger relevance of government intermediate inputs. Since government value added and intermediate inputs are imperfect substitutes, the government finds it optimal to switch partially from the in-house production of value added to the purchase of intermediate inputs produced by the private-sector firm as the latter

becomes more productive. Importantly, this mechanism does not rely on the differences in labor shares across the public and private sector. This feature adds a further channel that links variation in productivities to the structure of government spending. More specifically, as long as $\alpha_g \neq \alpha_p$, then a change in productivity which is common across sectors – such that A_p rises but the relative productivity Z stays constant – leads to a larger government intermediate inputs share.[16]

4 Quantitative Analysis

4.1 Empirical Strategy

In general, multi-sector models with a changing production structure do not follow a balanced growth path.[17] This feature characterizes also our model. We then study the performance of the model in explaining the variation in the structure of government consumption spending by comparing two steady-states which differ in the level of public-sector and private-sector value-added productivities, A_g and A_p. First, we normalize the level of both productivities in 1960 such that $A_{g,1960} = A_{p,1960} = 1$, and calibrate the model to match the share of government purchases from the private sector as of 1960. Next, we discipline the change in the two productivities such that the model is consistent with two facts: the observed time variation between 1960 and 2019 in (i) in the relative price of government value added with respect to the price of private-sector value added, and (ii) the level of total per-capita value added. Finally, we feed the model with the observed values of the two productivities in 2019, $A_{p,2019}$ and $A_{g,2019}$, and evaluate the quantitative performance of the model in explaining the changing structure of government spending by comparing the share

[16]This feature allows the model to be consistent with the observed pro-cyclicality of the government intermediate inputs share. A version of the model with TFP shocks yields a correlation of 0.85 between the share and GDP, very close to the value of 0.90 observed in the data.

[17]In the structural change literature, balanced growth path exists only in very particular cases. See Kongsamut, Rebelo and Xie (2001), Ngai and Pissarides (2007) and Boppart (2014).

of intermediate inputs in gross output of the government in the two steady-states.

Then, we analyze the implications of the changing structure of government spending on fiscal multipliers by studying the effects of government spending shocks around the 1960 and 2019 steady-states. These equilibria differ in the exogenous level of value-added productivities and therefore in the endogenous structure of government consumption spending. Throughout our analysis, we keep fixed all the other parameters, so we can ask to what extent the variation in the structure of government consumption spending alone can alter the transmission of government spending shocks.[18]

4.2 Calibration

Section 3.6 has established that in the model the change in the government intermediate inputs share depends on two key elements: the overall change in the productivity of the public-sector value added relative to the productivity of the private-sector value added, and the elasticity of substitution between government value added and intermediate inputs. To properly evaluate the quantitative performance of the model, we discipline these two elements with the data. Throughout the calibration, we set one period of the model to equal a quarter, as it is standard in the literature on fiscal multipliers.

To discipline the variation in the public-sector and private-sector productivities, we use two moments: the change in the relative price of public value added with respect to the price of private value added and the change in the level of real GDP between 1960 and 2019. Using data from the BEA, we find that (i) the ratio of the price deflator of public value added to the price deflator of private value added in 2019 is 2.26 times larger that the ratio observed in 1960, and (ii) in 2019 the real

[18]Strictly speaking, we also allow the disutility of labor in the utility function to be time varying, to keep a labor supply of $N_{ss} = 0.33$ in both steady-states. This choice alters the aggregate steady-state equilibrium of the model, but not its dynamics around the steady-state. See the next subsection for details.

GDP per capita is 3.2 times larger than that of 1960. Matching these two moments yields to the values of $A_g = 1.09$ and $A_p = 2.20$. Thus, our calibration implies that the public-sector productivity has increased by an annual rate of 0.15% between 1960 and 2019, whereas the annual growth rate of the private-sector productivity was 1.35%. This wedge in the growth rates of efficiency across sectors is what leads to the slowdown of the public-sector productivity in the model.

The calibration of the differences in the value-added labor shares between the private sector and the government is not straightforward, as the definition of value added in the national accounts differs across sectors, as we have already mentioned in Section 2.1. In the private sector, value added equals the sum of the compensation of employees, taxes of production and imports less subsidies, the depreciation of fixed capital, proprietors' income, and corporate profits. Instead, government value added equals just the sum of the compensation of employees and the depreciation of fixed capital. The discrepancy between the definitions of value added is also due to the fact that the Bureau of Economic Analysis assumes a zero-return on public capital (i.e. the gross operating surplus equals the depreciation of fixed capital and does not include any extra source of income and profit). For this reason, we compute the capital shares by harmonizing the definition of value added across sectors in two ways. First, we take the conservative approach of considering that value added in either sector equals the sum of the compensation of employees and the depreciation of fixed capital. This assumption washes out the role of taxes of production and imports less subsidies from the private-sector value added, and extends the assumption of zero-return to private-sector capital. In this way, we maximize the estimation of the labor share of the private sector by attributing all returns to capital to the profit share, rather than the capital share. Second, we adjust for the bias in the estimation of the labor share due to self-employment. Gollin (2002) discusses how the labor income of the self-employed is omitted in the computation of the labor share as it is registered as a form of business income. To account for this

fact, we follow Gollin (2002) and compute as labor income the operating surplus of private unincorporated enterprises, assuming that these companies use the same mix of labor and capital implemented in the rest of the economy.[19] Once we have the same definition of value added, we proceed in computing the average capital shares between 1960 and 2019. We find that the average labor share of government value added is $\alpha_g = 0.78$, whereas the private-sector value-added labor share equals $\alpha_p = 0.68$.[20]

