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# THE CHANGING STRUCTURE OF GOVERNMENT CONSUMPTION SPENDING*

By Alessio Moro and Omar Rachedi

*University of Cagliari, Italy; Esade Business School, Universitat Ramon Llull, Spain*

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 fiscal policy, by dampening the response of hours, public value added, and the labor share to government spending shocks, while leaving the response of total output unchanged. We rationalize these facts in a general equilibrium model where a decline of the public-sector relative productivity drives the changing structure of government spending, which in turn modifies the transmission mechanism of government spending shocks.

## 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 article 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 United States this share rose from 23% in 1960 to 33% in 2019. Thus, government spending experiences a structural change in that it relies more on private-sector goods, and less on its own production of value added.

Although structural changes are typically long-run phenomena, a growing body of the literature suggests that they can affect the short-run behavior of an economy, influencing its real business cycles (Da-Rocha and Restuccia, 2006; Moro, 2012, 2015) and the effectiveness of monetary policy (Galesi and Rachedi, 2019). The second contribution of this article is to show that the changing structure of government spending emerges together with a change in the transmission of fiscal policy. Specifically, we focus on U.S. quarterly data and estimate the government spending multipliers of five variables of interest: total value added, government value added, private value added, hours, and the labor share. In order to identify government spending shocks, we follow Ramey and Zubairy (2018), and combine a timing restriction with

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the use of a public spending news variable. This exercise uncovers the following two key findings.

First, a relatively larger share of purchases from the private sector in total public expenditures is associated with a disconnect between the responses of output and hours to government spending shocks: Although the response of output remains constant, the response of hours decreases. Our empirical estimates suggest that the overall change in the structure of government spending from 1960 to 2019 is associated with a 40% reduction in the responsiveness of hours to a public spending shock. This result appears particularly relevant when coupled with the observation that recent U.S. recoveries have not been associated with a contemporaneous increase in employment—a phenomenon referred to as "jobless recoveries" (Kolesnikova and Liu, 2011)—suggesting that fiscal policy might have become relatively less effective in stimulating employment when such stimulus was mostly needed.

Second, the changing structure of government spending is also associated to a reshape of how the additional dollars of output generated by a fiscal stimulus are split between the private and public sector, and between labor income and capital income. One the one hand, the multiplier of private value added increases—and that of public value added declines—at relatively larger shares of private-sector purchases in total public expenditures. Hence, the changes in the structure of government spending are tied to a higher capability of fiscal expansions to attain the main objective of reducing the slack of private economy activity (Auerbach et al., 2020). On the other hand, although we confirm the result of Cantore and Freund (2021) of a positive response of the labor share to fiscal shocks, its magnitude declines with the size of the private-sector share in government spending.

We then build a quantitative theory of the changing structure of government spending to rationalize the disconnect of output and hours to public spending shocks, as well as the variation in the distributional implications of fiscal policy. 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.

In this setting, the long-run evolution of the composition of government spending is endogenously determined by the combination of two factors: (i) the trend in the cost of the intermediate inputs produced by the private sector relative to the cost of public value added and (ii) the elasticity of substitution between inputs in the production function of the government. If government value added and intermediate inputs are imperfect substitutes, a drop in the relative cost of intermediates implies that the government optimally switches its input choice from the increasingly expensive own production of value added to the cheaper intermediate goods. Consequently, the share of purchases from the private sector in total government consumption spending rises.

We show that the two main conditions needed in the model to generate the observed change in the structure of government spending hold in the data. First, the price of the government intermediate inputs produced by the private sector drops substantially when compared to the price of government value added. This is due to the asymmetric dynamics of private and public Total Factor Productivity (TFP): Whereas private TFP grows at an annual rate of almost 1%, the level of public TFP barely changes over time. Thus, there is a marked decline in the relative productivity of the public sector. Second, we estimate the elasticity of substitution between government value added and intermediate inputs for the United States, and find that these are imperfect substitutes. Given these conditions, our model generates a long-run rise in the share of purchases from the private sector in total government consumption spending through a typical structural change mechanism: the asymmetric behavior of TFP growth across sectors (Ngai and Pissarides, 2007).

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. We then 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. The differential growth of private and public productivity allows the model to account for the whole increase in government purchases of private-sector goods.

Since the calibrated economy reproduces the long-run pattern of the 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 uniquely in the exogenous level of value-added productivities. This distinction makes the two equilibria differ endogenously in the share of government purchases from the private sector, so that we can ask to what extent the size of this share relates to the change in the transmission mechanism of fiscal shocks.

The model accounts fairly well 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. Instead, the total hours multiplier drops from 0.50 to 0.15 across the two steady states. Thus, the model accounts for 57% of the estimated drop in the absolute size of the hours worked multiplier due to rising relevance of private-sector goods in government consumption.

What drives the disconnect in the response of hours and output to government spending in the model? We highlight the existence of a direct channel that goes through rising productivities: Although the productivity of the public sector is stagnant, the surge in the private-sector productivity raises the efficiency of the economy in 2019, which allows to produce output with less hours than in 1960. Thus, the required change of hours to produce the same amount of output is smaller in the second steady state. In addition, the drop in the employment response due to the direct channel is then amplified by the differences in the labor intensity across sectors, as the labor share of the private-sector value added is relatively smaller.

In order to disentangle the role of the direct channel from the amplification due to the differences in the labor intensity, we evaluate an alternative specification of the model, in which the productivities vary 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, so that the rising productivity alone explains just half of the overall decline in the effects of public spending on hours of the baseline economy. The remaining half of the drop in the responsiveness of hours is due to the way the changing structure of government spending interacts with the labor share differential across sectors. In order to corroborate this claim, we show that if the labor share is equalized across sectors, then the drop in the response of hours to public expenditures is entirely due to the rising productivities, whereas the changing structure of government spending has no additional amplification effect.

Our model also rationalizes the fact that the changing structure of government consumption emerges together with a shift in the transmission of fiscal policy across the private and public sectors, as well as with a change in the responsiveness of the labor share. First, we show that although the total value-added multiplier 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: The private-sector value-added multiplier raises from 0.07 to 0.20—and that of public value added declines from 0.76 to 0.62—between the 1960 and 2019 steady states. Importantly, the version of the model, which abstracts from the changing structure of government spending cannot rationalize this empirical finding. Second, the model entirely accounts for the absolute drop in the size of the labor share multiplier between 1960 and 2019.

1.1. *Related Literature.* This article adds to the literature on causes and business-cycle implications of the secular changes in the production structure of advanced economies.[1] 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), Moro (2015), Galesi and Rachedi (2019), Storesletten et al. (2019), and Yao and Zhu (2021) show that changes in the sectoral composition have first-order effects on business cycle fluctuations. We emphasize how the changes in the government gross-output production function shapes the propagation of government spending shocks. In a similar spirit to our investigation, Debortoli and Gomes (2015) study a downward trend in the share of public investment in total government spending, and associate it with a different primary source of long-run growth, the investment-specific technical change.

The literature on fiscal multipliers tends 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; Ramey, 2011; Woodford, 2011). 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).[2] We contribute to this literature by showing that the response of private economic activity to government spending is associated with the government intermediate inputs share. Finally, this article adds to the literature on the determinants of government spending multipliers,[3] 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[4] equals the nominal value of 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 $P_{M_g,t}M_{g,t}$[5]

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

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.[6] Moreover, the NIPAs posit that the

[1] 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.

[2] 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).

[3] For example, slack in the economy in Auerbach and Gorodnichenko (2012), the level of government debt in Ilzetzki et al. (2013), the age structure of the population in Basso and Rachedi (2021), and the sectoral composition of public purchases in Bouakez et al. (2021).

[4] 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 article, we focus solely on government consumption expenditure and abstract from government investment expenditure.

[5] 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.

[6] Although 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.

