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State dependence of fiscal multipliers: the source of fluctuations matters[☆]

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We develop a general theory of state-dependent fiscal multipliers in a framework featuring two empirically relevant frictions: idle capacity and unsatisfied demand. Our key novel finding is that the *source of fluctuations* determines the cyclicality of multipliers. Policies that stimulate demand, such as government spending, have multipliers that are large in demand-driven recessions, but small and possibly negative in supply-driven downturns. Conversely, policies that boost supply, such as cuts in payroll taxes, are ineffective in demand-driven recessions, but powerful if the downturn is supply-driven. Austerity, implemented by a reduction in government consumption, can be the policy with the largest multiplier in supply-side recessions and demand-driven booms, provided elasticities of labor demand and supply are sufficiently low. We obtain model-free empirical support for our predictions by developing a novel econometric specification that allows to estimate spending and tax multipliers in recessions and expansions, *conditional* on those being either demand- or supply-driven.

1. Introduction

A long tradition in economics, starting with the general theory of Keynes (1936), envisages the possibility that the effect of fiscal policy on output is different in times of economic contractions and expansions. This notion of *state dependence* of fiscal multipliers has received renewed attention in recent years, when nominal interest rates reached the effective lower bound in a number of advanced economies, granting fiscal policy a chief stabilizing role. Despite the long history and recent revival, there is still no comprehensive theoretical framework to study the sources, magnitudes and policy implications stemming from state dependence of different fiscal instruments. Our study aims to fill this gap in the literature, and develops a general analytic theory of state-dependent fiscal multipliers for a broad range of spending and taxation policies. A key novel prediction of our theory is that fiscal multipliers' variation over the business cycle is pinned down by the *source of economic fluctuations*, a result that we prove in closed-form. Further, we perform model-free econometric assessment of our novel theoretical predictions and find strong empirical support in US data.

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Our theoretical framework accounts for empirically relevant frictions in the goods market, which manifest themselves in idle productive capacity on the firms' side and unsatisfied demand on the side of households. We track congestion in the goods market by looking at the ratio of households' shopping visits to firms' productive capacity; intuitively, whenever the goods market is congested, there is little idle capacity and large amount of unsatisfied demand, and *vice versa*. In our model, the effectiveness of fiscal policy is pinned down by the degree of goods market congestion. Demand-side stimuli that raise the number of visits are ineffective whenever congestion is already high, as they strongly crowd out private consumption. Supply-side stimuli that expand productive capacity are ineffective whenever congestion is already low, as they weakly crowd in private consumption. In demand-side recessions, visits drop and the goods market becomes less congested; by contrast, supply-side recessions witness shrunk capacity and hence stronger congestion. Therefore, the cyclical properties of fiscal multipliers are pinned down by the *type of shocks* that drive the business cycle, and we establish the following properties for a range of spending and taxation instruments.

First, multipliers associated with fiscal instruments that stimulate aggregate demand, such as government consumption spending and consumption tax cuts, are *countercyclical* under demand-driven fluctuations and *procyclical* under supply-driven fluctuations. A recession originated by a lack of demand generates a reduction in the number of household visits, thus *lowering congestion* in the goods market. In such environment, a demand-side fiscal stimulus that boosts aggregate demand and increases the number of visits leads to an increase in production without raising congestion. Consequently, the crowding out of private consumption is small, leading to a high value of the multiplier. By contrast, a supply-driven recession, originated by a fall in productivity, generates a contraction in capacity and hence an *increase in congestion*. A demand-side fiscal stimulus that leads to an increase in the number of visits results in a further increase in congestion that crowds out private consumption and generates a small and possibly negative multiplier.

Second, multipliers associated with interventions that stimulate aggregate supply, such as reductions in taxes on firms payroll, sales and households labor income, are *countercyclical* under supply-driven fluctuations and *procyclical* under demand-driven fluctuations. A supply-driven recession is associated with a drop in capacity and hence a surge in congestion; in such an environment, a tax cut that expands capacity leads to a substantial drop in congestion, which leads to strong crowding in of private consumption, and hence a high multiplier. Instead, in a demand-side recession, where visits and congestion drop, expanding capacity through tax cuts leads to a further drop in congestion, thus generating a weak crowding in of private consumption, and hence a low multiplier.

Third, our theoretical framework assigns an important role to fiscal austerity, implemented by a reduction in government consumption, in severe *supply-driven recessions* and *demand-driven booms*. In particular, we show that states of the world exist where goods market congestion is sufficiently high so that a demand-driven stimulus crowds out private consumption at a ratio of more than one-to-one, and the multiplier becomes negative. Moreover, provided elasticities of labor supply and labor demand are sufficiently low so that supply-side stimuli generate a very small drop in congestion, a government consumption austerity, which reduces visits and thus crowds in private consumption, becomes the policy with the highest multiplier. Our results provide a theoretical rationale for empirical findings in Alesina et al. (2015) on the preferential properties of spending-based austerity programs, as well as an alternative justification for austerity that does not rely on government credibility to avoid default (Reinhart and Rogoff, 2010).

Fourth, we develop and estimate an econometric specification that allows for model-free testing of our novel theoretical predictions. We build on the local projections approach of Jordà (2005) and estimate spending and tax cut multipliers in recessionary and expansionary episodes, *conditional* on those being demand- or supply-driven in nature. We determine the nature of each episode by looking at the co-movement between cyclical components of economic activity and inflation. A positive co-movement is taken to be indicative of demand-driven fluctuations, whereas negative co-movement corresponds to supply-driven fluctuations. Empirical studies as early as Bayoumi and Eichengreen (1992) have widely used this approach to pinning down the source of fluctuations, but we are the first study to exploit such co-movement in a state-dependent local projections setting. In accordance with our theory, we find (cumulative) spending multipliers to be high in demand- and low in supply-side recessions, especially at horizons shorter than two years; the opposite patterns hold for tax cut multipliers.

Contribution to the literature Our study contributes to the growing literature on theories of fiscal state dependence.[1] Early studies focus on fiscal policy at the effective lower bound, showing that fiscal multipliers rise substantially when nominal interest rates are close to zero (Christiano et al., 2011; Coenen et al., 2012; Fernández-Villaverde et al., 2015; Rendahl, 2016; Roulleau-Pasdeloup, 2020), although more recent studies challenge such findings under fully non-linear solutions (Boneva et al., 2016; Lindé and Trabandt, 2018), under market incompleteness (Hagedorn et al., 2019) or when the liquidity trap is driven by a self-fulfilling expectations shock (Mertens and Ravn, 2014). As for multipliers away from the effective lower bound, seminal work of Michaillat (2014) establishes that government employment multipliers increase in times of high unemployment; our work builds on the goods market search framework of Michaillat and Saez (2015) to generalize his seminal result to different fiscal instruments and source of fluctuations. Subsequently, Canzoneri et al. (2016) and Faria-e-Castro (2019) show that the widening of credit spreads caused by financial frictions increases government spending multipliers during recessions, Shen and Yang (2018) show that spending multipliers become countercyclical under downward nominal wage rigidity, Boehm and Pandalai-Nayar (2020) show that firm-level capacity constraints lead to fiscal multipliers that vary with

[1] See Ramey (2019) for a comprehensive review of recent developments in the fiscal policy literature.

utilization and Cloyne et al. (2020) find large fiscal multipliers when monetary policy is less activist. Fernández-Villaverde et al. (2019, 2021) show that search complementarities between producing firms generate multiple equilibria and that the fiscal multiplier becomes state dependent if fiscal policy is sufficiently powerful to move the economy across equilibria. In the study most related to ours, Michaillat and Saez (2019) conduct a normative analysis in a model with search frictions to show that the *socially optimal stock* of government spending can vary with unemployment.[2] Ziegenbein (2017) and Sims and Wolff (2018) show that multipliers out of tax cuts vary significantly across the business cycle and are larger in states in which output is high. In contemporaneous work, Jo and Zubairy (2022) show that in a New Keynesian model with downward nominal wage rigidity, spending multipliers in demand-driven recessions can be larger than in supply-driven downturns. Unlike our work, their framework does not predict state-dependence across demand- and supply-driven expansions, and the analysis is focused on government consumption.

Compared to the aforementioned studies, we are the first study to *jointly* rationalize state dependence in a broad range of spending and taxation multipliers and to develop a tractable model with closed-form solutions. To the best of our knowledge, we are also the first study to link the state dependence of fiscal multipliers to the source of economic fluctuations. Our theoretical findings offer direct guidance for the conduct of fiscal policy, particularly to establish the effectiveness of alternative fiscal instruments in a given phase of the business cycle.

Our study also contributes to the empirical literature on fiscal state dependence, and our econometric findings offer a resolution to the debate on the degree of variation of fiscal multipliers over the business cycle. Early studies find government spending multipliers to be substantially larger in recessions compared to expansions both in the US (Auerbach and Gorodnichenko, 2012; Fazzari et al., 2014) and internationally (Auerbach and Gorodnichenko, 2013). However, more recently, Ramey and Zubairy (2018) construct a comprehensive historical dataset for government spending in the US, and find almost acyclical spending multipliers. Moreover, empirical studies do not find spending multipliers to be substantially larger at the effective lower bound, either in the UK (Crafts and Mills, 2013), the US (Ramey and Zubairy, 2018), or Japan (Miyamoto et al., 2018). Ziegenbein (2017) and Eskandari (2019) find that tax cut multipliers are highly procyclical.

Our key empirical contribution is in showing that once the estimation controls for the source of economic fluctuations, both spending and tax cut multipliers exhibit significant state dependence and that their variation over phases of the business cycle is consistent with our theory. Note that our estimation of state-dependent spending multipliers uses the same dataset as Ramey and Zubairy (2018), and our specification nests theirs as a special case where the source of fluctuations is irrelevant. We therefore offer a resolution to the empirical debate on state dependence of spending multipliers on both empirical and theoretical grounds. Barnichon et al. (2021) propose an alternative resolution to recover state dependence by controlling for the *sign* of the spending shock.

The rest of the paper is structured as follows. Section 2 develops the theoretical framework. Section 3 derives and discusses the key results on the state dependence of spending and taxation multipliers. Section 4 studies the relative effectiveness of spending and taxation multipliers and investigates the role for fiscal austerity. Section 5 quantifies the state dependence of multipliers in a dynamic version of the model. Section 6 develops an econometric model that supports our theoretical results. Section 7 concludes and outlines possible directions for future research.

2. The theoretical framework

We begin by outlining empirical evidence regarding idle productive capacity on the firms' side and unsatisfied demand on the households' side. We then consider those features in a theoretical model that embeds search-and-matching frictions into the goods market of an otherwise standard production economy with endogenous labor supply and distortionary fiscal policy. By default, proofs of results in main text are in Appendix A.[3]

2.1. Market clearing, idle capacity and unsatisfied demand

The textbook definition of goods market clearing in a closed economy with fixed capital is given by $Y = C + G$, where Y is the productive capacity of the economy and $C + G$ represents aggregate demand coming from households and the government. In most standard models, it implies that firms sell off their entire capacity; otherwise prices fall sufficiently to clear any excess supply. At the same time, aggregate demand is generally assumed to be satisfied frictionlessly, with no resources spent on completing the purchases.

Despite the common assumption of a frictionless goods market in macroeconomic models, the data strongly endorses the presence of frictions that generate idle productive capacity and unsatisfied demand. Panel (a) of Fig. 1 uses firm-level US

[2] Though the conceptual framework used is similar, our analysis substantially differs from that in Michaillat and Saez (2019) in a number of ways. First, Michaillat and Saez (2019) do not study the role played by the source of fluctuations in determining cyclicality of fiscal multipliers. Second, the supply side of our economy is fully endogenous and allows us to study multipliers from both government consumption, which is the exclusive focus of Michaillat and Saez (2019), as well as a wider range of fiscal instruments, including government employment, distortionary taxation on consumption, labor income, and firms' sales. Third, the dynamic version of our model is set in discrete time and features transition dynamics, which allow us to study multipliers at different time horizons that can be mapped to empirical estimates in the literature. Fourth, we provide model-free econometric assessment of the predictions of our model, whereas Michaillat and Saez (2019) only perform model-based simulations.

[3] Ghassibe and Zanetti (2020) provide extended discussions of findings and proofs.