We estimate the elasticity of substitution between government value added and government intermediate inputs using U.S. time-series data. To back-up from the data a model-consistent estimate of this key parameter, we estimate the first-order condition of intermediate inputs of Equation (12). Namely, we estimate the regression

$$\log\left(\frac{P_t M_{g,t}}{P_{G,t} G_t}\right) = \text{const.} + (\nu_g - 1)\log\left(\frac{P_t}{P_{G,t}}\right) + \epsilon_t$$

where $P_t M_{g,t}$ denotes the nominal value of government intermediate inputs at time t, $P_{G,t} G_t$ is the nominal value of government gross output, const. $\equiv \log \omega_g$ is a constant, P_t is the price deflator of government intermediate inputs, and $P_{G,t}$ is the price deflator of government gross output. The object of interest is the coefficient $\nu_g - 1$, which yields a direct estimate of the elasticity of substitution between government value added and intermediate inputs. The identification of the elasticity ν_g comes from the cross-country variation in trends in the government intermediate inputs

[19] Since the fraction of self-employed is falling dramatically over time in the United States, as it dropped from 13.8% in the 1960 to below 3% in the early 2000s, the adjustment of Gollin (2002) in our setting is likely to generate an upper-bound for the measurement of the labor share of the private sector.

[20] Public firms have a higher labor intensity than private firms even within a sector, as documented by Dewenter and Malatesta (2001). Moreover, La Porta and Lopez-de-Silanes (1999) and Dewenter and Malatesta (2001) find that following a privatization the labor intensity of public firms shrinks by roughly 40%. Hence, the higher labor intensity is intrinsically linked to the ownership by the government. This difference between private and public firms could be driven by different managerial practices (see Bloom and Van Reenen, 2010) or non-market incentives (see Lippi and Schivardi, 2014). The scope of the paper is not to micro-found the differential in the labor share across public and private sector, and all the potential factors that can rationalize the distinct value-added labor shares are captured in a reduced form by wedge between the parameters α_p and α_g. We study the implications of this differential in the labor shares across public and private sector on the changing structure of government spending, implicitly assuming that this differential remains constant over time.

shares. We estimate the regression using annual U.S. data from 1960 to 2019, and find an elasticity of 1.67, thus confirming that government value added and intermediate inputs are imperfect substitutes. Accordingly, we set $\nu_g = 1.65$.

We set the steady-state level of government spending to equals 17% of the steady-state level of total GDP, to match the average government spending to GDP ratio from 1960 to 2019. For the persistence of the government spending shocks, we choose the standard value of $\rho_g = 0.9$. Then, we calibrate the time discount parameter to the standard value of $\beta = 0.99$, which implies an annual steady-state interest rate of 4%. For the utility function, we set the risk aversion to $\sigma = 2$, and we calibrate $\eta = 1/2$ such that the Frisch elasticity equals 2. Although this value is much higher than the estimates of micro labor supply elasticity, it is in line with the macro elasticity derived by Erosa et al. (2016). Finally, note that the amount of labor supply in the steady-state increases with the productivity level. Thus, for the model to display an amount of labor $N_{ss} = 0.33$ in both steady-states we follow Moro (2012) and Galesi and Rachedi (2019) and allow for a time varying disutility of labor.[21] Accordingly, we set θ to 2.6 in 1960 and to 8.2 in 2019.

In the law of motion of physical capital, we set the depreciation rate to $\delta = 0.025$, and we calibrate the adjustment cost parameter such that a government spending shock in the 1960 steady-state implies a 1-year cumulative investment fiscal multiplier of -0.4, in the range of the estimates of Blanchard and Perotti (2002). This procedure yields a value of $\Omega = 18.18$.

The elasticity of substitution across the varieties of the intermediate goods in the private sector is set to the standard parameter of $\epsilon = 6$. Then, we calibrate the Calvo parameter to $\phi = 0.75$, such that prices last on average 12 months, and we choose the values for the parameters of the Taylor rule following the estimates of Clarida et al. (2000): the inertia of the nominal interest rate equals $\rho_r = 0.8$, the

[21] With a constant parameter of the disutility the model would counterfactually imply a 60% rise in the steady-state amount of labor between 1960 and 2017.

Table 2: Calibration.