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.[7]

Then, the definition of the total GDP of the economy in the NIPAs sums the contribution of the 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 $P_{Y_p,t}Y_{p,t}$ 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,

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

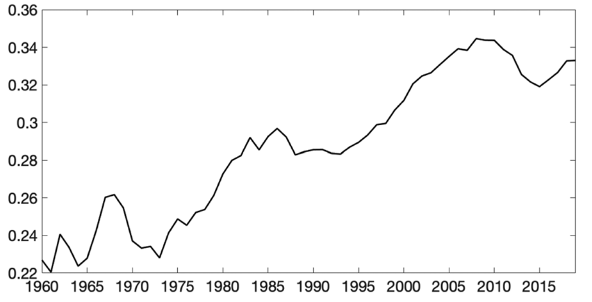
2.2. *The Government Intermediate Inputs Share.* In this article we document a novel stylized fact on government consumption spending, namely, that the relative size of its two components $P_{Y_g,t}Y_{g,t}$ and $P_{M_g,t}M_{g,t}$ changes dramatically over time in industrialized economies. In particular, 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 United States from 1960 to 2019, which rises from a value of 22.7% in 1960 up to 33.3% in 2019.[8] We refer to this new stylized fact as the changing structure of government consumption 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 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.

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.1 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.

[7] 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 nonwage 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.

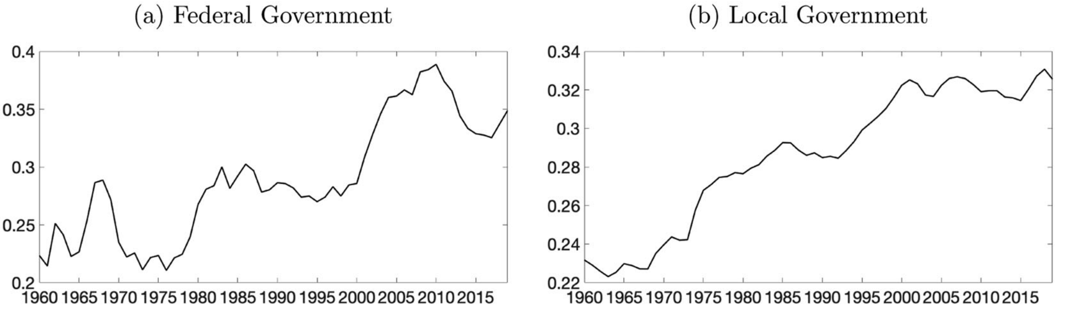
[8] Appendix A.4 reports the sources of the data series used in this section.




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

FIGURE 1

SHARE OF GOVERNMENT INTERMEDIATE INPUTS




NOTES: 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 are annual from 1960 until 2019.
SOURCE: Bureau of Economic Analysis.

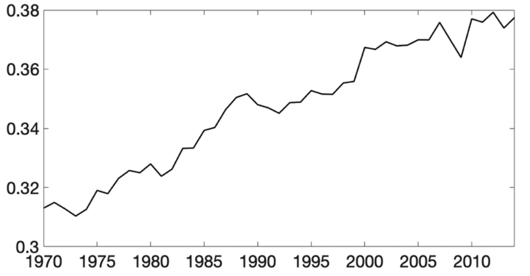
FIGURE 2

SHARE OF GOVERNMENT INTERMEDIATE INPUTS—DIFFERENT GOVERNMENT LEVELS

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.1 shows that even when we exclude either the finance and real estate sectors, or the professional and business services sectors, 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), Moro (2015), and Duarte and Restuccia (2020) have documented that the intermediate inputs shares in private gross output across sectors are roughly 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

[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).




NOTES: The graph plots the estimated coefficient of year fixed effects in a panel regression across 20 countries in which the government intermediate inputs share is regressed on country and year fixed effects.
SOURCE: World KLEMS Initiative.

FIGURE 3

THE GLOBAL RISE OF THE GOVERNMENT INTERMEDIATE INPUTS SHARE

production function were not accompanied by similar systematic dynamics in the private sector.

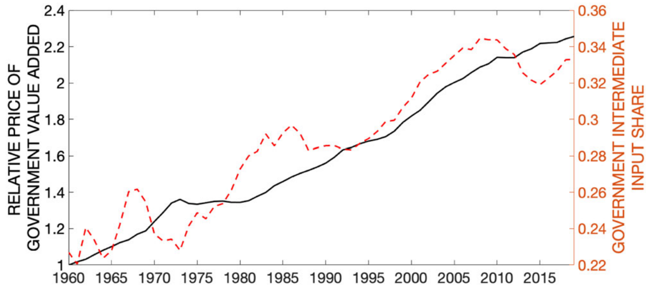
Importantly, the rise of the government intermediate inputs share does not characterize only the U.S. economy. Using data from the World KLEMS initiative on an unbalanced panel of 20 countries over the years 1970–2014, we uncover the global dimension of the changing structure of government spending.[10] In a similar vein as the analysis of Karabarnounis 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 as long as advanced economies are concerned: The average share has been rising from 31% to 38%.

2.3. *The Decline of the Public-Sector Productivity.* This section shows that the changing structure of government spending happens contemporaneously to two additional stylized facts: (i) the rise in the price of government value added relative to the price of private value added and (ii) the decline in the relative productivity of public-sector value added: Whereas the productivity of private-sector value added grows over time, that of the public sector barely changes.

Figure 4 reports the relative price of government value added together with the evolution of the share of private purchase in total government spending. The growing trend in the share is accompanied by an increasing trend in the relative price of government value added. Thus, from the perspective of the government, purchasing goods and services from the private sector becomes over time cheaper than producing its own value added.

What drives this growth in the relative price of government value added? As long-run trends in relative prices typically reflect differences in productivity, we report in Figure 5 the evolution of total factor productivity in private and public value added in the United States. Although data availability allows us to compare the two series only from 1987, the figure shows sustained growth for productivity of the private sector and stagnant growth for that of the public sector. The annual growth rate of private-sector productivity is 0.82%, whereas the annual growth rate of government productivity is 0.05%. For the latter, there is a similar evolution of productivity for both the federal government and the state and local governments. Thus, the differential evolution of productivity between the two sectors appears as the main determinant of the rise in the relative price of government value added.

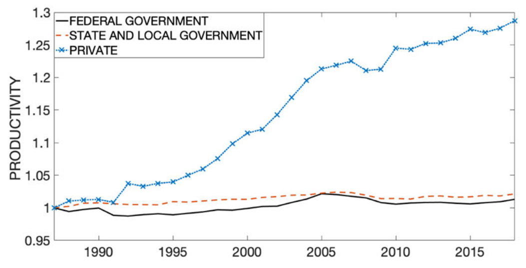
[10] The countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom, and United States.




NOTES: 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 are annual from 1960 until 2019.
SOURCE: Bureau of Economic Analysis.

FIGURE 4

THE RELATIVE PRICE OF THE PUBLIC-SECTOR VALUE ADDED




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

FIGURE 5

THE PRODUCTIVITY OF THE PRIVATE SECTOR AND THE GOVERNMENT

2.4. *Business Cycle Implications.* In this section we evaluate how the changing structure of government spending is associated to a change in the transmission of government spending shocks. Namely, we identify government spending shocks and study whether the fiscal multipliers associated with five variables of interest—total value added, private value added, government value added, hours worked, and the labor share—depend on whether total government spending is more intensive in either the purchase of private-sector goods or in the own production of government value added.

In order to perform this analysis, we follow Ramey and Zubairy (2018) and estimate the response of a set of key dependent variables to government spending shocks using a times-series of U.S. quarterly data from 1960 to 2015. More specifically, we use the Jordà's (2005) method to estimate the fiscal multiplier at any horizon $h$ by directly estimating the following regression using instrumental variables:

$$(4)\quad \sum_{j=0}^{h} Y_{t+j} = \gamma_h + \mathbf{Z}'_{t-1}\gamma + m_{1,h}\sum_{j=0}^{h} G_{t+j} + \cdots$$

$$+m_{2,h}\sum_{j=0}^{h} G_{t+j}\left(\frac{P_{t-1}M_{g,t-1}}{P_{G,t-1}G_{t-1}} - \frac{1}{T}\sum_{t=1}^{T}\frac{P_tM_{g,t}}{P_{G,t}G_t}\right) + \omega_{t+h} \quad \text{for } h = 0, 1, 2, \ldots,$$

where $Y_t$ is the dependent variable of interest, $\gamma_h$ is a constant term for each time-horizon period $h$, $\mathbf{Z}$ 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 it is 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.[12] Third, instead of 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.