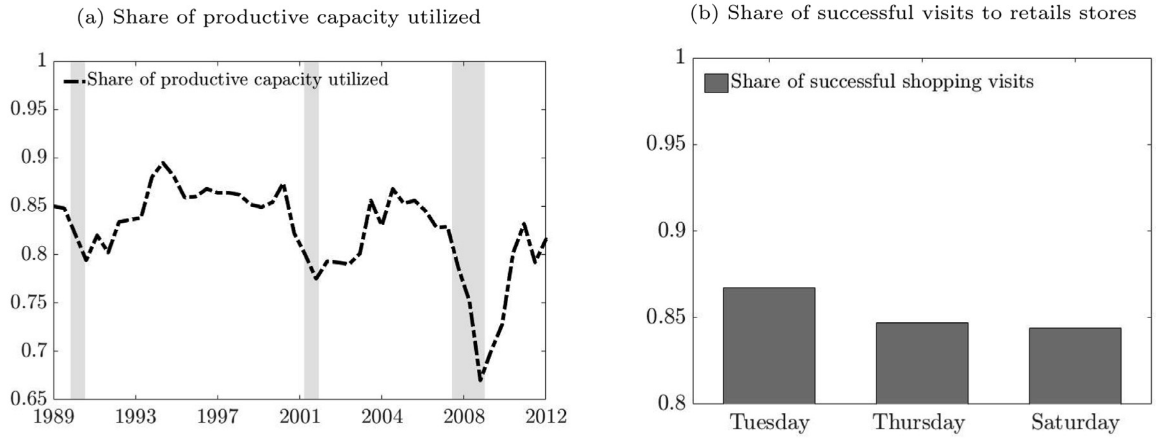

Fig. 1. Evidence on frictions in the United States goods market. *Notes:* panel (a) shows a time series of the share of current capacity utilized by US firms, as calculated by the Institute for Supply Management (ISM) with NBER recessions denoted by grey shaded areas, as reported by Michaillat and Saez (2015); panel (b) shows the share of successful visits to retail stores on different days of the week, as reported by Taylor and Fawcett (2001), where Tuesday-Thursday and Tuesday-Saturday differences are statistically significant at 5% level.

data collected by the Institute for Supply Management (ISM) to show that, on average, firms in manufacturing sectors sell around 80 percent of their current productive capacity, and the proportion of utilized capacity is subject to regular business cycle fluctuations, with much limited fractions utilized in recessions.

Similar frictions are present on the aggregate demand side. Several studies in the fields of business logistics and marketing research document that around 15 per cent of visits to US retail stores are unsuccessful due to stockouts (Taylor and Fawcett, 2001). Panel (b) of Fig. 1 shows that demand frictions are also cyclical, with visits to stores being on average more successful on weekdays, as opposed to weekends, when shops tend to be more congested. Such frictions also are encountered in online stores, where as many as 25 per cent of online orders cannot be fulfilled due to out-of-stock items (Jing and Lewis, 2011).

Workhorse macroeconomic models do not jointly account for idle productive capacity and unsatisfied demand, despite their clear empirical relevance. In the rest of the section, we outline a theoretical framework that jointly models those features in an otherwise standard macroeconomic model.

2.2. A model with search frictions in the goods market

We begin our analysis with a static model that features a goods market with search-and-matching frictions as in Michaillat and Saez (2015), which we augment with a competitive labor market[4] The majority of exposition and results in this section thus follow Michaillat and Saez (2015), with two important differences: endogenous labor supply by households and presence of distortionary fiscal instruments.

The economy is composed of households, firms, and the government. Firms hire labor in order to manufacture an endogenous *productive capacity* (k), and consumers and the government make a total of v *visits* in order to purchase goods.

Due to search-and-matching frictions, part of productive capacity remains idle and not all visits are successful, as encapsulated by the *matching function* that maps productive capacity (k) and visits (v) into *sales* (y): $y = (k^{-\delta} + v^{-\delta})^{-\frac{1}{\delta}}$, where $\delta > 0$ ensures that $y < \min\{k, v\}$. We define goods market *tightness* (x) as the ratio of visits to capacity: $x \equiv \frac{v}{k}$.

Abstracting from aggregate uncertainty, each unit of productive capacity is sold with probability $f(x) \equiv \frac{y}{k} = (1 + x^{-\delta})^{-\frac{1}{\delta}}$, where $f(0) = 0, \lim_{x\to+\infty} f(x) = 1$, and $f'(x) > 0, \forall x \in [0, +\infty)$. Intuitively, the probability of selling a unit of productive capacity is higher in a tighter goods market, and vice versa. Similarly, a purchasing visit is successful with probability $q(x) \equiv \frac{y}{v} = (1 + x^{\delta})^{-\frac{1}{\delta}}$, where $q(0) = 1, \lim_{x\to+\infty} q(x) = 0$ and $q'(x) < 0, \forall x \in [0, +\infty)$. The probability of a successful visit is lower in a tighter goods market, and vice versa.[5]

Within this framework, it is useful to think of productive capacity (k) as the size of the "store" and visits (v) as the length of the "queue" comprising private and government consumers. Goods market tightness (x) can be interpreted as the number of queuing consumers per square meter of the store or as a measure of congestion in the goods market.

[4] We develop and present a dynamic version of the model in Section 5. The framework builds on the general-disequilibrium model by Barro and Grossman (1971), whose application to fiscal policy is considered in van Wijnbergen (1987). Recent studies with goods market search frictions include Bai et al. (2012); Brzustowski et al. (2018); Den Haan (2013); Gourio and Rudanko (2014); Roldan-Blanco and Gilbukh (2020). Adding search frictions to the labor market with flexible wages leaves our results for fiscal multipliers unchanged.

[5] Petrosky-Nadeau et al. (2016) provide evidence that the average time spent shopping fell in the demand-deficient period of 2008–2010, which is consistent with the property that the probability of a successful visit rises in a less congested goods market.

2.3. Households

There is a continuum of identical households of size one. Households make v^c visits in order to purchase and consume c units of the produced good. There is a cost $\rho \in (0,1)$ of the produced good per visit.[6] Total sales of the produced good to households (y^c) comprise household consumption (c) and search costs (ρv^c): $y^c = c + \rho v^c$.

Since each visit is successful with probability $q(x)$, total sales are equal to $y^c = q(x)v^c$, and the consumption of c units of the produced good requires $c/(q(x)-\rho)$ visits. Therefore, the total number of goods that need to be purchased (inclusive of the cost of search) in order to consume c units is given by $[1+\gamma(x)]c$, where $\gamma(x) \equiv \frac{\rho x}{f(x)-\rho x}$ represents the wedge introduced by search-and-matching frictions that strictly rises in goods market tightness, such that $\gamma'(x) > 0, \forall x \in (0, x_m)$.[7] Intuitively, a tighter goods market diminishes the probability of a successful visit, increasing the expected number of visits required for a successful purchase, thus raising total search costs.

The representative household gains utility from consumption of the produced good (c), the non-produced good (m) that is in fixed exogenous supply ($\bar{m}$), and gains disutility from supplying labor (l).[8] Every household is small relative to the size of the market, and therefore takes the price (p), wage (w), goods market tightness (x) as given. The representative household maximizes utility function:

$$\max_{c,m,l}\left[\chi\frac{c^{1-\sigma}}{1-\sigma}+\zeta(m)-\frac{l^{1+\psi}}{1+\psi}\right] \tag{1}$$

subject to the budget constraint $p[1+\gamma(x)]c + m \le wl + \Pi + \bar{m} - T$, where $\chi > 0$ determines the relative preference for the produced good, ψ is the inverse Frisch elasticity of labor supply, Π is profits from firms owned by the representative household and T is a lump-sum tax collected by the government. Finally, $\zeta(.)$ is an increasing differentiable function.

The household optimization problem delivers the following optimality conditions.[9] First, the consumption function $c(p,x) = \frac{\chi}{p[1+\gamma(x)]}$, which indicates that, ceteris paribus, higher preference parameter χ increases consumption; whereas higher price (p) and tightness (x) increase the relative price of consumption and hence decrease consumption. Second, the labor supply function $l(w) = w^{\frac{1}{\psi}}$, which shows that, ceteris paribus, higher wage (w) increases the supply of labor.

2.4. Firms

The economy is populated by a continuum of perfectly competitive firms that manufacture an identical good that is sold in a market characterized by search-and-matching frictions. Firms have access to a production technology that transforms labor input (n) into *productive capacity* (k): $k(n) = an^{\alpha}$, where $\alpha \in (0,1]$ is returns to labor and $a > 0$ is the level of productivity.

In the presence of search-and-matching frictions, every unit of productive capacity is utilized with probability $f(x)$. Abstracting from uncertainty, the representative firm achieves the following level of *sales* $y(x,n)$: $y(x,n) = f(x)k(n) = f(x)an^{\alpha}$.

Each firm is small relative to the size of the market and thus takes the price (p) and wage (w) as well as goods market tightness (x) as given. The profit maximization problem of the representative firm is:

$$\max_{n} \Pi = [pf(x)an^{\alpha} - wn(1+\tau)], \tag{2}$$

where $\tau \in [0,1)$ is a payroll tax from the government.

The profit maximization delivers the following labor demand function: $n(w;p,x,\tau) = \left[\frac{\alpha pf(x)a}{w(1+\tau)}\right]^{\frac{1}{1-\alpha}}$. It shows that, ceteris paribus, a higher price (p) increases the revenue from every unit sold and hence incentivizes production and labor demand. Higher tightness (x) increases the probability of selling each unit produced and hence also incentivizes production and labor demand. Labor demand decreases with the cost of hiring labor, given by the wage (w). A payroll tax $\tau > 0$ increases the cost of hiring and thus lowers labor demand. Finally, higher productivity (a) increases the marginal product for each unit of labor hired, increasing labor demand.

2.5. Government

The government consumes an exogenous quantity G of the privately produced good and is subject to the same search-and-matching frictions as private consumers. Thus, for a given desired government consumption of the produced good G,

[6] An alternative way to model search costs for the households is to assume that there is a *utility* cost per visit. In Appendix F, we show that results of the analysis continue to hold with this alternative approach to modelling search costs.

[7] We restrict the admissible values of tightness to $(0, x_m)$, where x_m is given by the condition $f(x_m) = \rho x_m$; this approach ensures that the aggregate supply of the produced good, net of search costs, remains positive.

[8] The non-produced good is traded in a frictionless competitive market, and we use it as the numeraire by normalizing its price to one. Introducing the numeraire good m allows us to separately pin down both the price of the produced good p, as well as the wage w, in our static framework.

[9] For the remainder of the main text we assume log utility of consumption ($\sigma = 1$). Appendix E provides closed-form solutions for a generic CRRA utility of consumption. We also normalize the supply of the non-produced good so that $\zeta'(\bar{m}) = 1$.

the government must purchase $[1+\gamma(x)]G$ units, where $[1+\gamma(x)]$ is the same wedge as that faced by private consumers.[10] Given the rate of payroll tax τ and hence the tax revenue $wn\tau$ collected, the government imposes a lump-sum tax T on the households to balance the public budget: $T = p[1+\gamma(x)]G - wn\tau$.

There are alternative ways of including government into our model, such as public employment or distortionary taxation of firms' sales, households' labor income and consumption. We consider such extensions in Appendix C.1 and Appendix C.2.

2.6. Market clearing

Aggregate demand consists of the households' demand $c(p, x)$ and the government's exogenous demand G. Aggregate supply is given by the fraction of the firm's sales $y(x; n) = f(x)k(n; \tau)$ that is not spent on the cost of search, and hence is given by $f(x)k(x; \tau)/[1+\gamma(x)]$. Market clearing for the goods market is:

$$\underbrace{\frac{f(x)}{1+\gamma(x)}k(n;\tau)}_{\text{Aggregate supply}} = \underbrace{c(p,x)+G}_{\text{Aggregate demand}} . \tag{3}$$

We know that aggregate demand is downward-sloping in tightness-quantity space. As for the aggregate supply curve, it is backward-bending: it rises in tightness between $(0, x^*)$ and falls in tightness for values (x^*, x_m). For a given productive capacity k, goods market tightness exerts two counteracting effects on aggregate supply. On the one hand, higher x increases the probability $f(x)$ of selling each produced good, thus raising aggregate supply; on the other hand, search costs, encapsulated by the wedge $[1+\gamma(x)]$, increase in tightness. The increase in the selling probability outweighs the increase in search costs for tightness below the efficient level $(x < x^*)$. On the other hand, aggregate supply decreases for tightness above the efficient level $(x > x^*)$. Aggregate supply is maximized at $x = x^*$, where the two effects offset each other, which corresponds to the social planner's allocation in our economy, as shown formally in Appendix G.1.