Parameter	**Value**	**Target/Source**
Productivity Government Value Added in 1960	$A_g = 1$	Normalization
Productivity Private-Sector Value Added in 1960	$A_p = 1$	Normalization
Productivity Government Value Added in 2019	$A_g = 1.09$	$Y_{2019}/Y_{1960} = 3.22$
Productivity Private-Sector Value Added in 2019	$A_p = 2.20$	$\left(P_{Y_g,2019}/P_{2019}\right) \Big/ \left(P_{Y_g,1960}/P_{1960}\right) = 2.26$
Steady-State Government Spending in 1960	$G_{1960} = 0.13$	$P_{G,1960}G_{1960}/Y_{1960} = 0.17$
Steady-State Government Spending in 2019	$G_{2019} = 0.23$	$P_{G,2019}G_{2019}/Y_{2019} = 0.17$
Elasticity Govt. Gross Output	$\nu_m = 1.65$	Data
Share Inputs in Govt. Gross Output	$\omega_{m,g} = 0.22$	$M_{g,1960}/P_{G,1960}G_{1960}$
Labor Share Govt.	$\alpha_g = 0.78$	Data
Labor Share Private Sector	$\alpha_p = 0.68$	Data
Persistence Govt. Spending	$\rho_g = 0.9$	Standard Value
Time discount	$\beta = 0.99$	Steady-State Annual Interest Rate = 0.04
Risk Aversion	$\sigma = 2$	Standard Value
Disutility Labor in 1960	$\theta_{1960} = 2.6$	$N_{1960} = 0.33$
Disutility Labor in 2019	$\theta_{2019} = 8.2$	$N_{2019} = 0.33$
Inverse Frisch-Elasticity	$\eta = 0.5$	Erosa et al. (2016)
Depreciation Capital	$\delta = 0.025$	Standard Value
Adjustment Cost	$\Omega = 18.18$	Investment Fiscal Multiplier = -0.4
Elasticity Substitution Varieties	$\epsilon = 6$	Standard Value
Calvo Parameter	$\phi = 0.75$	Standard Value
Interest Rate Inertia	$\rho_i = 0.8$	Clarida et al. (2000)
Taylor Parameter Inflation	$\phi_\pi = 1.5$	Clarida et al. (2000)
Taylor Parameter Output Gap	$\phi_\pi = 0.2$	Clarida et al. (2000)

sensitivity to changes in inflation is $\phi_\pi = 1.5$, and the sensitivity to changes in the output gap is $\phi_y = 0.2$.

Finally, we set the parameter $\omega_{m,g} = 0.22$ such that, given all the other parameters, the model matches the government intermediate inputs share as of 1960.

4.3 The Changing Structure of Government Spending in the Model

We have calibrated the model to match the share of government intermediate inputs as of 1960 in the non-stochastic steady-state. Yet, the prediction of the model on how the slowdown in the relative productivity of the public sector drives the change in the share between 1960 and 2019 is left completely unrestricted, and hence informs on the quantitative appeal of the model in explaining the changes in the structure of government spending. In particular, we are interested in the value of the government intermediate inputs shares implied by the model in the non-stochastic steady-state of 2019, where the only difference with respect to the 1960 steady-state is the level of the public and private sector productivities, A_g and A_p.

Panel (a) of Table 3 reports the comparison between the two years in the model and the data. The model accounts entirely for the changes in the structure of government spending between 1960 and 2019, as it predicts an increase in the government intermediate inputs share from 22.7% to 33.3%, exactly as it is in the data.

How does ISTC raises the government intermediate inputs share? The characterization of Section 3.6 shows that if private-sector value added is more intensive in capital than government value added, a decline in the price of investment raises the relative productivity of the private sector. This pattern can be observed by the implications of the model on the relative price of government value added. The model predicts that the relative price has increased from 1 in 1960 to 1.61 in 2019. This change accounts for 48% of the actual increase observed in the data. Then,

Table 3: Results on the Changing Structure of Government Spending.

Variables	**1960**		**2019**	
	Model	Data	Model	Data
Panel (a): $\nu_m = 1.65$				
Government Intermediate Inputs Share	22.7%	22.7%	33.3%	33.3%
Government Value-Added Relative Price	1	1	2.26	2.26
Share of Government Employment	17.2%	20.8%	15.0%	15.7%
Panel (b): $\nu_m = 1.45$				
Government Intermediate Inputs Share	22.7%	22.7%	29.8%	33.3%
Government Value-Added Relative Price	1	1	2.26	2.26
Share of Government Employment	17.2%	20.8%	15.7%	15.7%
Panel (c): $\nu_m = 1.85$				
Government Intermediate Inputs Share	22.7%	22.7%	34.8%	33.3%
Government Value-Added Relative Price	1	1	2.26	2.26
Share of Government Employment	17.2%	20.8%	14.2%	15.7%

The Table reports the model implications on the share of government intermediate inputs, the relative price of government value added, and the share of government employment in total employment in the 1960 steady-state and the 2019 steady-state vis-à-vis the values of these variables observed in the data. Panel (a) considers the implications of the benchmark model in which $\nu_m = 1.65$. Panel (b) considers the case of a lower elasticity such that $\nu_m = 1.45$. Panel (c) considers the case of a higher elasticity such that $\nu_m = 1.85$.

if government value added and intermediate inputs are imperfect substitutes, the higher productivity of the private sector induces the government to purchase relatively more goods from the private sector, and rely less on the in-house production of value added. Basically, the government manages to contain the productivity slowdown of its own value added by increasing the share of intermediate inputs in its gross output.