In order to identify the government spending shocks, we follow Ramey and Zubairy (2018) and instrument $G_t$ with two variables: The first one is the Blanchard and Perotti (2002) shock, which relies on the assumption 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 (2011), 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, private-sector value added, government value added, total hours worked, and the labor share, as well as their interaction with the structure of government spending.[13][14] Column (1) reports the results for total value added, and shows that the one-year multiplier is 0.73, and does not depend on the structure of government spending. Indeed, the coefficient of 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 multiplier is 1.26, and in contrast with the result for total output, the coefficient associated to the interaction term is negative and highly statisti-

[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.

[12] The results are virtually the same in case we consider a four-quarter lag for the share of private-sector purchases in total government spending.

[13] In Appendix A.2 we also report a similar exercise for the two main private-sector components of total value added—consumption and investment—as well as for hourly wages.

[14] For further details on the series used in this exercise, we refer to Appendix A.4.

TABLE 1
ONE-YEAR CUMULATIVE RESPONSE OF OUTPUT TO GOVERNMENT SHOCKS

| Dependent Variable | Value Added (1) | Hours (2) | Government Value Added (3) | Private Value Added (4) | Labor Share (5) |
|---|---|---|---|---|---|
| $G_t$ | 0.733** | 1.264*** | 0.630** | 0.059 | 1.508*** |
| | (0.347) | (0.491) | (0.302) | (0.484) | (0.663) |
| $G_t \times (\frac{P_{t-1}M_{g,t-1}}{P_{G,t-1}G_{t-1}} - \frac{1}{T}\sum_{t=1}^{T}\frac{P_t M_{g,t}}{P_{G,t}G_t})$ | 0.153 | −0.058*** | −0.012** | 0.010** | −0.047*** |
| | (0.248) | (0.021) | (0.005) | (0.004) | (0.019) |
| Controls | Yes | Yes | Yes | Yes | Yes |
| *N*. observations | 224 | 224 | 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 $\epsilon_{i,t}^G$, 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, in Column (3) the dependent variable is real government value added, in Column (4) the dependent variable is real private-sector value added, and in Column (5) the dependent variable is the labor share, defined as the ratio between total employee compensation and total value added. Newey and West (1987) standard errors are reported in brackets. $*$, $**$, and $***$ indicate statistical significance at the 10%, 5%, and 1%, respectively.

cally significant: A one percentage point increase in the share of government intermediate inputs is associated with a drop in 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 can measure that in the United States the rising relevance of private-sector goods in government spending has been accompanied by a 40% reduction in the hours multiplier between 1960 and 2019, from to 1.61 to 1. If we translate this change into the employment outcomes of full-time workers, then the reduction in the hours multiplier implies that a one percentage point increase in government spending leads to a surge in the employment rate in 2019, which is 0.4 percentage points lower than in 1960.[15]

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 result points toward a disconnect in the response of output and hours to government spending. As government spending shifts toward the purchase of private-sector goods, fiscal policy maintains its effectiveness in stimulating total output, but triggers relatively smaller surges in employment. This novel prediction is especially relevant for policymakers, as job creation is typically considered one of the main goals of fiscal stimulus plans. Indeed, recent U.S. recoveries have not been associated with a contemporaneous increase in employment, a phenomenon labeled as "jobless recoveries" (Kolesnikova and Liu, 2011). Thus, our results suggest that fiscal policy might have become relatively less effective in stimulating employment when such stimulus was mostly needed.

Columns (3) and (4) display the multipliers for private and government value added and highlight two main findings. First, the high total value-added multiplier is entirely due to the high government value-added multiplier, as the estimate associated with private value added is not statistically different from zero. Second, although the total output fiscal multiplier does not change with the rising relevance of private-sector goods in total government spending, we uncover 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, Columns (3) and (4) show that the interaction term is positive and

[15] This calculation assumes that full-time workers supply 40 hours per week.

statistically significant for private value added, whereas it is negative and statistically significant for government value added.

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 are more likely to trigger a negative response of private economic activity at low levels of the government intermediate inputs share. The shift in the stimulus effects of government spending away from the public sector is relevant if we consider the fact that expansionary policies aim at reducing the slack in the private sector (Auerbach et al., 2020).

Finally, Column (5) reports the government spending multiplier of the aggregate labor share. As in Cantore and Freund (2021) we find a positive effect of fiscal shocks on the labor share. However, we find that this effect is dampened when the share of private-sector goods in total government spending is relatively higher, as the interaction term is negative and statistically significant. If we interpret again the relevance of our estimates in light of the U.S. experience, this result implies a 30% drop in the labor-share multiplier between 1960 and 2019, from 1.79 to 1.29.

Overall, we find that the changing structure of government spending is interlinked with a process of disconnect between the responses of output and hours worked to public expenditures shocks, as well as with a thorough shift in the way in which the additional dollars of output generated by a fiscal stimulus are split between the private and public sector, and between labor income and capital income. In the next section, we present a model, which can jointly rationalize the long-run trend in the structure of government spending and its short-run implications on the effectiveness of fiscal policy at the business cycle frequency.

## 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 nonunitary 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 that 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 GHH utility function as in Greenwood et al. (1988).

In the model, a decline in the relative productivity of the public sector drives the changing structure of government spending, which is then instrumental in shaping the transmission of fiscal policy at the business cycle frequency.

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

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

where $\beta$ is the time discount factor, $\sigma$ denotes the risk aversion, $\theta$ captures the disutility from working, and $\eta$ is the inverse of the Frisch elasticity. We consider a GHH utility because CRRA preferences generate counterfactually low fiscal multipliers in an environment that features physical capital, and the associated crowding-out of government spending on private investment.[16][17]

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

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

The household buys the consumption goods $C_t$ and the investment goods $I_t$ at the nominal price $P_t$, 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 $\Pi_t$. 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 $\delta$ is the depreciation rate and $\Omega$ captures investment adjustment costs.

The household provides labor and capital to both the private-sector firms ($p$) and the government ($g$), such that

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

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.

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 $\rho_g$ 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.[18]

[16] Bilbiie (2011) shows that the consumption-labor complementarities generated by GHH preferences can trigger a positive response of consumption to government spending when 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.

[17] Subsection A.3 of the Appendix studies the role of the changing structure of government spending on the fiscal multipliers in a version of the model, which features a standard CRRA utility function.

[18] The model is calibrated to the observed decline of the public-sector productivity between 1960 and 2019. Over this period of time, 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.

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[19]

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

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, $\omega_g$ is the weight of intermediate inputs in the government gross output, and $\nu_g$ 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 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

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

where $A_{g,t}$ denotes the exogenous level of productivity of the government value added, and $\alpha_g$ is the labor share of the public value-added technology. The production function (13) implies that the price of government value added is

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

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 into two levels: a continuum of monopolistically competitive producers indexed by $i \in [0, 1]$ and a final goods firm.

[19] 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.