Clearing in the labor market is achieved by equating labor demand, $n(w; p, x, \tau)$, to labor supply, $l(w)$:

$$\underbrace{l(w)}_{\text{Labor supply}} = \underbrace{n(w;p,x,\tau)}_{\text{Labor demand}} . \tag{4}$$

The labor supply function is upward sloping in the wage-employment space, whereas the labor demand function is downward sloping in the wage-employment space.

Equilibrium is described by price, wage, tightness, and allocations that satisfy the optimality conditions of households, firms, the government budget constraint, and the market clearing conditions. The system is indeterminate, as we are left with two equations in three unknowns (p, x, w). We therefore need a selection mechanism to choose a specific equilibrium.

2.7. Comparative statics: two polar equilibria

In the baseline model we follow Michaillat and Saez (2015) and resolve indeterminacy by considering two polar equilibrium cases. First, in a *competitive* equilibrium, tightness is fixed at its socially efficient level x^*, formally defined in Appendix G.1, and p and w adjust fully flexibly to satisfy optimality and market clearing conditions. Second, in a *fixprice* equilibrium, price p is fixed at a constant value p_0, and x and w adjust to satisfy optimality and market clearing conditions. Appendix B extends our analysis to more general equilibrium cases.

2.7.1. Comparative statics: competitive equilibrium

Following a positive demand shock, parameterized as an increase in χ, households choose to consume more, hence increasing the number of visits; since tightness is to remain fixed at x^*, the price p has to rise to discourage further consumption and expand capacity, until markets clear with more sales in the new equilibrium. On the other hand, after a positive supply shock, represented by a rise in a, capacity expands. In order to keep tightness fixed, the price has to fall, thus encouraging more consumption and more visits until markets clear with higher sales in equilibrium.[11] Lemma 1 formally summarizes the comparative statics for the competitive equilibrium:

Lemma 1. *In a competitive equilibrium, the comparative statics of tightness* (x)*, sales* (y) *and the price* (p) *are:* $\frac{dx}{d\chi} = 0$, $\frac{dy}{d\chi} > 0$, $\frac{dp}{d\chi} > 0$; $\frac{dx}{da} = 0$, $\frac{dy}{da} > 0$, $\frac{dp}{da} < 0$.

[10] Our model features a single production sector, so we abstract from any differences in sectoral compositions of government and household consumption, as documented by Ramey and Shapiro (1998) and Cox et al. (2020). However, our qualitative mechanism may still hold even if sectoral compositions are different: higher government consumption may draw factors of production away from households' sectors, thus increasing good market tightness in the latter. This mechanism is even more apparent if the government directly competes for factors of production with the private sector; we consider such extension in Appendix C.1.

[11] Figure D.8 in Appendix D provides graphical representation of comparative statics following demand- and supply-side shocks in a competitive equilibrium.

2.7.2. Comparative statics: fixprice equilibrium

After a positive demand shock, consumption and visits rise. Since the price p is fixed, the only way to clear such excess demand is for the tightness x to rise, which increases the cost of search, thus discouraging any further consumption until markets clear with higher sales in the new equilibrium. At the same time, following a positive supply shock, capacity expands, and the only way for such excess supply to be cleared is through a fall in tightness, which encourages consumption until markets clear.[12] Lemma 2 below formally summarizes the comparative statics in a fixprice equilibrium:

Lemma 2. *In a fixprice equilibrium, the comparative statics of tightness* (x)*, sales* (y)*, and the price* (p) *are:* $\frac{dx}{d\chi} > 0$, $\frac{dy}{d\chi} > 0$, $\frac{dp}{d\chi} = 0$; $\frac{dx}{da} < 0$, $\frac{dy}{da} = 0$, $\frac{dp}{da} = 0$.

3. Fiscal multipliers: key analytical results

In this section, we establish our key novel analytical results regarding cyclical properties of fiscal multipliers. In particular, we consider the *demand-side* multiplier, associated with government consumption, and the *supply-side* multiplier, associated with payroll tax cuts.[13] We show that in a competitive equilibrium the two multipliers are *identical* and *acyclical*. In a fixprice equilibrium, the demand-side multiplier is *countercyclical* under *demand-side fluctuations* and *procyclical* under *supply-side fluctuations*. Conversely, the supply-side multiplier is *procyclical* under *demand-side fluctuations* and *countercyclical* under *supply-side* fluctuations.

3.1. Definitions

A fiscal multiplier measures the effect of a marginal change in the fiscal instrument on GDP *in equilibrium*. The following definition introduces the demand-side fiscal multiplier, associated with increases in government spending:[14]

Definition 1. The demand-side fiscal multiplier, $\varphi^d(x)$, is given by: $\varphi^d(x) \equiv \frac{d\{c+G\}}{dG} = \frac{dc}{dG} + 1$.

Similarly, the following definition introduces the supply-side fiscal multiplier, associated with payroll tax cuts:

Definition 2. The supply-side fiscal multiplier, $\varphi^s(x)$, is given by: $\varphi^s(x) \equiv \frac{1}{c+G}\frac{d\{c+G\}}{d[-\tau]} = -\frac{1}{c}\frac{dc}{d\tau}$.

3.2. Competitive equilibrium multipliers

We first derive the fiscal multipliers in a competitive equilibrium, where p and w are fully flexible, and adjust in response to shocks to maintain tightness at the efficient level $(x = x^*)$ to satisfy the equilibrium conditions:

Proposition 1. *In a competitive equilibrium, the demand- and supply-side fiscal multipliers are equal and given by:*

$$\varphi^* \equiv \frac{\alpha}{1+\psi} = \frac{1-\frac{1}{|\epsilon^d|}}{1+\frac{1}{\epsilon^s}}, \tag{5}$$

where $|\epsilon^d| = \frac{1}{1-\alpha}$ *and* $\epsilon^s = \frac{1}{\psi}$ *are (absolute) elasticities of labor demand and labor supply.*

Proposition 1 outlines several important results. First, in a competitive equilibrium, the demand- and supply-side multipliers are equal, implying that either of the two fiscal interventions generates the same effect on GDP.

Second, the competitive equilibrium multiplier is determined exclusively by the elasticities of labor supply and demand, equal to $\epsilon^s \equiv \frac{1}{\psi}$ and $|\epsilon^d| \equiv \frac{1}{1-\alpha}$, respectively. As labor supply becomes perfectly inelastic ($\psi \to \infty$), the multiplier decreases ($\varphi^* \to 0$). The intuition is straightforward. When the ratio of "queue length" to "store size" is to be kept at the efficient level and the "store size" is fixed, the only way to accommodate additional government customers in the queue is for the price to increase to the point where private customers in the queue are crowded-out one-for-one. Similarly, payroll tax cuts that lead to higher employment and larger "store size" result in higher wages with no change in employment and consumption when labor supply is perfectly inelastic and tightness is kept at the efficient level.

On the other hand, when the demand and supply of labor are perfectly elastic ($\alpha = 1$ and $\psi = 0$), the fiscal multiplier reaches the maximum value of one ($\varphi^* = 1$). In this case, any additional queue length from government customers generates an increase in employment and enlarges the capacity of the store, without crowding out consumption and retaining tightness at the efficient level. Any payroll tax cuts leave wages unchanged and increase the supply of labor and hence the

[12] Figure D.9 in Appendix D provides graphical representation of comparative statics following demand- and supply-side shocks in a competitive equilibrium.

[13] In this section, we limit our attention to the two polar equilibria: competitive and fixprice. Appendix B studies fiscal multipliers under more general equilibrium types whereas Appendix C extends the analysis to multipliers out of government employment, as well as consumption, sales, and labor income tax cuts.

[14] For simplicity and to retain direct comparability with related studies, the multipliers are evaluated at the point where there is no government intervention, so that $G = 0$ and $\tau = 0$.

production of goods, which enlarges the capacity of the store. The only way to retain tightness at the efficient level is for the price to fall, leading to a one-for-one crowd-in of private customers into the queue.

It is now straightforward to establish that both demand- and supply-side fiscal multipliers are *acyclical* in a competitive equilibrium:

Corollary 1. *In a competitive equilibrium, both demand- and supply-side multipliers are acyclical.*

3.3. Fixprice equilibrium multipliers

3.3.1. Demand-side fiscal multiplier

Before studying the demand-side fiscal multiplier in a generic fixprice equilibrium, we make an intermediate step and derive the multiplier in the special case of *fixed capacity*, which arises under a perfectly inelastic labor supply ($\psi \to \infty$).

Lemma 3. *Let the fixed capacity fiscal multiplier, $\theta(x)$, be the demand-side fiscal multiplier in a fixprice equilibrium under fixed labor supply, such that*

$$\theta(x) \equiv \frac{d\{c+G\}}{dG}|_{\psi \to \infty}. \tag{6}$$

It can be shown that $\theta(x)$ has the following properties:

$$\theta(x) = \begin{cases} (0, -\infty), & \text{if} \quad x \in (x^*, x_m) \\ 0, & \text{if} \quad x = x^* \\ (0, 1), & \text{if} \quad x \in (0, x^*) \end{cases} \tag{7}$$

$$\theta'(x) < 0, \qquad \forall x \in (0, x_m),$$

where x_m is given by $f(x_m) = \rho x_m$.

Lemma 3 outlines several results. First, in an efficient fixprice equilibrium, where $x = x^*$, the fixed capacity fiscal multiplier is equal to zero, just like the competitive equilibrium multiplier under perfectly inelastic labor supply ($\psi \to \infty$), such that $\theta(x^*) = \varphi^*_{\psi \to \infty} = 0$. The only way additional government spending can be accommodated under fixed labor supply and a fixed price is by crowding out private consumption, which is achieved by an increase in tightness. Moreover, in an efficient fixprice equilibrium, the crowding out of consumption is exactly one-for-one, as the increase in tightness fails to increase supply in the goods market, which is already at its maximum, given the fixed capacity.

Second, whenever $x \in (0, x^*)$, additional demand from government spending is accommodated via higher tightness, which crowds out private consumption *less than one-for-one*. This is because under $x \in (0, x^*)$, the effect of higher tightness on increasing the fraction of capacity utilized $f(x)$ dominates the effect of increasing the search wedge $[1 + \gamma(x)]$, so that aggregate supply increases following the government consumption increase.

Third, whenever $x \in (x^*, x_m)$, higher government spending crowds out private consumption *more than one-for-one*. This is driven by the fact that under $x \in (x^*, x_m)$ the effect of higher tightness on increasing the cost of search $[1 + \gamma(x)]$ dominates the effect on increasing the fraction of capacity utilized $f(x)$, and aggregate supply falls following the rise in government consumption.

Having established the properties of $\theta(x)$, we can now provide a convenient expression for the demand-side fiscal multiplier in a generic fixprice equilibrium:

Proposition 2. *In a fixprice equilibrium, the demand-side fiscal multiplier, $\varphi^d(x)$, is given by:*

$$\varphi^d(x) = \underbrace{\varphi^*}_{\text{State-invariant component}} + \underbrace{\theta(x) \times (1 - \varphi^*)}_{\text{State-dependent component}}, \tag{8}$$

where φ^* is the competitive equilibrium multiplier. Hence, $\varphi^d(x) \in (-\infty, 1)$ and $\frac{d\varphi^d(x)}{dx} < 0, \forall x \in (0, x_m)$.

Proposition 2 establishes several important results. First, the demand-side fiscal multiplier can be represented as the sum of a state-invariant component, given by the competitive equilibrium multiplier φ^*, and a state-dependent component that is a function of the underlying goods market tightness.

Second, from the properties of $\theta(x)$, it follows that in a fixprice equilibrium, the demand-side fiscal multiplier lies between one and negative infinity and strictly falls in tightness on the whole domain. Hence, government expenditure always crowds out private consumption, and the crowding-out effect is stronger whenever the goods market tightness is higher, as shown graphically in Panel (a) of Fig. 2. Intuitively, a low goods market tightness environment is akin to a short queue for a given size of the store. When the government implements demand-side fiscal expansion by sending its customers to join a short queue, it does not make the shop excessively crowded and hence achieves a relatively high multiplier since the crowding out effect is limited. Instead, in a high tightness environment, the government sends customers to join a crowded store, which results in strongly crowding out private customers and delivering a low multiplier.