Table 3 reports the implications of the model on the changes of the government intermediate inputs share for different values of the elasticity of substitution between

government value added and intermediate inputs. Panel (b) considers the case of a lower elasticity such that $\nu_g = 1.45$ and Panel (c) considers the case of a higher elasticity such that $\nu_g = 1.85$. The results point out that even with a lower elasticity, the model still accounts for 62% of the observed change in the government intermediate inputs share. Instead, with a higher elasticity the model slightly overshoots by predicting that in 2019 the intermediate inputs share equals 34.8%.

Finally, the model also explains a large fraction of the observed reduction in the ratio of government employment to total employment. In the data, this ratio drops from 20.8% in 1960 to 15.7% in 2019. The model accounts for 54% of this decline, as it implies the ratios of 17.2% and 15% over the two steady-states.

4.4 Fiscal Multipliers

We now turn into the analysis of the model implications on how the changing structure of government spending alters the transmission of fiscal policy at the business cycle frequency. In Section 2.4, we have shown that the response of hours and government value added to government spending shocks declines when government spending is more tilted towards the purchase of private-sector goods, whereas whereas the response of total value added is independent on the structure of government spending. To uncover whether the model is consistent with this empirical evidence, we compare the fiscal multipliers implied by our economy around the 1960 and 2019 steady-states. As discussed above, the two equilibria differ only in the level of the value-added productivities, and therefore also in the endogenous structure of government spending. Throughout the exercise, we keep all the other parameters fixed, so we can ask to what extent the rise of the government intermediate inputs share alone can alter the transmission of fiscal shocks.

The first two columns of Table 4 report the 1 year cumulative fiscal multipliers

implied by the "Benchmark Economy" in the 1960 steady-state and in the 2019 steady state. The model predicts an output fiscal multiplier in the 1960 steady-state which equals 0.83. The response of investment has been calibrated to deliver a multiplier of -0.4, which implies that the consumption multiplier is positive and amounts to 0.23. Moving from the 1960 steady-state to the 2019 one does not alter the size of the output fiscal multiplier, which remains virtually unchanged at a value of 0.82. The model delivers an output fiscal multiplier which is very close to the value of 0.73 estimated in the data.[22]

The constancy of the total output fiscal multiplier hides offsetting changes in the multipliers of the private and public sectors: the private value-added fiscal multiplier rises from 0.07 to 0.20, whereas the public value-added fiscal multiplier drops from 0.76 to 0.62. This drop accounts for 91% of the estimated relationship between the decline in the response of government output to a government spending shock at larger levels of the government intermediate input share. Hence, the model accounts for our empirical evidence that highlights how the composition of the total value added multiplier shifts towards the private sector as government spending moves away from the own production of value added.

Importantly, the model successfully reproduces the dampening effect of the changing structure of government spending on the response of hours to a government spending shock. Indeed, the total hours fiscal multiplier drops from 0.50 to 0.15 over the two steady-states, and the decline in the responsiveness of hours is observed in both the private sector and public sector. When comparing the predictions of the model with the response of employment in the data, the first salient fact is that the model implies a lower value than the estimated value of 1.26. This underestimation is due to the lack of an extensive margin of labor in the model: all the variation in hours comes from the intensive margin of working longer, and

[22]Section C of the Appendix reports robustness checks on the fiscal multipliers in alternative versions of the model with a CRRA utility function and flexible prices.

Table 4: 1 Year Cumulative Fiscal Multipliers.

	Benchmark Economy		Fixed Structure Government Spending		No Labor Share Differences		No Labor Share Government Spending & No Labor Share Differences	
	Model 1960	Model 2019	Model 1960	Model 2019	Model 1960	Model 2019	Model 1960	Model 2019
Y_t	0.83	0.82	0.83	0.83	0.76	0.76	0.76	0.76
C_t	0.23	0.22	0.23	0.23	0.17	0.17	0.17	0.17
I_t	-0.40	-0.40	-0.40	-0.40	-0.40	-0.40	-0.40	-0.40
$Y_{p,t}$	0.07	0.20	0.07	0.07	0.01	0.01	0.01	0.01
$Y_{g,t}$	0.76	0.62	0.76	0.76	0.76	0.76	0.76	0.76
N_t	0.50	0.15	0.50	0.31	0.48	0.15	0.48	0.15
$N_{p,t}$	0.14	0.06	0.14	0.08	0.13	0.06	0.13	0.06
$N_{g,t}$	0.36	0.10	0.36	0.23	0.34	0.09	0.34	0.09
$W_t N_t / Y_t$	0.74	0.23	0.74	0.46	0.70	0.22	0.70	0.22