Each monopolistically competitive firm $i$ produces the value-added variety $Y^i_{p,t}$ with a Cobb–Douglas production function

$$Y^i_{p,t} = A_{p,t}\, {N^i_{p,t}}^{\alpha_p}\, {K^i_{p,t}}^{1-\alpha_p}, \tag{16}$$

where $A_{p,t}$ denotes the exogenous level of productivity of the private-sector value added, $K^i_{p,t}$ and $N^i_{p,t}$ are the amounts of capital and labor hired by firm $i$. In equilibrium, the market clearing conditions imply that $\int_0^1 N^i_{p,t}\, di = N_{p,t}$ and $\int_0^1 K^i_{p,t}\, di = K_{p,t}$. Then, $\alpha_p$ is the labor share of the private-sector value added. Importantly, we allow the labor share in private value added $\alpha_p$ to differ from the labor share in government value added $\alpha_g$. In the calibration, we set these parameters to match the shares observed in Bureau of Economic Analysis (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 $\phi$ 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

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

where $\varphi_t$ 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 Good Private-Sector Firm.* The perfectly competitive final goods firm aggregates the different value-added varieties $Y^i_{p,t}$ produced by the continuum of monopolistically competitive firms using the CES function

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

where $\epsilon$ 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 of their nominal values 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, $\rho_r$ denotes the degree of interest rate inertia, $\phi_\pi$ and $\phi_y$ 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 decline of the public-sector value-added productivity with respect to the private-sector value-added productivity induces a switch of the government input choice toward the purchase of intermediate inputs.

Then, we derive the steady-state equilibrium government intermediate inputs share as a function of the level of the productivities of the public-sector value added, $A_g$, and the private-sector value added, $A_p$, as follows:

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

where $\Phi$ is a positive convolution of parameters, such that

$$\Phi = \left(\frac{\epsilon-1}{\epsilon}\right)^{\frac{\alpha_g}{\alpha_p}} \frac{\left[\alpha_p^{\alpha_p}(1-\alpha_p)^{(1-\alpha_p)}\right]^{\frac{\alpha_g}{\alpha_p}}}{\alpha_g^{\alpha_g}(1-\alpha_g)^{(1-\alpha_g)}} \left[\frac{\beta}{1-\beta(1-\delta)}\right]^{\frac{\alpha_g-\alpha_p}{\alpha_p}} > 0. \tag{22}$$

In Figure 5 we have documented that over the recent decades the productivity of the public sector has been relatively stagnant, whereas the annual growth rate of the private-sector value-added productivity has been around 0.82%. We now evaluate the implications of this stylized fact on the dynamics implied by our model for the structural change of the structure of government spending. To do so, we assume that the productivity of the public sector is constant over time, consistently with the empirical evidence, and we analyze how the steady-state equilibrium government intermediate inputs share changes with variations in the productivity of the private sector. Equation (23) defines the derivative of the government intermediate inputs share with respect to $A_p$:

$$\frac{\partial \frac{P_{ss}M_{g,ss}}{P_{G,ss}G_{ss}}}{\partial A_p} = (\nu_g-1)\frac{\alpha_g}{\alpha_p}\frac{\omega_g(1-\omega_g)\Phi A_g^{(\nu_g-1)} A_p^{\left[\frac{\alpha_g}{\alpha_p}(1-\nu_g)-1\right]}}{\left[\omega_g + (1-\omega_g)\Phi A_g^{(\nu_g-1)} A_p^{\frac{\alpha_g}{\alpha_p}(1-\nu_g)}\right]^2}. \tag{23}$$

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 positive 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 surge in the private-sector productivity when that of the public sector is stagnant—that is, a decline in the relative productivity of public-sector value added—leads to the changing structure of government spending toward a larger relevance of 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 relatively more productive.

TABLE 2
CALIBRATION

| Parameter | Value | Target/Source |
|---|---|---|
| Productivity government value added in 1960 | $A_{g,1960} = 1$ | Normalization |
| Productivity private-sector value added in 1960 | $A_{p,1960} = 1$ | Normalization |
| Productivity government value added in 2019 | $A_{g,2019} = 1.09$ | $Y_{2019}/Y_{1960} = 3.22$ |
| Productivity private-sector value added in 2019 | $A_{p,2019} = 2.20$ | $(P_{Y_g,2019}/P_{2019})/(P_{Y_g,1960}/P_{1960}) = 2.26$ |
| 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 | $\nu_g = 1.65$ | Data |
| Share inputs in govt. gross output | $\omega_g = 0.22$ | $M_{g,1960}/P_{G,1960}G_{1960}$ |
| 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 | $\rho_r = 0.8$ | Clarida et al. (2000) |
| Taylor parameter inflation | $\phi_\pi = 1.5$ | Clarida et al. (2000) |
| Taylor parameter output gap | $\phi_y = 0.2$ | Clarida et al. (2000) |

## 4. QUANTITATIVE ANALYSIS

4.1. *Calibration.* Subsection 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. In order 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. Throughout the calibration, we set one period of the model to equal a quarter, as it is standard in the literature on fiscal multipliers. We report all the calibrated parameters as well as their respective targets and sources in Table 2.

We calibrate the public-sector and private-sector productivities as follows. First, we set the values of the productivities for the 1960 steady state. Specifically, we normalize the level of both productivities in 1960 such that $A_{g,1960} = A_{p,1960} = 1$, as it is typically done in the quantitative analysis of structural change economies. Second, we set the values of the productivities for the 2019 steady state. In order to discipline the variation in the productivities over the two steady states, 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 GDP per capita is 3.2 times larger than that of 1960. Matching these two moments yields to the values of $A_{g,2019} = 1.09$ and $A_{p,2019} = 2.20$. 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 decline of the public-sector relative 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 Subsection 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 labor 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, instead of 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. In order 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.[20] Once we have the same definition of value added, we proceed in computing the average labor 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 $\alpha_p = 0.68$.[21]

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. We estimate the regression using annual U.S. data from 1960 to 2019, and find an elasticity of 1.67,

[20] 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.

[21] 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 nonmarket incentives (see Lippi and Schivardi, 2014). The scope of the article is not to microfound the differential in the labor share across public and private sectors, 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 $\alpha_p$ and $\alpha_g$. We study the implications of this differential in the labor shares across public and private sectors on the changing structure of government spending, assuming that this differential remains constant over time.

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 equal 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 higher than the estimates of microlabor supply elasticity, it is in line with the macroelasticity 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.[22] Accordingly, we set $\theta$ 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 one-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 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.

4.2. *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 nonstochastic steady state. Yet, the prediction of the model on how the decline 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 capability 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 share implied by the model in the nonstochastic steady state of 2019, in which 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 change 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. [23]

The long-run evolution in the share of purchases from the private sector in government consumption spending in the model is driven by a typical structural change mechanism (Ngai and Pissarides, 2007). The differential productivity growth between the private and the public sectors drives a wedge between the stagnant cost of public value added and the rapidly declining price of the intermediate goods purchased from the private sector. Consequently, the cost

[22] 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.

[23] This perfect match is not inherited by the fact that we estimate the elasticity of substitution of the government gross-output technology over the same time period of interest over which we study the changes in the structure of government spending. For instance, if we calibrate the economy to the U.S. data as of the end of 2020, the model prediction on the government intermediate inputs share in 2020 falls short by 0.4 percentage points with respect to the data. However, we opt to calibrate the model to the data up to 2019 to rule out any consideration of the way in which the Covid crisis may have impacted government spending.

TABLE 3
RESULTS ON THE CHANGING STRUCTURE OF GOVERNMENT SPENDING

| | 1960 | | 2019 | |
|---|---|---|---|---|
| Variables | Model | Data | Model | Data |
| Panel A: $\nu_g = 1.65$ | | | | |
| 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: $\nu_g = 1.45$ | | | | |
| 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: $\nu_g = 1.85$ | | | | |
| 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% |

NOTE: 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 $\nu_g = 1.65$. Panel B considers the case of a lower elasticity such that $\nu_g = 1.45$. Panel C considers the case of a higher elasticity such that $\nu_g = 1.85$.

of public value added relative to that of the private-sector goods substantially rises. Specifically, the calibration of the productivities implies a surge in the relative price of public value added from a value of 1 in the 1960 steady state to a value of 2.26 in the 2019 steady state, that is, a 1.3% annual increase.