Third, as seen in Panel (a) of Fig. 2, under sufficiently high tightness $\hat{x}$, the demand-side fiscal multiplier turns negative, implying that private consumption gets crowded out more than one-for-one. This is despite the fact that in a generic fixprice

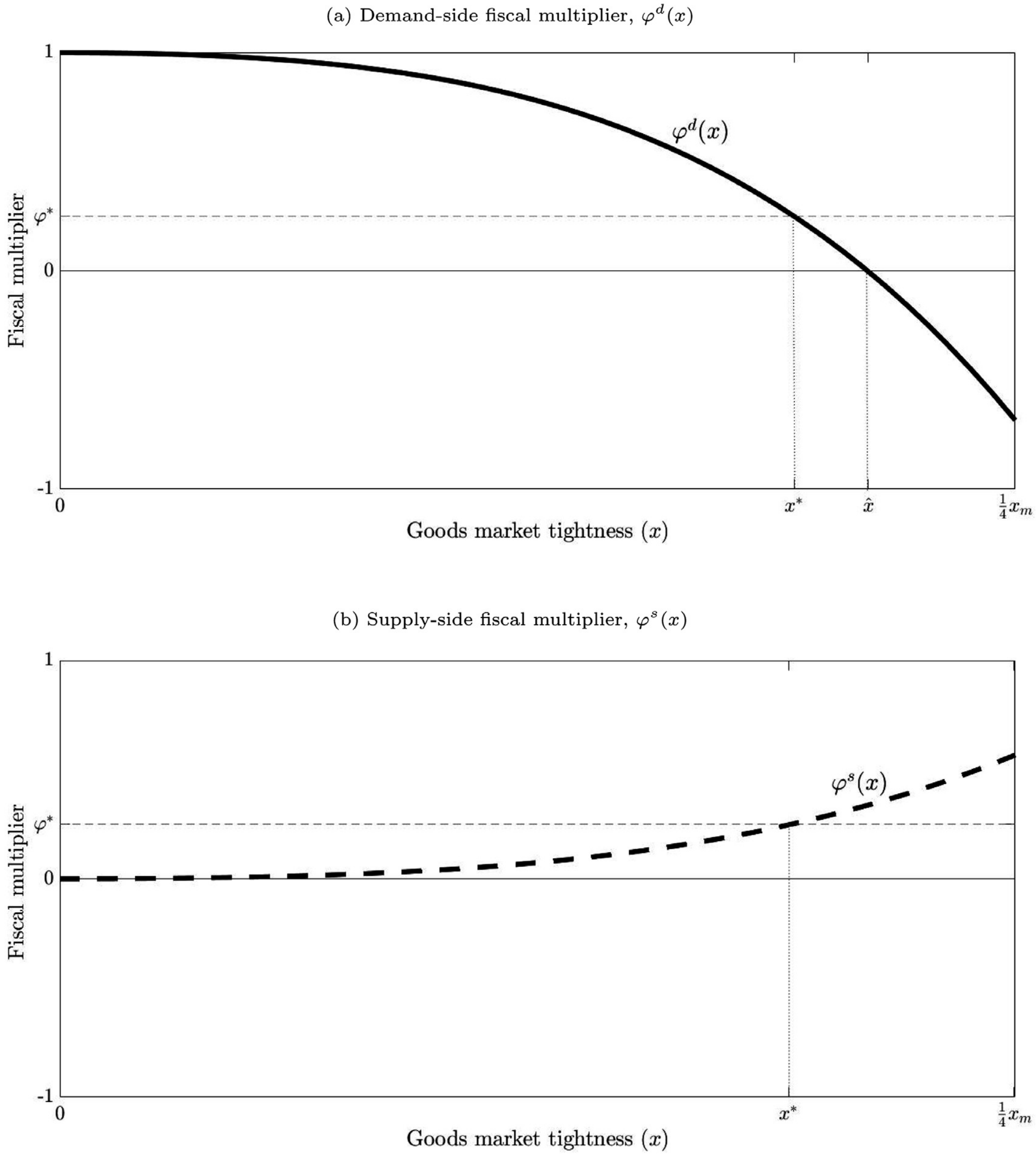

Fig. 2. Fiscal multipliers in a fixprice equilibrium. *Notes:* Panels (a) and (b) show demand-side and supply-side fiscal multipliers in a fixprice equilibrium of a calibrated version of our model ($\alpha = 0.3, \delta = 2, \rho = 0.1, \psi = 0.2$) for values of goods market tightness in the range $(0, \frac{1}{4}x_m)$ (to avoid extreme values as x gets closer to x_m); Panel (a) shows that the demand-side fiscal multiplier $\varphi^d(x)$ starts at one when $x = 0$, then strictly falls in goods market tightness, and turns negative after $x = \hat{x}$; Panel (b) shows that the supply-side fiscal multiplier φ^s starts at zero when $x = 0$, then strictly rises in tightness, tending to infinity as $x \to x_m$.

equilibrium higher tightness increases labor demand and, ceteris paribus, gives a boost to capacity and aggregate supply. Moreover, as we establish in the next corollary, such threshold $\hat{x}$ always exists, regardless of the elasticities of labor demand and labor supply:

Corollary 2. *There always exists tightness $\hat{x} \in (x^*, x_m)$, such that $\varphi^d(\hat{x}) = 0$ and $\varphi^d(x) < 0, \forall x \in (\hat{x}, x_m)$, and it is equal to: $\hat{x} = \theta^{-1}\left(-\frac{\varphi^*}{1-\varphi^*}\right)$, where $\frac{d\hat{x}}{d\varphi^*} > 0$.*

Most importantly, results in Proposition 2 imply well-defined, cyclical properties of the demand-side fiscal multiplier, outlined in the next corollary:

Corollary 3. *In a fixprice equilibrium, the demand-side fiscal multiplier, $\varphi^d(x)$, is countercyclical under demand-side fluctuations and procyclical under supply-side fluctuations.*

Corollary 3 establishes that the demand-side multiplier, associated with government consumption, is large in *demand-driven recessions* and *supply-driven expansions*, but small in *supply-driven recessions* and *demand-side expansions*. Intuitively, a demand-driven recession lowers the length of the "queue", whereas a supply-driven expansion increases the size of the "store"; in both cases, congestion of the store falls. In such cases, an increase in government consumption adds government customers to an uncongested store, leading to a small amount of private consumption crowding out, and hence a higher multiplier. Conversely, both a supply-driven recession and a demand-driven expansion make the "store" more congested, leading to strong crowding out of private consumption, and hence a lower multiplier, following an increase in government consumption. Michaillat (2014) establishes an isomorphic result for public employment multiplier under search frictions in the labor market and productivity-driven fluctuations: in recessions congestion in the labor market drops, which reduces crowding out coming from extra public employment. Our finding thus generalizes his seminal result to government consumption and different sources of fluctuations.

3.3.2. Supply-side fiscal multiplier

The next proposition provides an expression for the supply-side fiscal multiplier in a generic fixprice equilibrium:

Proposition 3. *In a fixprice equilibrium, the supply-side fiscal multiplier, $\varphi^s(x)$, is given by:*

$$\varphi^s(x) = \underbrace{\varphi^*}_{\text{State-invariant component}} - \underbrace{\theta(x) \times \varphi^*}_{\text{State-dependent component}}, \tag{9}$$

where φ^* is the competitive equilibrium multiplier. Hence, $\varphi^s(x) \in (0, +\infty)$ and $\frac{d\varphi^s(x)}{dx} > 0, \forall x \in (0, x_m)$.

Proposition 3 shows that the supply-side multiplier is the sum of a state-invariant component, equal to the competitive multiplier φ^*, and a state-dependent component that depends on goods market tightness.

The supply-side fiscal multiplier is always positive and strictly increases in goods market tightness on the whole domain, shown graphically in Panel (b) of Fig. 2. Hence, supply-side fiscal policy always crowds in private consumption and does so more strongly in a tighter goods market. Supply-side fiscal policy in the form of a payroll tax cut encourages more labor demand for a given wage, which in turn increases capacity and reduces goods market tightness, lowering the search wedge and encouraging higher consumption; the latter positive effect on consumption through capacity expansion is stronger whenever capacity is already low, relative to the number of visits. Intuitively, the payroll tax cut increases the size of the "store" and hence reduces its congestion, thus crowding in private consumption; moreover, such crowding in of private consumption is stronger whenever the store already is very congested.

The next corollary uses the results from Proposition 3 to establish the cyclicality properties of the supply-side fiscal multiplier in a fixprice equilibrium:

Corollary 4. *In a fixprice equilibrium, the supply-side fiscal multiplier, $\varphi^s(x)$, is procyclical under demand-side fluctuations and countercyclical under supply-side fluctuations.*

Corollary 4 establishes that the supply-side multiplier, associated with payroll tax cuts, is high in *supply-driven recessions* and *demand-driven expansions*, but low in *demand-driven recessions* and *supply-driven expansions*. Intuitively, a supply-driven recession makes the size of the "store" smaller, whereas a demand-driven expansion increases the "queue" length; in either case, the store becomes more congested. In such cases, a supply-side policy that generates an increase in capacity produces large fiscal multipliers by lowering the congestion of the "store" and strongly crowding in private consumption. On the other hand, in demand-driven recessions and supply-driven expansions the "store" becomes much less congested, so that any further increases in capacity generate only modest decreases in the cost of search, and hence a very modest crowding in of private consumption. Landais et al. (2018) establish an isomorphic result for a labor market with search frictions and productivity-driven fluctuations: in expansions the elasticity of unemployment to unemployment insurance increases. Our result is thus a generalization of their seminal finding to alternative supply-side instruments and other sources of fluctuations.

3.4. Robustness of results

3.4.1. Robustness I: more general equilibrium types

In Appendix B, we solve for demand-side and supply-side multipliers under much more general equilibrium types and establish their cyclical properties, which we summarize here.

First, we show that results obtained under a competitive equilibrium fully extend to a class of *flexible* equilibria, where tightness is fixed at an arbitrary level $x^L \in (0, x_m)$ and does not respond to shocks,[15] Second, we show that the cyclicality

[15] Such equilibria could be obtained, for example, when the price is established by Nash bargaining between firms and households, or when the price is set at a fixed markup over the marginal cost.

properties established under a fixprice equilibrium extend to a more general class of *frictional* equilibria, where prices are only partially rigid, and not completely fixed.

3.4.2. Robustness II: alternative fiscal policy instruments

In Appendix C, we extend our analysis to alternative fiscal instruments. Here we briefly summarize the results.

First, we show that multipliers out of consumption tax cuts and government employment strictly fall in tightness and hence their cyclicality properties are identical to those of the government consumption multiplier established earlier. Second, we show that multipliers out of cuts in the rate of labor income tax and the rate of firms' sales tax are both identical to the multiplier out of a cut in the rate of firms' payroll tax.

3.5. Evidence on the equilibrium type

Our analysis shows that the joint dynamics of price and tightness adjustment pin down the cyclical properties of fiscal multipliers.

Michaillat and Saez (2015) construct a measure of goods market tightness and show that it varies significantly over time, suggesting that equilibria that feature cyclical variations in tightness provide a better description of the US economy at business cycle frequencies. The latter also implies that equilibria featuring state-dependent fiscal multipliers, with their cyclicality determined by the source of economic fluctuations, are more empirically relevant.

Moreover, Michaillat and Saez (2015) document a strong co-movement between the cyclical components of goods market tightness and sales, which, according to Lemma 2, reflects the dominance of demand shocks as the primary source of fluctuations.[16,17] Combined with the cyclicality properties established in Corollary 3, the latter suggests that the demand-side multiplier is, *on average*, countercyclical. This finding is consistent with some empirical literature (Auerbach and Gorodnichenko, 2012; 2013; Fazzari et al., 2014), although Ramey and Zubairy (2018) estimate spending multipliers to be mildly countercyclical at best. The predominance of demand shocks, combined with cyclicality properties established in Corollary 4, suggest that the supply-side multiplier is, *on average*, procyclical. Such a finding is consistent with the econometric findings in Ziegenbein (2017) and Eskandari (2019), who estimate multipliers out of tax cuts to be much lower in recessions than in expansions.

The fact that spending and tax cut multipliers are, respectively, countercyclical and procyclical, *on average*, gives us no indication on their relative sizes in a *particular* recessionary or expansionary episode. Indeed, our analytical results show that depending on the *type of shock* that generates the episode in the first place, the magnitudes of both multipliers may be substantially different. In order to gain further understanding of the behaviour of the *relative* magnitudes of demand- and supply-side multipliers, in the next section, we provide further analytical results regarding the particular states of the world in which the size of multipliers is different. In Section 5 we develop and calibrate a quantitative dynamic version of our model, and use a non-linear solution method to evaluate both spending and taxation multipliers in shock-specific recessionary and expansionary episodes. Subsequently, in Section 6 we develop an econometric specification that allows to estimate spending and tax cut multipliers in recessionary and expansionary episodes, *conditional* on those being either demand- or supply-driven.