The Table reports the 1-year cumulative fiscal multipliers of the "Benchmark Economy", the "Fixed Structure Government Spending" in which there is no change in the structure of government spending (with a Cogg-Douglas production function for government value added, such that $\nu_m = 1$, and the share of government intermediate inputs does not vary over time) albeit we keep the time-variation in the productivities of public-sector and private-sector value added, the "No Labor Share Differences", in which the labor share of value added is equalized across the public and private sectors, and the "Fixed Structure Government Spending & No Labor Share Differences", which equals the "Fixed Structure Government Spending", with the only difference being the lack of differences in the labor share of value added across the public and private sectors. "Model 1960" refers to the steady-state calibrated to match the share of government purchases from the private sector as of 1960. "Model 2019" refers to the steady-state in which the productivities of public-sector and private-sector value added are set to match the relative price of government value added as of 2019.

there is no change in the pool of workers. Thus, our economy does not account for the fact that unemployment drops substantially when the government purchases private-sector goods, a mechanism that Monacelli et al. (2010) document to be the leading driver of the positive response of total hours. Second, the estimates of our empirical evidence imply a decline from 1.26 to 0.64 in the response of hours for the United States between 1960 and 2019. Hence, the model overestimates by around 40% the relationship between the rising relevance of private-sector goods in government consumption and the decrease in the response of hours to government spending shocks estimated in the data.

What drives the disconnect in the response of hours and output to government spending in the model? We highlight the contribution of two channels. First, although the public-sector productivity barely rises over time, the sharp increase in the private-sector value-added productivity makes the 2019 steady-state to be much more efficient than the 1960 steady-state. As a result, although a government spending shock raises both the demand and supply of labor, the higher productivity of the economy reduces the required amount of hours to increase output by one unit. Then, this mechanism is further amplified by the changing structure of government spending. Indeed, the 2019 steady-state features a larger share of goods and services from the private sector in total government spending. Second, the rise in the government intermediate input share increases the relevance of private-sector goods in total government spending. As the private sector displays a lower labor share in value added than the government, the changing structure of government spending implies a dampening in the response of employment to a spending shock.

To disentangle the quantitative contribution of these two channels, we study the transmission of government spending shocks in three alternative specifications of the model. The first economy, which we refer to as "Fixed Structure Government Spending", features the variation in both the public-sector and private-sector productivity, but abstracts from the changing structure of government spending, as

the share of government intermediate inputs is fixed over time. We implement this case by positing that the government gross-output production function of Equation (10) is a Cobb-Douglas, that is, $\nu_m = 1$. Under this condition, the structure of government spending is independent from changes in the relative productivity of the public sector. The second economy, which we refer to as "No Labor Share Differences", is a variant of the baseline model with the only difference that there the labor share is equalized across the public and private sector. More specifically, we set $\alpha_g = \alpha_p = 0.695$ such that the aggregate labor share is consistent with that of the baseline economy. Finally, the third economy, which we refer to as "Fixed Structure Government Spending & No Labor Share Differences" features no change in the share of government intermediate inputs in gross output and no difference in the labor share across sectors.

The results in Table 4 show that when there is no change in the structure of government spending, the rise in the productivities leads anyway to a drop in the response of employment to a government spending shock from 0.50 in 1960 to 0.31 in 2019, whereas in the baseline model the drop in the employment response goes from 0.50 to 0.15. Thus, the changing structure of government spending per se accounts for 46% of the decline in the employment response implied by the model, whereas the rising productivities explain the remaining 54%. However, when we compare the implications of the "No Labor Share Differences" and the "Fixed Structure Government Spending & No Labor Share Differences" economies, then the changing structure of government spending has no effect on the dampening of the employment response, since it hinges entirely on the upward trend of the productivities. Thus, the differential values in the labor share is the key channel through which the rising government intermediate input share reduces the responsiveness of employment to government spending. As the private sector is less intensive in labor than the public sector, a switch of government spending out from the own production of value added and toward the purchases of private-sector goods reduces the overall contribution

of labor income in value added, and thus dampens the adjustment in employment.

Table 4 also reports the implications of the model on the effects of government spending shocks on the aggregate labor share. We find that in the 1960 steady state, the multiplier of the labor share is 0.74. This finding is consistent with the positive response of the labor share to unanticipated shocks to government spending documented in Cantore and Freund (2021). Mirroring the dynamics of the employment multiplier, we also find a substantial drop in the response of the labor share, which equals 0.23 in the 2019 steady state. This implies that the changing structure of government spending is substantially altering the way the additional income generated in response to a government spending shock is allocated between workers and capitalists. Although our model features a representative agent and cannot properly evaluate the implications of this distributional effect, the drop in the responsiveness of the labor share could suggest a shift in the pool of winners and losers of stimulus packages.

Finally, it is worth emphasizing that the model also implies a correlation for the government intermediate input share with the total amount of government spending that equals 0.85, which matches almost exactly the value observed in the data, that is 0.91. Overall, these findings highlight that our model economy generates an endogenous changing structure of government spending which provides predictions on the transmission of government spending in line with the data, illustrating how the rise in the government intermediate input share and the disconnect in the response of hours and output to fiscal policy are interlinked processes are two interlinked processes, in which the common driver is the slowdown of the relative productivity of the public-sector value added.