As the public-sector production function features a degree of imperfect substitutability between the purchase of goods and services from the private sector and the in-house production of value added, the rising cost of public value added leads the government to optimally react by purchasing relatively more private-sector intermediate inputs. Basically, the government manages to contain the productivity decline—and the rising cost—of its own value added by increasing the share of private-sector goods 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 67% 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.

### 4.3. *Fiscal Multipliers.*

4.3.1. *Empirical strategy.* 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 Subsection 2.4, we have shown that the response of hours, government value added, and the labor share to government spending shocks declines when government spending is more tilted toward the purchase of private-sector goods, whereas the response of total value added is independent of the structure of government spending. In general, multisector models with a changing production structure do not follow a balanced growth path.[24] This feature characterizes also our model. Thus, to uncover whether our theory can account for this empirical evidence, we compare the fiscal multipliers implied by our economy around the 1960 and 2019 steady states, which differ only in the level of public-sector and private-sector value-added productivities, $A_g$ and $A_p$. This unique exogenous difference implies a different endogenous structure of government consumption spending. Thus, as we keep fixed all the other parameters, we can ask to what extent the variation in the structure of government consumption spending in the model is associated to a change in the transmission of government spending shocks.[25] This analysis will allow us to study whether our model can rationalize the empirical evidence on the association between the process of structural transformation of government spending and the change in the transmission of fiscal policy. In our theory, these two phenomena are jointly linked, as they both are endogenous equilibrium outcomes generated by the asymmetric changes in value-added productivities of the private and public sectors.

Before studying the fiscal multipliers generated by the model, let us discuss the implications of our theory on the cyclicality of the share of government intermediate inputs. First, our 1960 economy generates a correlation of 0.85 between the cyclical components of government intermediate input share and total government spending, close to the value of 0.79 observed in the data. Second, the correlation between the cyclical components of the government intermediate input share and GDP is 0.66, sightly lower than the 0.82 of the data.[26]

4.3.2. *The disconnect between the output and the hours multipliers.* We start by reporting in Panel A of Table 4 the one-year cumulative fiscal multipliers associated with total value added and hours. Columns (1) and (2) show the multipliers implied by the empirical estimates derived in Subsection 2.4, whereas Columns (3) and (4) show the 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. 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.[27]

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. If we compare the model predictions with our empirical results, we find that the decline implied by the model explains 57% of the absolute drop in the size of the hours multiplier estimated in the data.

What drives the disconnect in the response of hours and output to government spending in the model? We first highlight the existence of a *direct channel* that goes through the rising productivities: Although the public-sector productivity barely rises over time, the sharp increase in the private-sector value-added productivity makes the 2019 steady state substantially more efficient than the 1960 steady state. Consequently, the higher productivity of the economy reduces the required amount of hours to increase output by one unit. In addition, we find that the drop in responsiveness of hours implied by the direct channel is further amplified by the way in which the changing structure of government spending interacts with the differential in

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

[25] 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.

[26] The correlations generated by our model barely change between the two steady states. In a version of the model, which features TFP shocks, the correlation of the government intermediate input share with GDP becomes even closer to the value observed in the data, as it equals 0.87.

[27] Subsection A.3 of the Appendix reports robustness checks on the fiscal multipliers in alternative versions of the model with a CRRA utility function.

TABLE 4
ONE-YEAR CUMULATIVE FISCAL MULTIPLIERS

| | Data | | Benchmark Economy | | Fixed Structure Government Spending | | No Labor Share Differences | | No Labor Share Differences & Fixed Structure Government Spending | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Implied 1960 (1) | Implied 2019 (2) | Model 1960 (3) | Model 2019 (4) | Model 1960 (5) | Model 2019 (6) | Model 1960 (7) | Model 2019 (8) | Model 1960 (9) | Model 2019 (10) |
| Panel A: Total output and total hours | | | | | | | | | | |
| $Y_t$ | 0.73 | 0.73 | 0.83 | 0.82 | 0.83 | 0.83 | 0.72 | 0.72 | 0.72 | 0.72 |
| $N_t$ | 1.61 | 1 | 0.50 | 0.15 | 0.50 | 0.31 | 0.33 | 0.14 | 0.33 | 0.14 |
| Panel B: Private output, public output, and the labor share | | | | | | | | | | |
| $Q_t Y_{g,t}$ | 0.68 | 0.55 | 0.76 | 0.62 | 0.76 | 0.76 | 0.75 | 0.60 | 0.75 | 0.75 |
| $Y_{p,t}$ | 0.05 | 0.18 | 0.07 | 0.20 | 0.07 | 0.07 | −0.04 | 0.13 | −0.04 | −0.04 |
| $W_t N_t / Y_t$ | 1.79 | 1.29 | 0.74 | 0.23 | 0.74 | 0.46 | 0.85 | 0.32 | 0.85 | 0.32 |
| Panel C: Prices | | | | | | | | | | |
| $Q_t$ | – | – | 0.79 | 1.13 | 0.79 | 0.88 | – | – | – | – |
| $W_t$ | – | – | 1.12 | 1.01 | 1.12 | 1.10 | 1.03 | 1.00 | 1.03 | 1.00 |
| $R_{k,t}$ | – | – | 0.07 | 0.02 | 0.07 | 0.04 | 0.05 | 0.04 | 0.05 | 0.04 |
| Panel D: Additional variables | | | | | | | | | | |
| $C_t$ | – | – | 0.23 | 0.22 | 0.23 | 0.23 | 0.12 | 0.12 | 0.12 | 0.12 |
| $I_t$ | – | – | −0.40 | −0.40 | −0.40 | −0.40 | −0.40 | −0.40 | −0.40 | −0.40 |
| $N_{p,t}$ | – | – | 0.14 | 0.06 | 0.14 | 0.08 | 0.05 | 0.03 | 0.05 | 0.03 |
| $N_{g,t}$ | – | – | 0.36 | 0.10 | 0.36 | 0.23 | 0.28 | 0.11 | 0.28 | 0.11 |

NOTE: The table reports the one-year cumulative fiscal multipliers implied by the empirical estimates of Table 1, as well as those derived by the "Benchmark Economy," the "Fixed Structure Government Spending" in which there is no change in the structure of government spending (with a Cobb–Douglas production function for government value added, such that $\nu_g = 1$, 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 "No Labor Share Differences & Fixed Structure Government Spending," 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.

labor intensity across the private and public sectors, amplifying the dampening in the response of hours to a spending shock.

In order to disentangle the contribution of these two mechanisms, we proceed in two steps. First, this subsection isolates quantitatively the relevance of these two channels by looking at the implications of counterfactual versions of the model economy. Second, the next subsection uses the log-linearized expression for total output to highlight how the differences in labor intensity across sectors lead to an amplification of the drop in the responsiveness of hours worked.

As far as the counterfactual exercises are concerned, we study the transmission of government spending shocks in an alternative specification in which both the public-sector and private-sector productivities change over time as in the baseline economy, but we abstract from the changing structure of government spending, by keeping the share of government intermediate inputs fixed over time. This case, which we refer to as the "Fixed Structure Government Spending" economy, is implemented by positing that the government gross-output production function in Equation (10) is a Cobb–Douglas, that is, $\nu_g = 1$. Under this condition, the analytical results of Equation (23) imply that the structure of government spending is independent from changes in the relative productivity of the public sector.

The results in Columns (5) and (6) of Table 4 show that when there is no change in the structure of government spending, the rise in the productivities leads also to a drop in the response of employment to a government spending shock from 0.50 in 1960 to 0.31 in 2019. However, the variation in the hours multiplier implied by "Fixed Structure Government Spending" economy accounts for only half of the overall drop generated by the baseline economy. The remaining half of the drop in the responsiveness of hours is due to the amplification generated by the way in which the changing structure of government spending interacts with the labor share differentials across sectors.