4. Fiscal multipliers: additional analytical results

We now provide further analytical results that describe how the *relative* size of demand- and supply-side multipliers in a fixprice equilibrium varies with goods market tightness. First, we establish that the demand-side multiplier is lower than the supply-side multiplier whenever goods market tightness is above the socially efficient level, and vice versa. Second, we show that for sufficiently low elasticities of labor supply and demand, there always exists a sufficiently high level of tightness that makes *spending austerity* the policy with the largest multiplier.

4.1. Link between demand- and supply-side multipliers

One can combine Propositions 2 and 3 to conveniently link the demand- and supply-side multipliers in a fixprice equilibrium:

Corollary 5. *In a fixprice equilibrium, the demand-side and supply-side fiscal multipliers are related as:*

$$\underbrace{\varphi^d(x)}_{\text{Demand-side multiplier}} = \underbrace{\theta(x)}_{\text{Fixed capacity multiplier}} + \underbrace{\varphi^s(x)}_{\text{Supply-side multiplier}}. \tag{10}$$

[16] Strictly speaking, Lemma 2 only applies whenever prices remain completely fixed over the business cycle. In Lemma 5 in Appendix B.2 we show that in any equilibrium where prices are partially rigid, but not completely fixed, tightness and sales co-move under demand-driven fluctuations and counter-move under supply-driven fluctuations.

[17] Figure I.12 in Appendix I.2 reports estimated impulse responses of output, inflation and goods market tightness to an identified productivity shock based on Fernald (2014). Consistently with our theory, a positive productivity shock leads to a statistically significant increase in output and a statistically significant drop in inflation and goods market tightness.

Hence, the demand-side multiplier is lower whenever $x \in (x^*, x_m)$, higher whenever $x \in (0, x^*)$, and equal to the supply-side multiplier when $x = x^*$.

Corollary 5 establishes that in the special case of an efficient fixprice equilibrium, where $x = x^*$ and $\theta(x^*) = 0$, the size of demand- and supply-side multipliers is the same, $\varphi^d(x^*) = \varphi^s(x^*) = \varphi^*$. When $x \in (x^*, x_m)$ and hence $\theta(x) \in (-\infty, 0)$, the demand-side multiplier is smaller than the supply-side multiplier, $\varphi^d(x) < \varphi^s(x)$, since enlarging capacity by stimulating supply lowers tightness and search costs in the inefficiently congested goods market, thus crowding in private consumption and making supply-side policies more effective. The opposite result holds when $x \in (0, x^*)$ and $\theta(x) \in (0, 1)$, making the demand-side multiplier higher than the supply-side multiplier.

4.2. Austerity multipliers

So far, we have focused on policies that either increase government consumption or cut the rate of payroll tax. However, policymakers also have reverse options at their disposal, namely spending austerity, implemented as a reduction in government consumption, and also an increase in the tax rate.

In our framework, the multiplier from austerity implemented by a reduction in government consumption is the mirror image of the demand-side multiplier, and is equal to $-\varphi^d(x)$. Similarly, the multiplier from an increase in the rate of payroll tax is equal to $-\varphi^s(x)$. From Proposition 3, we know that $\varphi^s(x) \in (0, +\infty), \forall x \in (0, x_m)$, which implies that the multiplier from an increase in the rate of payroll tax is *negative* on the whole domain of tightness, and hence in no state of the world can it be the policy option with the highest multiplier. However, we know from Corollary 2 that there exists $\hat{x} \geq x^*$ such that whenever $x \in (\hat{x}, x_m)$, the spending multiplier is in fact negative, implying that the austerity multiplier is positive. Yet, is there an admissible level of tightness such that the austerity multiplier is sufficiently positive to exceed the supply-side multiplier from tax cuts? The next corollary establishes that the answer is yes, as long as the elasticities of labor demand ($|\epsilon^d|$) and labor supply (ϵ^s) are sufficiently low.

Corollary 6. *For sufficiently low elasticities of labor demand and labor supply such that $\varphi^* < 0.5$, an **Austerity Threshold** $\tilde{x} \in [\hat{x}, x_m)$ exists such that:*

$$-\varphi^d(x) > \varphi^s(x) > \varphi^d(x), \quad \forall x \in (\tilde{x}, x_m). \tag{11}$$

Furthermore, $\tilde{x} = \theta^{-1}\left(-\frac{2\varphi^*}{1-2\varphi^*}\right), \varphi^* < 0.5$, and hence $\frac{d\tilde{x}}{d\varphi^*} > 0$.

Panel (a) of Fig. 3 compares the austerity multiplier against demand- and supply-side multipliers for an inelastic labor market ($\varphi^* < 0.5$). It shows that the multiplier associated with government consumption austerity exceeds the supply-side multiplier (dashed line) *and* demand side multiplier (dark-solid line), provided that tightness is larger than $\tilde{x}$.[18] Panel (b) reports that case for a flexible labor market ($\varphi^* > 0.5$), showing that if the labor market is sufficiently flexible, the supply-side multiplier is always lager than the austerity multiplier, and the Austerity Threshold does not exist.

In intuitive terms, Corollary 6 states that the store can be so congested, that decreasing tightness by removing government customers from the queue could be more effective at crowding in private consumption than enlarging the store by tax cuts. In particular, this could only be the case when the elasticities of labor demand and labor supply are sufficiently low, so that tax cuts that encourage more labor demand are not effective at increasing equilibrium employment and capacity. Based on our results about cyclical fluctuations in tightness in Lemma 2, the Austerity Threshold could be reached in an economy with sufficiently inelastic labor markets, which is hit by either a very strong positive demand-side shock or following a severe negative supply-side shock.

5. Fiscal multipliers in a quantitative dynamic model

In this section, we develop and calibrate a discrete-time dynamic version of our model and use a non-linear solution method in order to quantitatively assess cyclical properties of both spending and taxation multipliers, conditional on different sources of fluctuations.[19] Relative to our static model, we make the additional assumption of *long-term customer relationships* between households and firms, which is empirically relevant and it allows us to map our matching process to realistic goods market frictions.[20] The dynamic model corroborates the finding in our static model and shows substantial state dependence *conditional* on a particular type of shock that drives the business cycle, especially for impact multipliers.[21]

[18] Note that $\tilde{x} \geq \hat{x}$. Reaching the Austerity Threshold requires tightness to be larger than the threshold that makes the government spending multiplier negative, defined in Corollary 2.

[19] In this section we limit our attention to multipliers out of government consumption and payroll tax cuts. In Appendix H.2, we study cyclical properties of multipliers out of cuts in taxes on consumption and labor supply in our dynamic model.

[20] Michaillat and Saez (2015) offer cross-country evidence that long-term customer relationships are prevalent in goods markets; for example, they report that in the US around 77 per cent of sales go to long-term customers. Moreover, Gourio and Rudanko (2014) show theoretically how such desire to accumulate long-term customers can be microfounded.

[21] In this section we overview the model, the full set of decentralized equilibrium conditions is given in Appendix H.1.

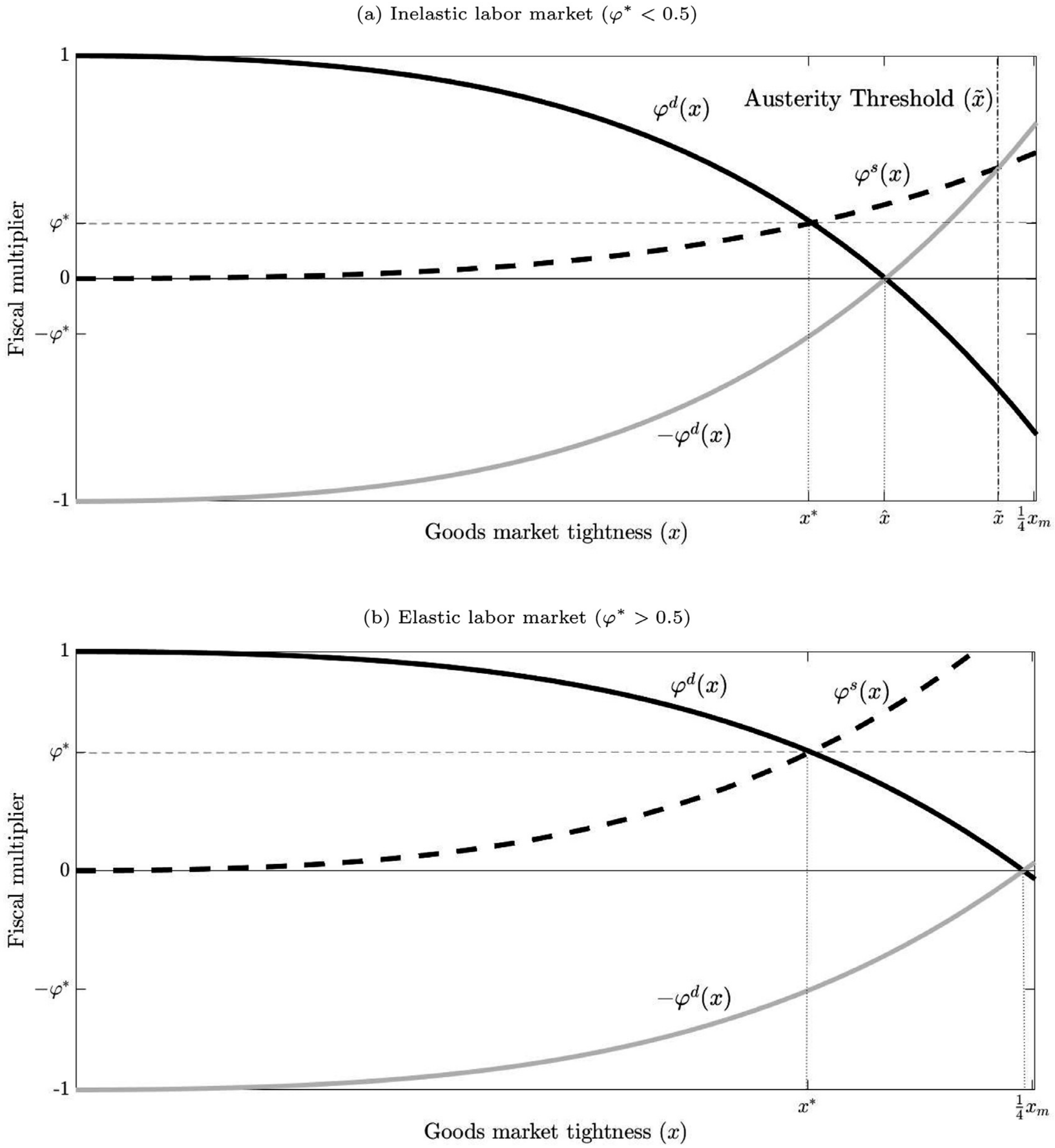

Fig. 3. Comparing fiscal multipliers in a fixprice equilibrium. *Notes:* Panels (a) and (b) show demand-side, supply-side and spending austerity multipliers in a fixprice equilibrium of a calibrated version of our model ($\delta = 2, \rho = 0.1, \psi = 0.2$); in Panel (a), we set $\alpha = 0.3$, so that the elasticity of labor demand is relatively low and $\varphi^* = 0.25 < 0.5$ – in this case one can see that Austerity Threshold $\tilde{x}$ exists, and for all $x \in (\tilde{x}, x_m)$ spending-austerity is the policy with the highest multiplier; in Panel (b), we set $\alpha = 0.65$ so that labor demand is relatively elastic and $\varphi^* = 0.57 > 0.5$ – in this case, Austerity Threshold does not exist and spending austerity is never the policy with the highest multiplier.

5.1. Goods market with long-term customer relationships

Sales materialize through *long-term customer relationships* between firms and consumers from private and government sectors that are subject to an exogenous destruction rate η per period. The total number of long-term customer relationships at the end of period t is y_t. At the beginning of each period t, firms inherit $(1-\eta)y_{t-1}$ relationships that have survived destruction in the previous period $t-1$, and they hire labor n_t to yield current capacity $k_t = a_t n_t^{\alpha}$, which they utilize through the relationships carried over from last period, leaving $[k_t - (1-\eta)y_{t-1}]$ as unutilzed capacity. Households and the government make v_t visits to form new relationships that fill the unutilzed capacity. However, not every purchasing visit is successful. The number of new customer relationships formed in each period is tracked by the matching function:

$$\left[(k_t - (1-\eta)y_{t-1})^{-\delta} + v_t^{-\delta}\right]^{-\frac{1}{\delta}}, \tag{12}$$

where $\delta > 0$ ensures that not every unit of unitilized capacity is filled and not every visit is successful. Goods market tightness is defined as: $x_t \equiv \frac{v_t}{k_t-(1-\eta)y_{t-1}}$, and the probability of filling a unit of unutilized capacity is given by $f(x_t) \equiv (1+x_t^{-\delta})^{-\frac{1}{\delta}}$, $f' > 0$, whereas the probability of a given visit yielding a new relationship is given by $q(x_t) \equiv (1+x_t^{\delta})^{-\frac{1}{\delta}}$, $q' < 0$.