5 Concluding Remarks

This paper documents that the structure of government spending in advanced economies changes continuously over time. In particular, the government purchases relatively more goods from the private sector, and relies less on the in-house production of value added. We refer to this novel stylized fact as the rise of the government intermediate inputs share.

Although the change in the structure of government spending occurs slowly over time, it alters the transmission of government spending shocks, by generating a disconnect in the responses of hours and total output. Using linear-projection methods on U.S. data, we document that the response of hours to government spending shocks is lower when the government relies more on the purchase of private-sector goods. Instead, there is no relationship between the response of total output and the structure of government spending.

To rationalize these facts, we build a general equilibrium model and show that the slowdown of the relative productivity of the public sector can account for the bulk of the change in the structure of government spending. We extend a standard New Keynesian model with an explicit production function for government gross output, and find that a relative decline in the productivity of the public sector vis-à-vis the private sector boosts the share of government intermediate inputs. This prediction of the model hinges on one specific condition which we find to hold in the data: the imperfect substitution between government value added and intermediate inputs.

The model can also explain the disconnect in the response of output and hours to government spending observed in the data. The key to this result is the effect that investment-specific technological change has on the overall productivity of the economy, as well as the productivities of the private sector vis-á-vis the government. First, ISTC enhances the overall productivity of the economy, so that the production

of a unit of output in 2019 requires a lower amount of hours than in 1960. Second, this pattern is amplified as government spending tilts towards the private sector, which is less intensive in labor and has also increased its productivity relative to the public sector.

Overall, our results point to a substantial role of the structure of government spending in shaping the transmission of fiscal policy, and highlights that fiscal stimulus may not be able to overturn the emergence of jobless recoveries, as over time government spending become less effective in boosting hours worked.

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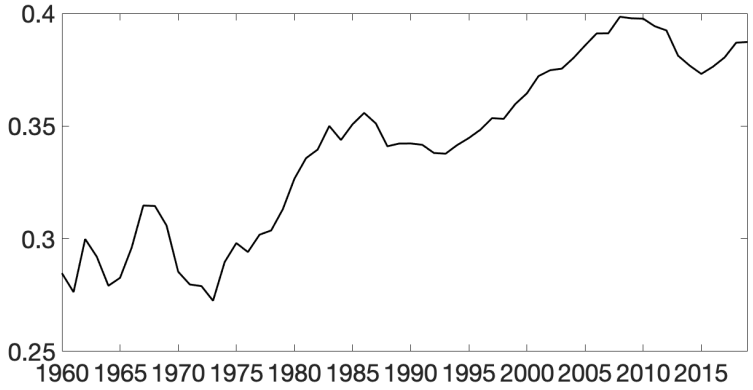
A Further Evidence on the Rise of the Government Intermediate Input Share

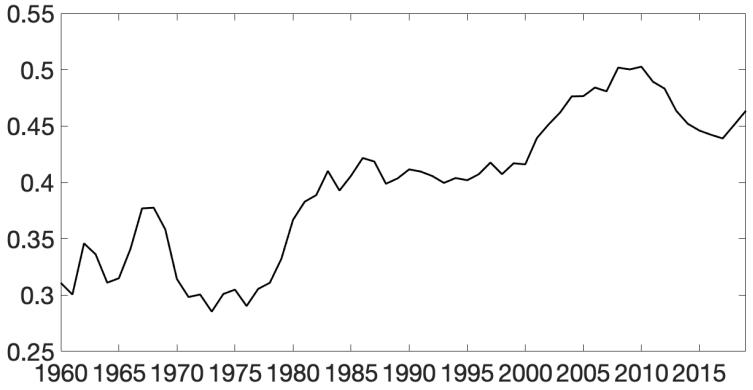
To provide further robustness to the rise in the share of government intermediate inputs in total gross output, we carry out two exercises. In the first one, we compute the share of government intermediate inputs by abstracting from the contribution of the depreciation of physical capital in public gross output. Figure A.1 reports the share of government intermediate inputs computed by excluding capital depreciation for the general government, federal government, and the state and local government. In the second one, we compute the government intermediate inputs share by excluding each time a key sector in the provision of goods and services to the government. Figure A.2 shows that even when we exclude either the finance and real estate sector, or the professional and business services sector, or the educational services sector, or the health care services sector, the government intermediate inputs share always displays an upward trend. In both cases, we find that our novel stylized fact on the changing structure of government spending holds in these two alternative settings.

Figure A.1: Share of Government Intermediate Inputs - Excluding Capital Depreciation.