In order to corroborate the relevance of the changing structure of government spending on the decline in the response of hours through its interaction with the asymmetric labor share across the public and private sectors, we consider two further model versions: the "No Labor Share Differences," which is a variant of the baseline model with the only difference that there the labor share is equalized across the public and private sectors to $\alpha_g = \alpha_p = 0.695$, such that the aggregate labor share is consistent with that of the baseline economy; and the "No Labor Share Differences & Fixed Structure Government Spending," which features no difference in the labor share across sectors and no change in the share of government intermediate inputs in gross output. When we abstract from the labor share differentials, we still observe a drop in the hours multiplier over the two steady states, but this decline is entirely due to the rising productivities channel, as shown in Columns (7) and (8). Indeed, Columns (9) and (10) show that the model version, which also abstracts from the changing structure of government spending, generates exactly the same decline in the responsiveness of hours featured in the "No Labor Share Differences" economy. Thus, the variation in the composition of government spending alters the response of hours to public expenditure shocks as long as the private sector and the public sector differ in their value-added labor shares.

4.3.3. *The role of the labor share differences.* How does the differential in labor intensities between the private and public value added amplify the drop in the responsiveness of hours? We address this question by studying the relationship between the log-deviations from the steady state of total output and hours. In our model, total output equals the sum of private and public value added, that is, $Y_t = Y_{p,t} + Q_t Y_{g,t}$, where $Q_t$ denotes the relative price of the public-sector value added in terms of the price of the private-sector value added, which equals

$$Q_t = \left[ \frac{\epsilon - 1}{\epsilon} \frac{A_g}{A_p} \frac{\alpha_p^{\alpha_p} (1 - \alpha_p)^{1-\alpha_p}}{\alpha_g^{\alpha_g} (1 - \alpha_g)^{1-\alpha_g}} \right] \left( \frac{W_t}{R_{K,t}} \right)^{\alpha_g - \alpha_p}. \tag{24}$$

If we take the first-order approximation of total output, $Y_t$, around the steady state, and assume that (i) capital is predetermined and (ii) the deviations in hours are symmetric across the private and public sector, we then have the following relationship that links the changes in total output to a weighted sum of the variation in total hours and the variation in the relative price:

$$\tilde{Y}_t = [\zeta \alpha_p + (1-\zeta)\alpha_g]\tilde{N}_t + (1-\zeta)\tilde{Q}_t, \quad (25)$$

where $\tilde{X}_t$ denotes the log-deviations from steady state of variable $X$, and $\zeta \equiv \frac{Y_p}{Y}$ is the steady-state share of private value added in total value added.

If the labor share is equalized across sectors (i.e., $\alpha_g = \alpha_p = \alpha$), and thus the prices of the public-sector and private-sector value added coincide at any given point of time (i.e., $\tilde{Q} = 0$), then Equation (25) simplifies to $\tilde{Y}_t = \alpha \tilde{N}_t$. In this setting, the constancy of the response of total output across steady states implies that a reduction in the labor share of the economy should come with a surge in the responsiveness of hours to fiscal shocks.

However, as long as the labor intensity differs across sectors, the response of hours depends also on the public-sector relative price. In particular, the real value of total output increases with the relative price.[28] Consequently, changes in the relative price alter the required amount of hours associated to any given value of total output. Following this logic, the disconnect between a constant total output multiplier and a declining sensitivity of total hours to government spending exists if fiscal shocks raise relatively more the public-sector relative price in the 2019 economy than in the 1960 one. This is indeed what happens in our model: Panel C of Table 4 shows that the public-sector relative-price multiplier increases substantially between the two steady states.

What drives this surge in the responsiveness of the relative price? The direct channel of rising productivities implies an asymmetric reaction of the marginal products of labor and capital to fiscal shocks: Since capital barely changes with government spending, the drop in the responsiveness of hours to fiscal shocks leads to a larger capital-to-labor ratio in 2019 than in 1960, thus exerting an upward pressure on wages and reducing the sensitivity of the return to capital. In this way, moving from the 1960 to the 2019 economy reduces proportionately more the return-to-capital multiplier than the wage multiplier. According to Equation (24), these changes allow government spending to raise more the public-sector relative price in the 2019 steady state than in the 1960 one.

Thus, the differentials in the labor intensity across sectors activate a relationship through which an asymmetric dampening of the responses of wages and the return to capital to government spending amplifies the drop in the hours multiplier.

4.3.4. *Further analysis on the transmission of government spending.* Panel B of Table 4 reports the one-year cumulative fiscal multipliers associated with public value added, private value added, and the labor share both in the data and in the different versions of the model. First, we find that the "Benchmark Economy" can rationalize the empirical evidence on the association between the changing structure of government spending and the variation in the transmission of fiscal policy across public and private value added. In the model the constancy of the total output fiscal multiplier hides, offsetting changes in the multipliers of the private and public sectors: Columns (3) and (4) show that moving from the 1960 economy to the 2019 economy leads to a drop in the public value-added fiscal multiplier from 0.76 to 0.62, whereas the private value-added fiscal multiplier rises from 0.07 to 0.20. It is important to stress that the model versions that abstract from the changing structure of government spending cannot

[28] In a multisector model, the amount of output of good $i$ in units of the numeraire good is given by the price of good $i$ relative to the numeraire multiplied by the physical output of good $i$. Thus, even if the latter is unchanged, a surge in the relative price of good $i$ increases the total output of the economy measured in terms of the numeraire good.

account for this modification in the transmission of fiscal policy between public and private sectors. Second, the model also accounts for the estimated reduction in the responsiveness of the labor share: Although the labor-share multiplier is positive in both steady states—in line with the evidence documented by Cantore and Freund (2021)—we find a substantial drop in the response of the labor share, from 0.74 to 0.23. Thus, our theory can account for the relationship between the changing structure of government spending and the shift in propagation of government spending shocks across labor and capital income.

Panel D of Table 4 reports the model implications on an additional set of key variables: consumption, investment, as well as private and public hours. We find that the constancy of the output multiplier is also mirrored by a lack of change in its two main components: consumption and investment. The lack of an association between the changing structure of government spending on the size of the consumption and investment multipliers is consistent with the empirical evidence in Appendix A.2. Then, we show that the drop in the hours multiplier is due to a reduction in the responsiveness of hours worked both in the private and public sectors. Although the public-sector hours multiplier drops substantially, from 0.36 to 0.10, also the private-sector hours multiplier experiences a decline, from 0.14 to 0.06.

All in all, the fact that these implications are in line with what are observed in the data lends further credence to our model as an ideal laboratory to study how the changes in the structure of government spending are associated with shifts in the transmission of fiscal policy at the business cycle frequency.

## 5. CONCLUDING REMARKS

This article documents that the structure of government spending in advanced economies changes continuously over time—such that the government purchases relatively more goods from the private sector, and relies less on the in-house production of value added—and shows how this process is interlinked with a modification in the transmission mechanism of fiscal policy.

On the one hand, we show that over time the fiscal stimulus affects more private economic activity, suggesting that fiscal policy might become more effective in reducing the economic slack of the private sector. On the other hand, we uncover how the rise in the government intermediate input share leads to a disconnect in the response of hours and output to fiscal policy. This disconnect implies that nowadays a 1% surge in government spending implies a rise in the employment rate that is 0.4 percentage points lower than it would have been in 1960.