5.2. Households

As in the static version of our model, households face a cost $\rho \in (0, 1)$ of consumption goods per visit. They form long-run customer relationships both to consume and purchase goods that go towards satisfying the total cost of visits. At the beginning of period t, households have $(1-\eta)y^c_{t-1}$ relationships that survived from the previous period, and the number of new relationships formed in period t is: $y^c_t - (1-\eta)y^c_{t-1}$. Since every visit is only successful with probability $q(x_t)$, the total number of visits required to form new relationships in period t is $(y^c_t - (1-\eta)y^c_{t-1})/q(x_t)$, yielding the following expression for y^c_t: $y^c_t = c_t + \rho\left[\frac{y^c_t-(1-\eta)y^c_{t-1}}{q(x_t)}\right]$, which can be rearranged to obtain a more familiar-looking expression for y^c_t:

$$y^c_t = [1+\gamma(x_t)]c_t - (1-\eta)\gamma(x_t)y^c_{t-1}, \tag{13}$$

where, as before, $\gamma(x_t) \equiv \frac{\rho x_t}{f(x_t)-\rho x_t}$ is the wedge introduced by search-and-matching frictions.

There is a continuum of identical infinitely lived households. Markets are assumed to be complete, so a full set of Arrow–Debreu securities is available. The representative household is small relative to the size of the market, and maximizes expected discounted lifetime utility, taking prices, wages and goods market tightness as given:

$$\max_{\{c_{t+s}, y^c_{t+s}, m_{t+s}, B_{t+s+1}, l_{t+s}\}_{s=0}^{\infty}} \mathbb{E}_t \sum_{s=0}^{\infty} \beta^s \left[\chi_{t+s}\frac{c_{t+s}^{1-\sigma}}{1-\sigma} + \zeta(m_{t+s}) - \nu\frac{l_{t+s}^{1+\psi}}{1+\psi}\right] \tag{14}$$

subject to Eq. (13) and the following budget constraint: $p_t y^c_t + m_t + \mathbb{E}_t\left[F_{t,t+1}B_{t+1}\right] \le w_t l_t + \bar{m}_t + B_t + \Pi_t - T_t, \forall t \ge 0$, where $\ln\chi_t = \rho_\chi \ln\chi_{t-1} + \varepsilon^\chi_t, \varepsilon^\chi_t \sim^{iid} (0, \sigma^2_\chi)$, is an exogenous process for the relative preference for consumption, β is the utility discount factor, ν captures relative labor disutility, and the rest of the notation carries over from the static version of the model. The exogenous supply of the non-produced good is assumed to be constant over time ($\bar{m}_t = \bar{m}, \forall t \ge 0$), normalized so that $\zeta'(\bar{m}) = 1$.

5.3. Firms

There is a continuum of identical perfectly competitive producing a homogenous good. At the beginning of each period t, firms have $(1-\eta)y_{t-1}$ customer relationships that have survived from the previous period $t-1$. Firms hire labor n_t that yields current capacity $k_t = a_t n_t^\alpha$, leaving $[a_t n_t^\alpha - (1-\eta)y_{t-1}]$, a fraction $f(x_t)$ of which is then utilized. The latter gives the following equation of motion for firms' sales:

$$y_t = (1-\eta)y_{t-1} + f(x_t)[a_t n_t^\alpha - (1-\eta)y_{t-1}], \qquad \forall t \ge 0 \tag{15}$$

where $\ln a_t = \rho_a \ln a_{t-1} + \varepsilon^a_t$, and $\varepsilon^a_t \sim^{iid} (0, \sigma^2_a)$, is an exogenous process for productivity.

The representative firm is small relative to the size of the market, and therefore maximizes its lifetime discounted profits taking prices, wages, and tightness as given:

$$\max_{\{y_{t+s}, n_{t+s}\}_{s=0}^{\infty}} \mathbb{E}_t \sum_{s=0}^{\infty} F_{t,t+s}[p_{t+s}y_{t+s} - w_{t+s}n_{t+s}(1+\tau_{t+s})] \tag{16}$$

subject to Eq. (15).

5.4. Government

In the baseline version of our model, government consumption is isomorphic to private consumption. Given a sequence of government spending $\{G_t\}_{t=0}^{\infty}$, the government's customer relationships y^G_t evolve in the same way as those of the households described in (13). The government levies a lump-sum tax T_t on households to run balanced budgets every period, given a sequence of payroll tax rates $\{\tau_t\}_{t=0}^{\infty}$: $\quad T_t = p_t y^G_t - w_t n_t \tau_t, \forall t \ge 0$

We assume exogenous autoregressive paths for government spending: $G_t = (1-\rho_G)g + \rho_G G_{t-1} + \varepsilon^G_t, \forall t \ge 0$ and payroll tax rates: $\tau_t = (1-\rho_\tau)\tau + \rho_\tau\tau_{t-1} + \varepsilon^\tau_t, \forall t \ge 0$, where $\{\varepsilon^G\}_t \sim^{iid} (0, \sigma^2_G)$ and $\{\varepsilon^\tau\}_t \sim^{iid} (0, \sigma^2_\tau)$ are exogenous government spending and payroll taxation shocks, respectively.

5.5. Closing the model: pricing rule

Recall that in the main text we introduced broad classes of flexible and frictional equilibria, which differ in the way the model is closed. We are going to follow a similar approach in our dynamic model. As an example of a flexible equilibrium,

Table 1
Parameter calibrations (United States, annual frequency).

Parameter	Description	Value	Source/target
Household parameters			
β	Time discount factor	0.96	Annual real rate of 4 per cent
σ	Relative risk aversion	1.00	Chetty (2006)
ψ	Inverse Frisch elasticity of labor supply	0.50	Standard
ν	Disutility of supplying labor	2.13	Target $l = 1/3$
Firm parameters			
α	Returns to labor	0.60	Standard
ε	Price rigidity	0.70	Standard
Goods market parameters			
η	Rate of destruction of customer relationships	0.40	Mattersion (2001)
ρ	Goods cost per visit	0.41	Target $q(x) = 0.77$
δ	Elasticity parameter of the matching function	3.62	Target $\left[\frac{f(x)}{\eta+f(x)(1-\eta)}\right]^{\frac{1}{\alpha}} = 0.91$
Fiscal policy parameters			
g	Steady state government spending	0.07	Target $g/(c+g) = 0.18$
τ	Steady state firms' payroll tax rate	0.20	–
Exogenous processes parameters			
$\rho_\chi = \rho_a = \rho_G = \rho_\tau$	Persistence of exogenous processes	0.90	Standard

one could consider our equilibrium conditions, augmented by a sequence of prices $\{\tilde{p}_t\}_{t=0}^{\infty}$ that would ensure that resulting equilibrium tightness is at the same level that would be chosen by a social planner.[22]

As an example of a frictional equilibrium, one could close the model with a pricing equation that describes persistent adjustment to the price $\tilde{p}_t$: $p_t = p_{t-1}^{\varepsilon}\tilde{p}_t^{1-\varepsilon}, \forall t \geq 0$, where $\varepsilon \in (0, 1]$ pins down the degree of price rigidity.

5.6. Calibration

We calibrate the model on US data at annual frequencies. We set $\beta = 0.96$ (to produce a real interest rate of 4 per cent in steady state), $\sigma = 1.00$, $\psi = 0.50$ and $\alpha = 0.60$. The labor disutility parameter $\nu = 2.33$ is set to target a steady-state employment rate of 1/3. The degree of price rigidity is calibrated at $\varepsilon = 0.70$. We set $\eta = 0.40$, which yields the rate of destruction of customer relationships equal to 40 per cent per year (based on US customer attrition evidence in Mattersion, 2001).

The cost per visit ρ and elasticity of marching function δ are non-standard parameters. We calibrate them by targeting the steady-state rate of current labor utilization $\left[\frac{f(x)}{\eta+f(x)(1-\eta)}\right]^{\frac{1}{\alpha}}$ (estimated at 0.91 as the long-run average of labor utilization rate, reported by the Institute for Supply Management)[23] and the steady-steady probability of a successful shopping visit $q(x)$ (estimated at 0.77 as one minus the average stock-out rate, reported by Taylor and Fawcett (2001) and Jing and Lewis (2011).

Steady state of government spending parameter g is set to match the spending-to-GDP ratio equal to 18% in steady state. The steady-state payroll tax rate τ is calibrated to be equal to 0.20. Finally, all autoregressive parameters are set equal at 0.9, so that $\rho_\chi = \rho_a = \rho_G = \rho_\tau = 0.9$. Table 1 summarizes the calibration.

5.7. Conditional *state-dependent fiscal multipliers*

To quantitatively assess the degree of state-dependence of fiscal multipliers and its variation with the source of business cycle fluctuations, we compute spending and tax cut multipliers in recessionary and expansionary episodes, conditioning on whether a particular episode was generated by a demand or supply shock. We consider a fully non-linear solution to our model under perfect foresight.

We first compute the impulse response of GDP to a one-time preference/technology shock, $\{GDP_j^{shock}\}_{j=0}^{H}$, where $shock \in \{\varepsilon^\chi, \varepsilon^a\}$; we then compute the impulse response of GDP subject to the same shock, combined with either a spending shock $\{\varepsilon^G > 0\}$ or a tax cut shock $\{-\varepsilon^\tau < 0\}$, to obtain time series that embed the interaction between the fundamental shock driving the business cycle and the shock related to the expansion in government spending, $\{GDP_j^{shock+\varepsilon^G}\}_{j=0}^{H}$, or reduction in taxes, $\{GDP_j^{shock-\varepsilon^\tau}\}_{j=0}^{H}$. We construct the *conditional* government spending multiplier as follows:

$$\varphi^G(shock) = \frac{\sum_{j=0}^{H}\left[GDP_j^{shock+\varepsilon^G} - GDP_j^{shock}\right]}{\sum_{j=0}^{H}\left[G_j^{\varepsilon^G} - g\right]}, \tag{17}$$

[22] Appendix G.2 provides the solution to the social planner's problem in the dynamic model.

[23] From the equation of motion of firms' sales in (15) it follows that in steady state $y = \frac{f(x)}{\eta+f(x)(1-\eta)}an^\alpha = a\left\{\left[\frac{f(x)}{\eta+f(x)(1-\eta)}\right]^{\frac{1}{\alpha}}n\right\}^\alpha$, so that $\left[\frac{f(x)}{\eta+f(x)(1-\eta)}\right]^{\frac{1}{\alpha}}$ is the steady-state labor utilization rate.