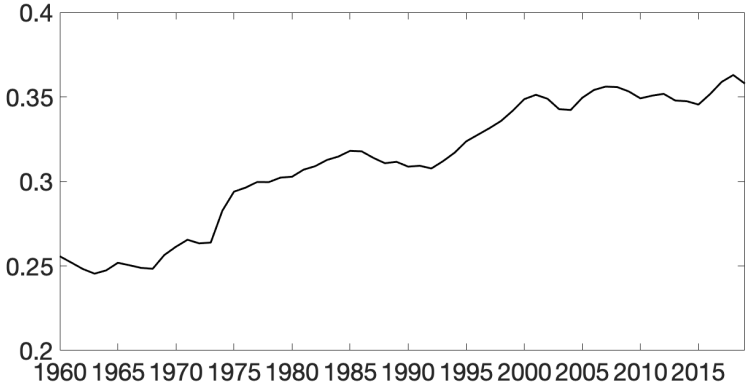
(a) General Government



(b) Federal Government



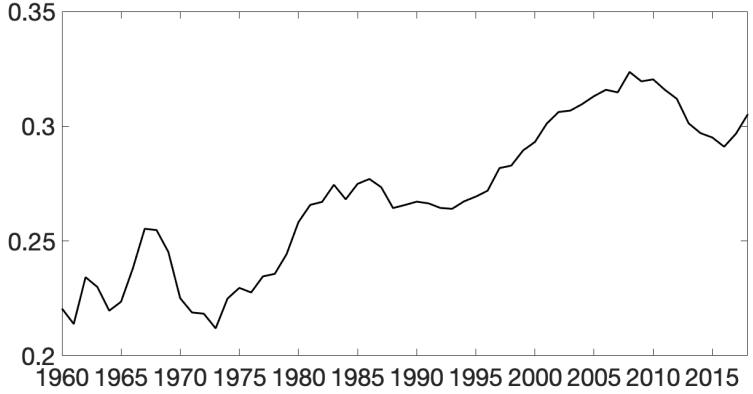
(c) State and Local Government



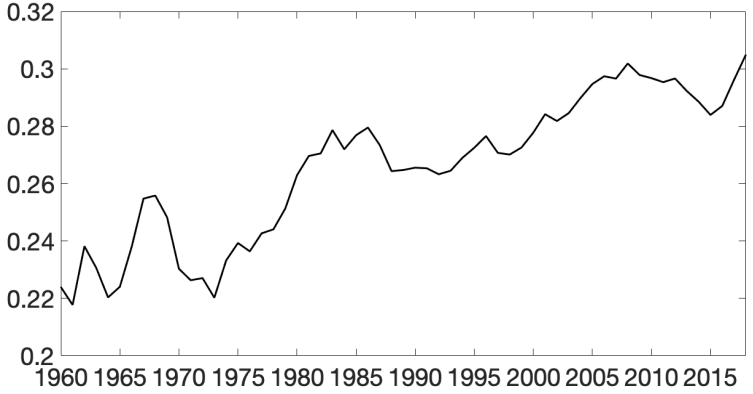
Note: The graphs report the share of intermediate inputs in the gross output of the general government (Panel a), the federal government (Panel b), and the state and local government (Panel c) when excluding capital depreciation from the definition of government gross output. The data is annual from 1960 until 2019. Source: Bureau of Economic Analysis.

Figure A.2: Share of Government Intermediate Inputs - Excluding Specific Sectors.

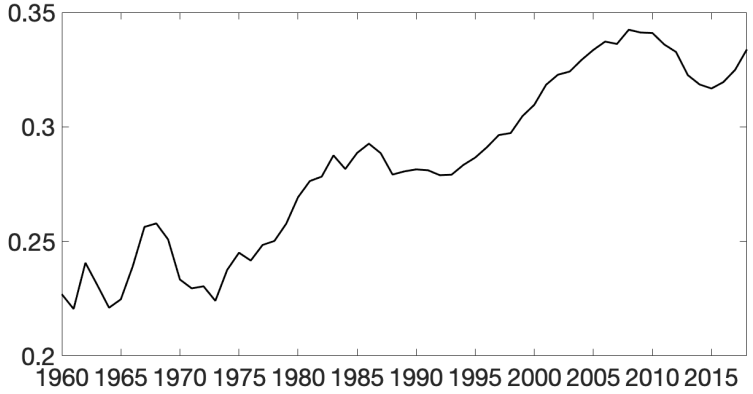
(a) Excluding Financial & Real Estate Services



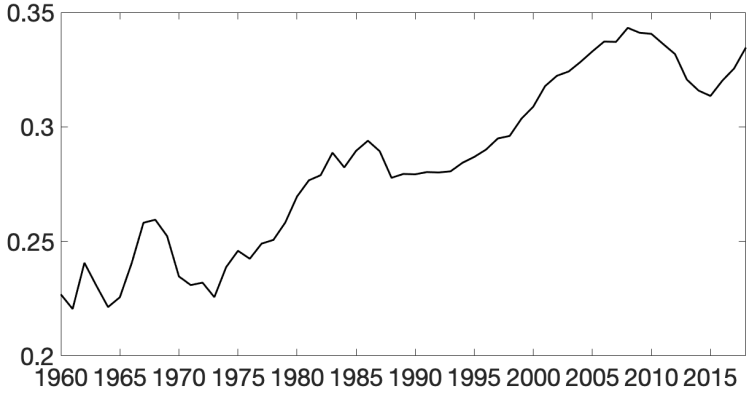
(b) Excluding Professional Services



(c) Excluding Educational Services



(d) Excluding Health Care Services



Note: The graphs report the share of intermediate inputs in the gross output of the general government when excluding the inputs provided by either the financial services and real estate sector (Panel a), or the professional and business services sector (Panel b), or the educational services sector (Panel c), or the health care services sector (Panel d). The data is annual from 1960 until 2018. Source: Bureau of Economic Analysis.