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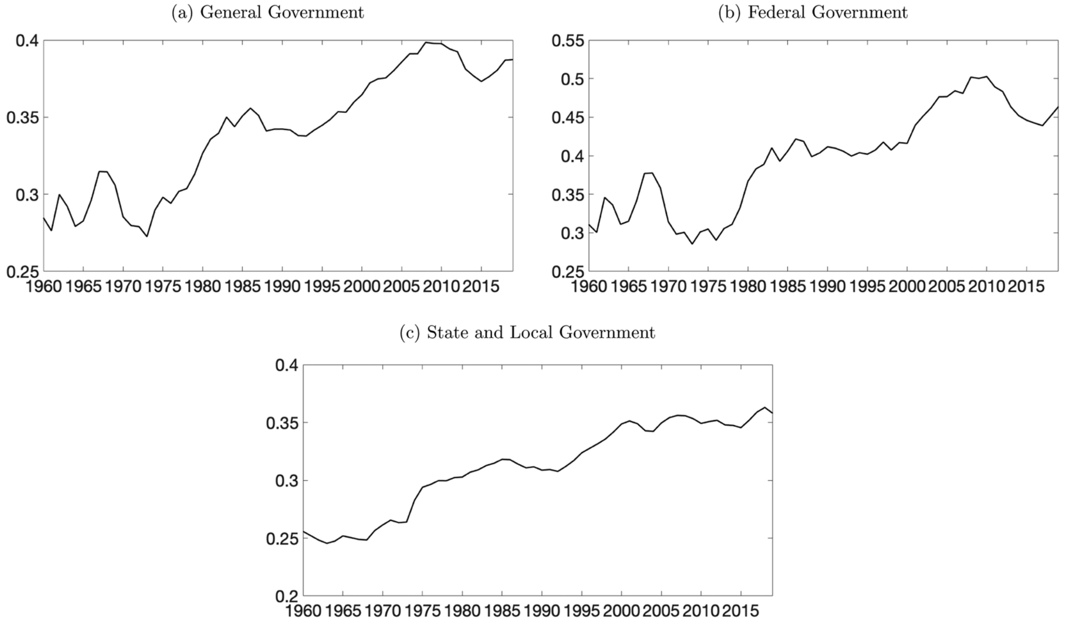
## APPENDIX A

A.1 *Further Evidence on the Rise of the Government Intermediate Input Share.* In order 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. As mentioned in Subsection 2.1, 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. More specifically, the services produced by the government sector are shown as if they were purchased by the public sector itself. Then, when deriving public value added, the NIPA sums the compensation paid to public employees to the consumption of government-owned fixed capital, that is, the




NOTES: 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 are annual from 1960 until 2019.
SOURCE: Bureau of Economic Analysis.

FIGURE A.1

SHARE OF GOVERNMENT INTERMEDIATE INPUTS—EXCLUDING CAPITAL DEPRECIATION

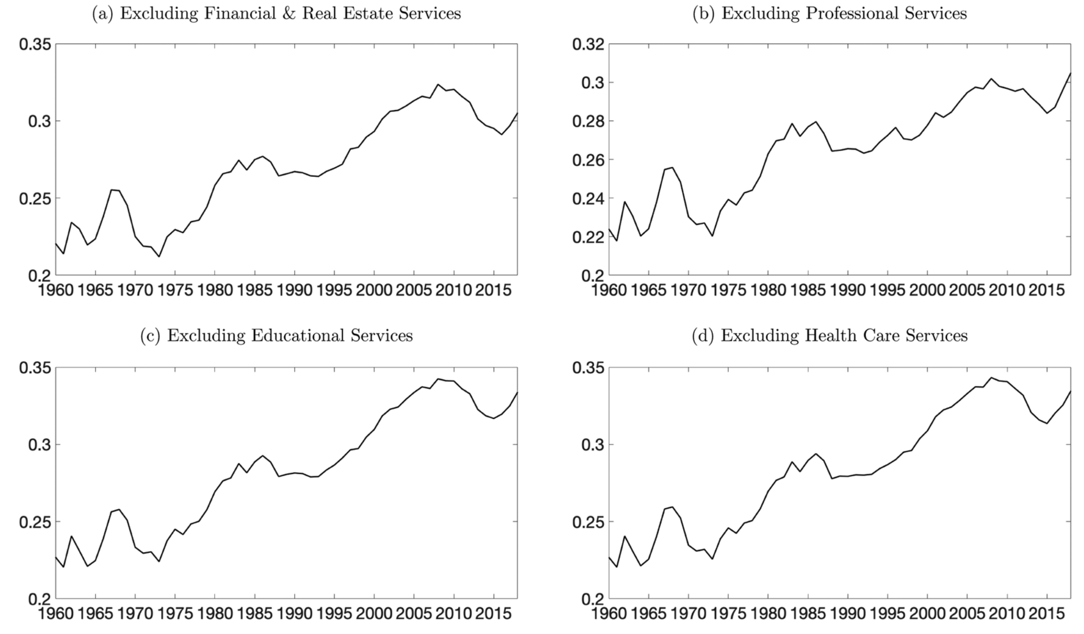
depreciation of government-owned capital.[29] Figure A.1 then reports the share of government intermediate inputs computed by excluding capital depreciation for the general government, federal government, and the state and local government. The graphs show that excluding capital depreciation barely alters our findings on the changing structure of government spending.

In the second robustness exercise, 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 sectors, or the professional and business services sectors, or the educational services sector, or the health care services sector, the government intermediate inputs share always displays an upward trend. Again, we find that our novel stylized fact on the changing structure of government spending holds in these alternative settings.

A.2 *Further Evidence on the Fiscal Multipliers.* In Subsection 2.4, we have documented how the size of the government spending multipliers of total value added, government value added, private value added, hours worked, and the labor share correlates with the changing structure of government spending. In this section, we provide further evidence by evaluating the multipliers of consumption, investment, and the hourly real wage. Also in this case, we follow the same identification strategy of Ramey and Zubairy (2018), and estimate the one-year multipliers using Jordà's (2005) local projection methods.

Table A.1 reports the results of this exercise. First, we find that neither the level of the consumption spending multiplier nor its interaction with the share of government intermediate

[29] As reported in BEA Accounts Description, "CFC, or depreciation, measures the decline in the value of the stock of fixed assets due to wear and tear, obsolescence, aging, and accidental damage; however, it does not include losses caused by a natural disaster or war losses of military equipment. CFC for general government provides a partial measure of the services derived from government capital investment – that is, of the value added (measured as the




NOTES: 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 are annual from 1960 until 2018.
SOURCE: Bureau of Economic Analysis.

FIGURE A.2

SHARE OF GOVERNMENT INTERMEDIATE INPUTS—EXCLUDING SPECIFIC SECTORS

TABLE A.1
RESPONSE OF OUTPUT TO GOVERNMENT SHOCKS—FURTHER EVIDENCE

| Dependent | Consumption (1) | Investment (2) | Wage All Workers (3) | Wage Production Nonsupervisory Workers (3) |
|---|---|---|---|---|
| $G_t$ | −0.128 | −0.490** | 0.636 | 0.658 |
| | (0.099) | (0.237) | (0.514) | (0.510) |
| $G_t \times \left(\frac{P_{t-1}M_{g,t-1}}{P_{G,t-1}G_{t-1}} - \frac{1}{T}\sum_{t=1}^{T}\frac{P_t M_{g,t}}{P_{G,t}G_t}\right)$ | 0.084 | −0.012 | −0.135 | −0.139* |
| | (0.127) | (0.094) | (0.073) | (0.070) |
| Controls | Yes | Yes | Yes | Yes |
| *N*. observations | 224 | 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 consumption, in Column (2) the dependent variable is real investment, in Column (3) the dependent variable is the real wage for all workers, and in Column (4) the dependent variable is the real wage for production and nonsupervisory workers. Newey–West (1987) standard errors are reported in brackets. $*$, $**$, and $***$ indicate statistical significance at the 10%, 5%, and 1%, respectively.

inputs is statistically different from zero. The result on the level is consistent with a large body of the fiscal policy literature, which finds that consumption responds weakly to government spending shocks. As far as the role of the interaction term is concerned, the lack of a sta-

expense incurred) as a result of using government capital goods in the production of services. (CFC is only a partial measure because the rate of return on government assets is assumed to be zero.)"