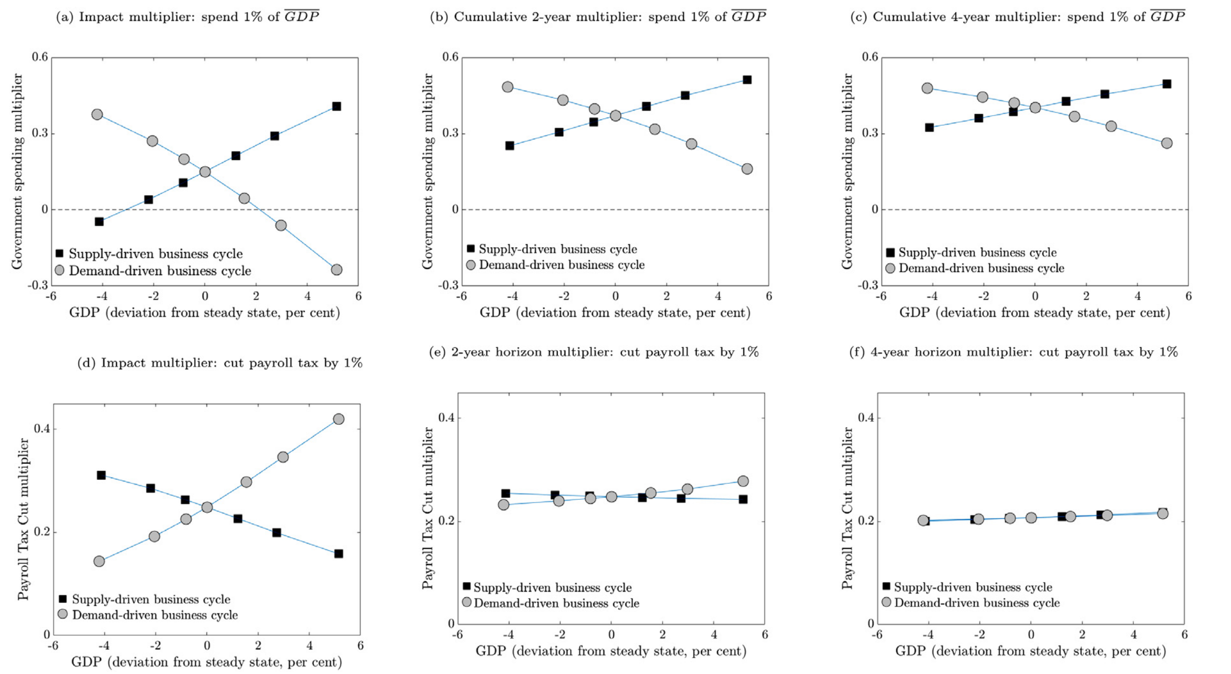

Fig. 4. Conditional state-dependent fiscal multipliers. *Notes:* Panel (a) shows impact multipliers following a one-time innovation to the government spending process equal to 1% of steady-state GDP, in recessionary and expansionary episodes caused by different types of shocks; Panels (b) and (c) repeat the exercise for cumulative multipliers, computed over a 2-year and 4-year horizon, respectively. Panel (d) shows impact multipliers following a one-time innovation to the payroll tax rate process equal to negative 1 percentage point, in recessionary and expansionary episodes caused by different types of shocks; Panels (e) and (f) repeat the exercise for the 2-year and 4-year horizon tax cut multipliers, respectively.

where $\left\{G_j^{\varepsilon^G}\right\}_{j=0}^{H}$ is the impulse response of government spending to the spending shock $\{\varepsilon^G > 0\}$ and H is the horizon of the impulse response, so that $\sum_{j=0}^{H}\left[G_j^{\varepsilon^G} - g\right]$ denotes a cumulative increase in government spending compared to its steady-state value.

Similarly, we construct horizon-H *conditional* tax cut multipliers out of cutting the rate of tax τ_t as:

$$\varphi^{\tau}(shock) = \frac{\left[GDP_H^{shock-\varepsilon^{\tau}} - GDP_H^{shock}\right]/\overline{GDP}}{\varepsilon^{\tau}} \tag{18}$$

where $\overline{GDP}$ is steady-state level of GDP.

We calibrate $\varepsilon^G = 0.01\overline{GDP}$ to consider a one-period spending shock equal to 1 per cent of steady-state GDP; further, we set $\varepsilon^{\tau} = 0.01$, so that we consider a 1 percentage point cut in the rate of the payroll tax.

To investigate the link between state dependence and the horizon of the response, we distinguish between the *impact* multipliers ($H = 0$), and *cumulative* 2-year ($H = 2$) and 4-year ($H = 4$) multipliers, following the convention in the empirical literature that considers a two- and four-year horizons (Ramey and Zubairy, 2018).

Fig. 4 shows our constructed *conditional* government spending and payroll tax cut multipliers. Panel (a) plots the impact of the government spending multiplier, which is equal to around 0.15 when GDP is at the steady-state value. A strong demand-driven recession that takes GDP 4 per cent below the steady state, raises the spending multiplier to 0.40. On the other hand, a demand-driven expansion that raises output 4 per cent above the steady state, decreases the multiplier to −0.2. Under supply-driven fluctuations, the cyclicality of spending multipliers is reversed. In a supply-driven recession, where GDP drops 4 per cent below the steady state, the spending multiplier drops to around −0.05, and in a 4 per cent supply-driven expansion the multiplier increases to around 0.30. From Panels (b) and (c), the above properties are preserved for cumulative spending multipliers, although the degree of state dependence is weaker. This is because price rigidity is crucial for state dependence in our model, and over the five-year horizon a higher fraction of firms gets to adjust prices.

Panel (d) of Fig. 4 shows that the impact multiplier out of payroll tax cuts is close to 0.25 in steady state, but almost doubles in size in a 4 per cent demand-driven expansion, and increases to 0.30 in a 2 per cent supply-side recession. However, it drops to almost 0.15 in a 4 per cent demand-side recession and a 4 per cent supply-side expansion. As before, Panel (e) and (f) show that the two- and four-year horizon multipliers out of payroll tax cuts preserve the properties of their impact counterparts, although state dependence is significantly muted.

5.8. Implications for fiscal policy during the Covid-19 crisis

Our results are linked to the recent research on the size of fiscal multipliers during the large and unprecedented stimulus in response to the Covid-19 crisis, which has been fundamentally different from previous recessions, since it involved lockdown policies and supply-chain issues that limited the supply capacity of the economy (Baek et al., 2021).

Through the lens of our model, the supply constraints weakened the effectiveness of fiscal spending by reducing the idle capacity of the economy, with additional government spending having a limited impact on production. Empirical studies such as Auerbach et al. (2022) support such conclusions, as they find that the size of spending multiplier was high only in cities that were not subject to strong stay-at-home orders.

Our framework suggests that fiscal multipliers from supply-side tax cuts could, in principle, be powerful in counteracting supply-side restrictions, such as the ones created by the Covid-19 crisis. However, the nature of the restrictions during the Covid-19 crisis, such as restrained mobility of goods and the time lag involved with the implementation of tax cuts may also limit the effectiveness of supply-side stimuli. In this sense, empirical evaluation of multipliers out of tax cuts in recessions, such as the one caused by Covid-19, is a promising avenue for future research.

6. Econometric evidence

This section develops and estimates a novel econometric model that allows to perform reduced-form estimation of *conditional* state-dependent fiscal multipliers, controlling for either the demand- or supply-driven nature of a given recessionary or expansionary state. We find strong empirical support to our theoretical predictions: the estimated spending multipliers in demand-side recessions are substantially higher than those in supply-side recessions, particularly at shorter horizons. At the same time we find tax cut multipliers to be significantly higher in supply-side recessions compared to the demand-side ones.

6.1. Conditional state-dependent fiscal multipliers

We use the local projection methodology of Jordà (2005) to evaluate spending and tax cut multipliers in recessionary and expansionary episodes, *conditional* on those being demand- or supply-driven. Our approach identifies demand- and supply-driven fluctuations using observed co-movement between cyclical components of economic activity and inflation. In accordance with the insights of a wide range of models, a demand-side recession is characterized by a joint fall in economic activity and inflation while a supply-driven recession is characterized by a fall in economic activity and a rise in inflation.[24] This study is the first one to estimate state-dependent fiscal multipliers controlling for the source of fluctuations.

6.1.1. Conditional state-dependent spending multipliers

We extend the one-step IV procedure from Ramey and Zubairy (2018) to account for the source of economic fluctuations. Instead of distinguishing between expansions and recessions using an unconditional unemployment threshold $\bar{U}$, we split recessionary states, where $U_t \geq \bar{U}$, into those where inflation is below its trend value, $\pi_t < \bar{\pi}_t$, corresponding to demand-side recessions, and those where inflation is above trend, $\pi_t \geq \bar{\pi}_t$, corresponding to supply-side recessions. In Appendix I we additionally split expansionary states, $U_t < \bar{U}$, into those where inflation is below its trend value, $\pi_t < \bar{\pi}_t$, corresponding to supply-side expansions, and those where inflation is above trend, $\pi_t \geq \bar{\pi}_t$, corresponding to demand-side expansions. Our baseline specification to estimate cumulative spending multipliers at horizon H is:

$$\begin{aligned}\sum_{s=t}^{t+H}\left(\frac{GDP}{GDP^*}\right)_s = {} & \mathbf{1}\{U_{t-1} < \bar{U}\}\left[\alpha_H^E + \beta_H^E \sum_{s=t}^{t+H}\left(\frac{G}{GDP^*}\right)_s + \gamma_H^E \mathbf{z}_{t-1}\right] \\ & + \mathbf{1}\{U_{t-1} \geq \bar{U}; \pi_{t-1} < \bar{\pi}_{t-1}\}\left[\alpha_H^{DR} + \beta_H^{DR} \sum_{s=t}^{t+H}\left(\frac{G}{GDP^*}\right)_s + \gamma_H^{DR} \mathbf{z}_{t-1}\right] \\ & + \mathbf{1}\{U_{t-1} \geq \bar{U}; \pi_{t-1} \geq \bar{\pi}_{t-1}\}\left[\alpha_H^{SR} + \beta_H^{SR} \sum_{s=t}^{t+H}\left(\frac{G}{GDP^*}\right)_s + \gamma_H^{SR} \mathbf{z}_{t-1}\right] + \varepsilon_{t+H},\end{aligned} \tag{19}$$

where $\sum_{s=t}^{t+H}\left(\frac{GDP}{GDP^*}\right)_s$ and $\sum_{s=t}^{t+H}\left(\frac{G}{GDP^*}\right)_s$ are cumulative real GDP and real government expenditures, both normalized by trend real GDP (GDP^*),[25] $\mathbf{z}_{t-1}$ is a vector of controls[26] and $\mathbf{1}\{.\}$ is the indicator variable. The above equation is estimated by 2SLS, where the instrument set includes exogenous government spending shocks interacted with the state-specific indicator variable.

[24] In Appendix I.1 we take a closer look at which specific episodes are classified as demand- or supply-driven recessions.

[25] Following Ramey and Zubairy (2018), this normalization is to ensure cumulative GDP and government spending are measured in the same units, which avoids the need to covert estimates in logs to levels.

[26] The precise set of variables used as controls is outlined in description to the relevant regression tables.

An advantage of this approach is that our estimates for β_H^E, β_H^{DR}, and β_H^{SR} directly give us values for horizon-H cumulative spending multipliers in, respectively, expansions (E), demand-side recessions (DR), and supply-side recessions (SR). Our theory predicts that spending multipliers in demand-side recessions are higher that those in supply-side recessions, so that $\beta_H^{DR} > \beta_H^{SR}$, and we can test this prediction.

6.1.2. Conditional state-dependent tax cut multipliers

In a similar fashion, we use local projections to estimate *conditional* state dependence for tax cut multipliers. Our baseline specification to estimate tax cut multipliers at horizon H is given by:

$$\begin{aligned} \ln GDP_{t+H} - \ln GDP_{t-1} = &\ \mathbf{1}\{U_{t-1} < \bar{U}\}\left[\alpha_H^E + \beta_H^E \tau_t + \gamma_H^E \mathbf{z}_{t-1}\right] \\ &+ \mathbf{1}\{U_{t-1} \geq \bar{U}; \pi_{t-1} < \bar{\pi}_{t-1}\}\left[\alpha_H^{DR} + \beta_H^{DR} \tau_t + \gamma_H^{DR} \mathbf{z}_{t-1}\right] \\ &+ \mathbf{1}\{U_{t-1} \geq \bar{U}; \pi_{t-1} \geq \bar{\pi}_{t-1}\}\left[\alpha_H^{SR} + \beta_H^{SR} \tau_t + \gamma_H^{SR} \mathbf{z}_{t-1}\right] + \varepsilon_{t+H}, \end{aligned} \tag{20}$$

where τ_t is an exogenous shock to the average tax rate in the economy, and the rest of the notation carries over from the spending multiplier regressions. Given a time series for exogenous tax rate shocks, the above specification is estimated by OLS.

The estimates for β_H^E, β_H^{DR}, and β_H^{SR} directly provide values for horizon-H tax cut multipliers in, respectively, expansions (E), demand-side recessions (DR), and supply-side recessions (SR). Our theory predicts that tax cut multipliers in demand-side recessions are lower than those in supply-side recessions.

6.2. Data

We estimate the model using quarterly US data. We use the series for real GDP (GDP), civilian unemployment (U), and government consumption and fixed capital formation (G) data that extend back to 1889 by Ramey and Zubairy (2018). Trend GDP (GDP^*) is measured as sixth-order polynomial exponential trend of real GDP, following Gordon and Krenn (2010). We measure quarterly inflation (π_t) as year-on-year change in (log) GDP deflator, and trend inflation ($\bar{\pi}_t$) is obtained by HP-filtering the raw inflation series with a smoothing parameter $\lambda = 1600$ for quarterly data. The baseline unemployment threshold is set at $\bar{U} = 6.5\%$, consistent with Ramey and Zubairy (2018).