Table B.1: Response of Output to Government Shocks - Further Evidence

Dependent	Consumption	Investment	Wage
	(1)	(2)	(2)
G_t	-0.128	-0.490**	0.636
	(0.099)	(0.237)	(0.514)
$G_t \times \left(\frac{P_{t-1}M_{g,t-1}}{P_{G,t-1}G_{t-1}} - \frac{1}{T}\sum_{t=1}^{T}\frac{P_tM_{g,t}}{P_{G,t}G_t}\right)$	0.084	-0.012	0.228
	(0.127)	(0.094)	(0.173)
Controls	YES	YES	YES
N. Observations	224	224	224

The table reports the estimates of the one-year cumulative fiscal multiplier based on a local projection method applied to quarterly U.S. data from 1960 to 2015. In all regressions, the independent variables are the identified government spending shocks $\epsilon^G_{i,t}$, and the interaction of these shocks with the demeaned lagged share of government intermediate inputs in total government gross output. In Column (1), the dependent variable is real consumption, in Column (2) the dependent variable is real investment, and in Column (3) the dependent variable is the real wage. Newey-West (1987) standard errors are reported in brackets. *, **, and *** indicate statistical significance at the 10%, 5% and 1%, respectively.

B Further Evidence on the Fiscal Multipliers

C Fiscal Multipliers in the Model: Robustness Checks

The model incorporates two features which are intended to generate short-run dynamics following government spending shocks that are quantitatively in line with the empirical evidence on fiscal multipliers: a GHH utility function and the New Keynesian set up of the economy (i.e., monopolistic competition and Calvo (1983) staggered price setting in the private sector).

This section shows that the implications of the changing structure of government consumption spending on the dynamics of fiscal multipliers over time does not qualitatively change in case we abstract from the features mentioned above. Indeed, Table C.2 reports the fiscal multipliers in two alternative specifications of the "Benchmark Economy".

In the first alternative specification, the "CRRA Utility Economy", the utility function is a CRRA instead of the GHH of the baseline model. The dynamics of the fiscal multipliers across the 1960 and the 2019 steady-states are similar to those observed in "Benchmark Economy". The only difference relies on the fact that without the consumption-labor complementarity of the GHH preferences, the model with a CRRA utility displays a negative response of consumption, a negative response of private value added, and therefore a much lower level in the total output fiscal multiplier, in line with the results of Biilbie (2011), which show that GHH preferences and sticky prices can rationalize a positive consumption fiscal multiplier.

The second alternative specification, the "Flexible Price Economy &CRRA Utility Economy", builds on the previous case by also abstracting from the price rigidity feature of the New Keynesian setup of the model. In this neoclassical economy, the size of the multiplier is slightly drops, as the output fiscal multiplier equals 0.44 across the two steady-states. This is consistent with the results of Woodford (2011), who points out that price stickiness raises the size of the fiscal multiplier.

Table C.2: 1 Year Cumulative Fiscal Multipliers - Robustness.

	Benchmark Economy		CRRA Utility Economy		Flexible Prices & CRRA Utility Economy	
	Model 1960	Model 2019	Model 1960	Model 2019	Model 1960	Model 2019
Y_t	0.83	0.82	0.51	0.52	0.44	0.44
C_t	0.23	0.22	-0.17	-0.16	-0.20	0.20
I_t	-0.40	-0.40	-0.32	-0.31	-0.36	-0.36
$Y_{p,t}$	0.07	0.20	-0.26	-0.14	-0.33	-0.22
$Y_{g,t}$	0.76	0.62	0.77	0.66	0.77	0.67
N_t	0.50	0.15	0.39	0.10	0.36	0.11
$N_{p,t}$	0.14	0.06	-0.02	-0.02	-0.07	0.00
$N_{g,t}$	0.36	0.10	0.41	0.10	0.42	0.11
$W_t N_t / Y_t$	0.74	0.23	0.27	0.08	0.19	0.05

The Table reports the 1-year cumulative fiscal multipliers of the "Benchmark Economy", the "CRRA Utility Economy" in which the utility of the households is a CRRA function and not anymore a GHH function, and the "Flexible Prices Economy & CRRA Utility Economy", which builds on the previous case by also abstracting from price rigidity. "Model 1960" refers to the steady-state calibrated to match the government purchases from the private sector as of 1960. "Model 2019" refers to the steady-state in which the relative price of investment goods is set as of 2019.

Overall, both cases highlight that the changing structure of government spending implies a shift of the stimulus effect of government spending from government value added to private value added, and a sharp reduction in the responsiveness of hours, independently of the specification of the utility function or the presence of price-setting frictions. Thus, that although these two features of the model are required to have quantitative implications on the size of output fiscal multipliers which are in line of the empirical evidence, their presence does not alter our main findings on the relationship between the changing structure of government consumption spending and the transmission of fiscal policy.