TABLE A.2
ONE-YEAR CUMULATIVE FISCAL MULTIPLIERS—ROBUSTNESS

| | Data | | Benchmark Economy | | CRRA Utility Economy | |
|---|---|---|---|---|---|---|
| | Implied 1960 (1) | Implied 2019 (2) | Model 1960 (3) | Model 2019 (4) | Model 1960 (5) | Model 2019 (6) |
| $Y_t$ | 0.73 | 0.73 | 0.83 | 0.82 | 0.51 | 0.52 |
| $N_t$ | 1.61 | 1 | 0.50 | 0.15 | 0.39 | 0.10 |
| $Q_t Y_{g,t}$ | 0.68 | 0.55 | 0.76 | 0.62 | 0.77 | 0.66 |
| $Y_{p,t}$ | 0.05 | 0.18 | 0.07 | 0.20 | −0.26 | −0.14 |
| $W_t N_t / Y_t$ | 1.79 | 1.29 | 0.74 | 0.23 | 0.27 | 0.08 |

NOTE: The table reports the one-year cumulative fiscal multipliers implied by the empirical estimates of Table 1, as well as those derived by of the “Benchmark Economy” and the “CRRA Utility Economy,” in which the utility of the households is a CRRA function and not anymore a GHH function. “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.

tistically significant relationship of the consumption multiplier with the changing structure of government spending is consistent with the implications of our model, as we show in Subsection 4.2.

Second, we find that the investment multiplier is negative and statistically significant, and it equals −0.49. However, as for consumption, we find that the interaction with the changing structure of government spending is not statistically significant.

Third, we report the real wage multiplier in two different cases: one in which we consider the hourly wage of all employees, in Column (3), and one in which we consider the hourly wage of production and nonsupervisory employees, in Column (4). In both cases, although we find a positive value for the average wage multiplier, the estimate is not statistically different from zero. Again, this result is also consistent with the large error bands associated with the response of wages to government spending shocks, which has also spurred a debate on whether fiscal policy affects either positively or negatively the wage rate (Perotti, 2007; Ramey, 2011, 2012). As far as the interaction term is concerned, we find a positive estimate, which is only statistically significant at the 10% for the multiplier associated with the hourly wage of production and nonsupervisory employees. Instead, the $p$-value of the estimate of the multiplier associated to the hourly wage of all workers is around 13%, close to the 10% threshold. Although we do not find a conclusive evidence that the wage multiplier does shrink with the changing structure of government spending, this result is qualitatively consistent with the implication of the model on the drop of the wage response to government spending shocks as the government intermediate input share increases.

A.3 *Fiscal Multipliers in the Model: The Case of CRRA Preferences.* The model incorporates one important feature, which is 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. 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 GHH utility, and rather consider the standard CRRA preference.

Table A.2 compares the fiscal multipliers associated with “Benchmark Economy” with those of the “CRRA Utility Economy,” that is an alternative economy in which the utility function is defined as follows:

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

Importantly, the parameterization of the "CRRA Utility Economy" follows exactly that of the "Benchmark Economy": $\beta = 0.99$, $\sigma = 2$, $\eta = 0.5$, and $\theta$ is calibrated to match a steady-state value for labor of 0.33.

The dynamics of the fiscal multipliers across the 1960 and the 2019 steady states of the two economies are remarkably similar. The only difference relies on the fact that without the consumption-labor complementarity of the GHH preferences, the model with a CRRA utility leads to a much lower level in the total output fiscal multiplier due to the negative response of consumption. This is in line with the results of Bilbiie (2011), which shows that GHH preferences can rationalize a positive consumption fiscal multiplier as long as prices are sticky.

Overall, this analysis highlights 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, government value added, and the labor share, independently of the specification of the utility function. Thus, although the GHH preference is required to have quantitative implications on the size of output fiscal multipliers, which are in line of the empirical evidence, its presence does not alter our main findings on the relationship between the changing structure of government consumption spending and the transmission of fiscal policy.

A.4 *Data.* This section provides a list of all the data sources used throughout the article.

Gross output of general government: BEA NIPA table 3.10.5, Gross output of general government, Line 1, 1960–2019, Annual.

Gross output of federal government: BEA NIPA table 3.10.5, Gross output of federal government, Line 13, 1960–2019, Annual.

Gross output of state and local government: BEA NIPA table 3.10.5, Gross output of state and local government, Line 48, 1960–2019, Annual.

Intermediate inputs of general government: BEA NIPA table 3.10.5, Intermediate goods and services purchased, Line 6, 1960–2019, Annual.

Intermediate inputs of federal government: BEA NIPA table 3.10.5, Intermediate goods and services purchased, Line 17, 1960–2019, Annual.

Intermediate Inputs of state and local government: BEA NIPA table 3.10.5, Intermediate goods and services purchased, Line 52, 1960–2019, Annual.

Capital depreciation of general government: BEA NIPA table 3.10.5, Consumption of fixed capital, Line 5, 1960-2019, Annual.

Capital depreciation of federal government: BEA NIPA table 3.10.5, Consumption of fixed capital, Line 16, 1960–2019, Annual.

Capital depreciation of state and local government: BEA NIPA table 3.10.5, Consumption of fixed capital, Line 51, 1960–2019, Annual.

Government value-added deflator: BEA NIPA table 3.10.4, Price index for general government value added, 1960–2019, Annual.

Private-sector value-added deflator: BEA NIPA table 1.3.4, Price index for gross value added of nonfarm business, Line 3, 1960–2019, Annual.

Federal government productivity: Integrated Multifactor Productivity, Federal Government, BEA/BLS integrated industry-level production account for the United States, 1987–2018, Annual.

State and local government productivity: Integrated Multifactor Productivity, State and Local Government, BEA/BLS integrated industry-level production account for the United States, 1987–2018, Annual.

Private-sector productivity: Integrated Multifactor Productivity, Private Non-Farm Business Sector, BEA/BLS integrated industry-level production account for the United States, 1987–2018, Annual.

Government employment: BEA NIPA table 6.4, Full-Time and Part-Time Employees of Government, Line 75, 1960–2019, Annual.

Total employment: BEA NIPA table 6.4, Full-Time and Part-Time Employees of Domestic Industries, Line 2, 1960–2019, Annual.

Government spending: BEA NIPA table 3.10.3, Real gross output of general government (quantity index), Line 2, 1960–2015, Quarterly.

Total value added: BEA NIPA table 1.1.3, Real gross domestic product (quantity index), Line 1, 1960–2015, Quarterly.

Private-sector value added: BEA NIPA table 1.3.3, Real gross domestic product of nonfarm business (quantity index), Line 1, 1960–2015, Quarterly.

Government value added: BEA NIPA table 3.10.3, Real value added of general government (quantity index), Line 3, 1960–2015, Quarterly.

Ramey News: Ramey and Zubairy (2018), 1960–2015, Quarterly.

Hours worked: BLS, Average weekly hours of all employees, 1960–2015, Quarterly.

Labor share: Ratio of (i) BEA NIPA table 1.10, Compensation of employees, paid to persons, Line 4, 1960–2015, Quarterly, to (ii) BEA NIPA table 1.10, Gross domestic income, Line 1, 1960–2015, Quarterly.

Consumption: BEA NIPA table 1.1.3, Real personal consumption expenditures in nondurable goods (quantity index), Line 5, 1960–2015, Quarterly.

Investment: BEA NIPA table 1.1.3, Real gross private domestic nonresidential investment (quantity index), Line 9, 1960–2015, Quarterly.

Wage—All workers: BLS, Average hourly earning of all employees, 1960–2015, Quarterly.

Wage—Production and nonsupervisory workers: BLS, Average hourly earning of production and nonsupervisory employees,1960–2015, Quarterly.

Tax revenues: BEA NIPA table 3.1, Current tax receipts, Line 2, 1960–2015, Quarterly.

Total transfers: BEA NIPA table 3.1, Current transfer payments, Line 22, 1960–2015, Quarterly.

Government debt: Flow of Funds, Federal Government and State and Local Government, Debt Securities and Loans, Liability, 1960–2015, Quarterly.

Households' debt: Flow of Funds, Households and Nonprofit Organizations, Debt Securities and Loans, Liability, 1960–2015, Quarterly.

Unemployment rate: BLS, Unemployment Rate, 1960–2015, Quarterly.

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