Our baseline measure of government spending shock is the narrative military spending news shocks in Ramey and Zubairy (2018), and for tax rate shocks we use the measure in Romer and Romer (2010).

For spending multipliers, the sample is 1909:Q1-2015:Q4; for tax cut multipliers, we use the shorter sample 1947:Q1-2007:Q4, as driven by availability of tax shocks in Romer and Romer (2010).[27]

6.3. Empirical results

6.3.1. Conditional state-dependent spending multipliers

Table 2 shows baseline estimation results for spending multipliers. Column (1) shows that the 2-year cumulative spending multiplier is equal to 0.70 without any conditioning on the source of fluctuations. Column (2) replicates the exercise in Ramey and Zubairy (2018), by distinguishing between recessions and expansions based on an unconditional unemployment threshold. The 2-year cumulative multiplier is equal to 0.68 in expansions, which is larger than the estimated recession multiplier equal to 0.54, although the difference is not statistically significant. These estimates blend demand- and supply-driven episodes, while our theory shows that the source of fluctuations is crucial to establish an estimate for the spending multiplier. To test our theoretical prediction, column (3) separately estimates 2-year cumulative spending multipliers in demand- and supply-driven recessions. Consistent with our theoretical findings, the spending multiplier in demand-driven recessions is equal to 0.86, larger than the multiplier of 0.32 in supply-driven recessions.

Columns (4)-(6) repeat the exercise for 4-year cumulative multipliers. As before, conditioning on recessions and expansions delivers spending multipliers that are slightly higher in expansions (0.76) than in recessions (0.65), although the difference is not statistically significant. Instead, controlling for whether recessions are generated by demand- or supply-side shocks corroborates our theory: spending multipliers are higher in demand-side recessions (0.71) than in supply-side recessions (0.63), although the difference is smaller than in the case of 2-year multipliers. The finding that conditional state dependence becomes weaker at longer horizons is consistent with our theory, as verified in the quantitative dynamic model. At longer time horizons, prices adjust to shocks and tightness plays a smaller role in business cycle adjustment, bringing the multiplier closer to its value under flexible prices, determined by the elasticities of labor demand and labor supply.

To investigate the relationship between the degree of conditional state dependence and the horizon of cumulation, Fig. 5 repeats the exercise for horizons from 4 to 20 quarters. In Panel (a), we do not condition on the source of fluctuations and

[27] The narrative military spending news shocks series from Ramey and Zubairy (2018) goes back to 1889:Q1, but we exclude the first twenty years of their sample due to excessive volatility of inflation in that time period. Our baseline results are robust to considering the full sample and are available upon request.

Table 2
Conditional state-dependent spending multipliers ($\bar{U} = 6.5\%$); US military spending news shocks.

US data: 1909:Q1–2015:Q4	2-year horizon			4-year horizon		
State	(1)	(2)	(3)	(4)	(5)	(6)
β_H: Linear	**0.70*** **			**0.75*** **		
	(0.06)			*(0.06)*		
$\beta_H^E : \mathbf{1}\{U_t < \bar{U}\}$		**0.68*** **	**0.68*** **		**0.76*** **	**0.76*** **
		(0.10)	*(0.09)*		*(0.13)*	*(0.12)*
$\beta_H^R : \mathbf{1}\{U_t \geq \bar{U}\}$		**0.54*** **			**0.65*** **	
		(0.13)			*(0.08)*	
$\beta_H^{DR} : \mathbf{1}\{U_t \geq \bar{U}; \pi_t < \bar{\pi}_t\}$			**0.86*** **			**0.72*** **
			(0.33)			*(0.12)*
$\beta_H^{SR} : \mathbf{1}\{U_t \geq \bar{U}; \pi_t \geq \bar{\pi}_t\}$			**0.32*** **			**0.63*** **
			(0.11)			*(0.09)*
$\beta_H^E = \beta_H^R$ (p-value)		0.37			0.44	
$\beta_H^{DR} = \beta_H^{SR}$ (p-value)			0.14			0.54
T	416	416	416	408	408	408

Notes: HAC standard errors are reported in parentheses, with ***(**,*) denoting statistical significance at 1%(5%, 10%) level; all regressions include a set of controls, consisting of four lags of real GDP, real government spending and military spending news shocks, all normalized by trend real GDP as well as a constant (coefficients on controls are allowed to be state-specific).

Table 3
Conditional state-dependent tax cut multipliers ($\bar{U} = 6.5\%$; US Romer–Romer narrative tax shocks).

US data: 1947:Q1–2007:Q4	2-year horizon			4-year horizon		
State	(1)	(2)	(3)	(4)	(5)	(6)
β_H: Linear	1.50			**1.71** **		
	(1.14)			*(0.82)*		
$\beta_H^E : \mathbf{1}\{U_t < \bar{U}\}$		1.81	1.81		**2.37** **	**2.37** **
		(1.17)	*(1.12)*		*(0.99)*	*(0.99)*
$\beta_H^R : \mathbf{1}\{U_t \geq \bar{U}\}$		0.98			1.24	
		(1.07)			*(0.87)*	
$\beta_H^{DR} : \mathbf{1}\{U_t \geq \bar{U}; \pi_t < \bar{\pi}_t\}$			1.49			-1.98
			(1.04)			*(2.75)*
$\beta_H^{SR} : \mathbf{1}\{U_t \geq \bar{U}; \pi_t \geq \bar{\pi}_t\}$			**4.29***			**1.80***
			(2.18)			*(1.00)*
$\beta_H^E = \beta_H^R$ (p-value)		0.48			0.39	
$\beta_H^{DR} = \beta_H^{SR}$ (p-value)			0.25			0.20
T	240	240	240	240	240	240

Notes: HAC standard errors are reported in parentheses, with ***(**,*) denoting statistical significance at 1%(5%, 10%) level; all regressions include a set of controls, consisting of four lags of (log) real GDP as well as a constant (coefficients on controls are allowed to be state-specific).

simply distinguish between recessions and expansions; consistently with Ramey and Zubairy (2018), very limited state dependence is detected, with formal statistical tests showing no significant differences at any horizon. However, when we condition on the source of fluctuations in Panel (b), we find that, consistent with our theory, spending multipliers in demand-side recessions are higher than those in supply-side recessions at all horizons. Moreover, the degree of such conditional state dependence is strongest at shorter horizons: 4 quarters after a spending shock, the cumulative spending multiplier is close to one in demand-driven recessions, but close to zero in supply-side recessions. On the other hand, and again consistent with our theory, multipliers in demand- and supply-side recessions become very similar after 12 quarters. We formally test the restriction $\beta_H^{DR} = \beta_H^{SR}$, which implies that the source of fluctuations does not matter as in Ramey and Zubairy (2018), and can reject it at the 10% level at 6- and 7-quarter horizons, and at 32% level for all horizons between 4 and 11 quarters.

6.3.2. Conditional state-dependent tax cut multipliers

Table 3 shows baseline estimation results for tax cut multipliers. Column (1) shows that 2-year tax cut multiplier is 1.50 without any conditioning on the state of the economy, and not significantly different from zero. The lack of significance could be explained by the fact that tax cuts affect GDP through expansions in capacity, a very gradual process that is difficult to detect within 2 years. Column (3) conditions the estimates on recessions, and it shows that the tax cut multiplier is equal to 1.81 in expansions and 0.98 in recessions, although again neither are significantly different from zero. As before, the recessionary states blend demand- and supply-driven episodes, and our theory predicts that tax cut multipliers are larger in supply-side recessions. Results in column (3), derived by controlling for the source of fluctuations, support our theoretical

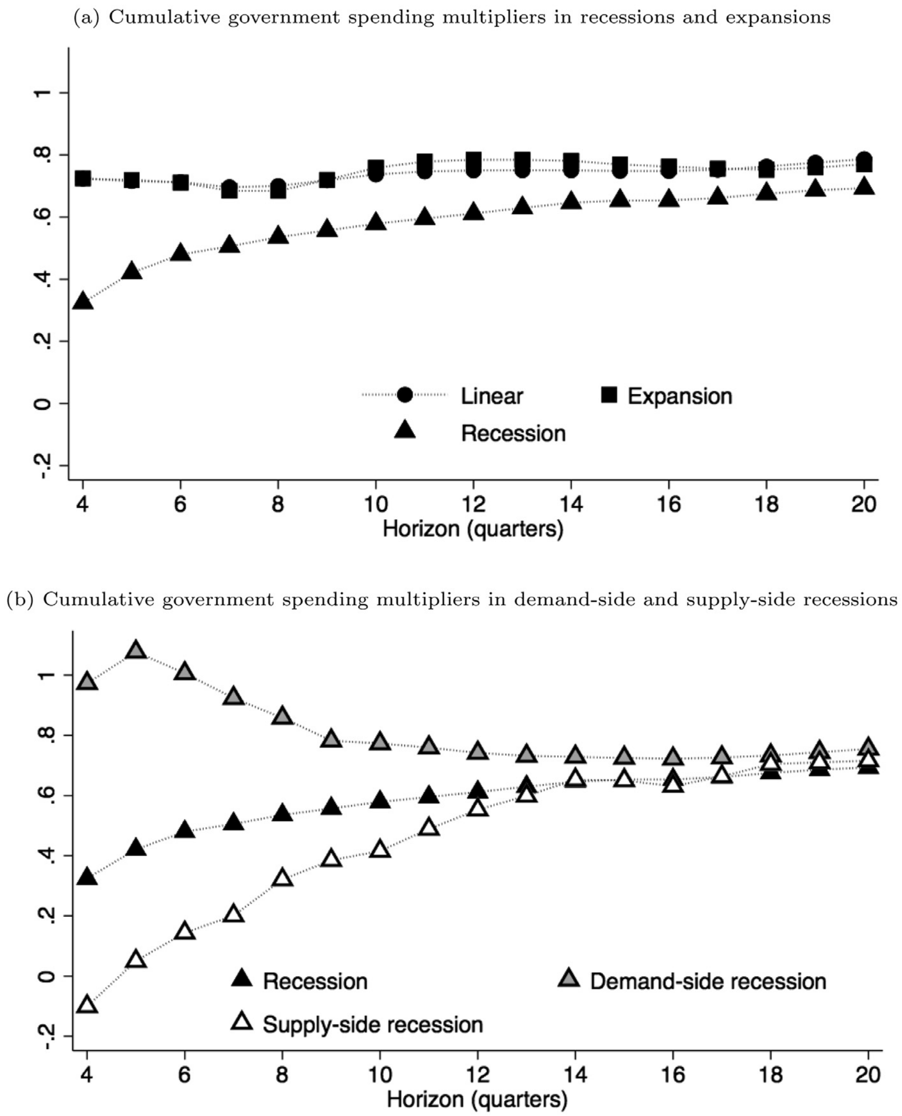

Fig. 5. Government spending multipliers across horizons (US military spending news shocks, 1909–2015). *Notes:* Panel (a) shows cumulative government spending multipliers estimated in recessionary $\mathbf{1}\{U_t \geq \bar{U}\}$ and expansionary $\mathbf{1}\{U_t < \bar{U}\}$ episodes as well as linear benchmarks for different cumulation horizons $4 \leq H \leq 20$; Panel (b) shows cumulative government spending multipliers estimated in demand-side recessionary episodes $\mathbf{1}\{U_t \geq \bar{U}; \pi_t < \bar{\pi}_t\}$ and supply-side recessionary episodes $\mathbf{1}\{U_t \geq \bar{U}; \pi_t \geq \bar{\pi}_t\}$ as well as unconditional recessions $\mathbf{1}\{U_t \geq \bar{U}\}$ for different horizons $4 \leq H \leq 20$; we set $\bar{U} = 6.5\%$ in all estimations.

prediction: in demand-driven recessions, the tax cut multiplier is 1.49 and not significantly different from zero, whereas in supply-side recessions it is 4.29, and statistically significant at 10% level.

Columns (4)–(6) repeat the tax-cut estimation exercise for the 4-year horizon. The unconditional tax cut multiplier in column (4) is 1.71 and statistically significant at 5% level. The fact that the multiplier is significant at 4-year horizon, and not at 2-year horizon, is consistent with the fact that capacity expansion is considered to be a gradual process. Column (5) reports that the tax cut multiplier is equal to 2.37, and significant at 5 per cent level, in expansions, but lower and equal to 1.24 and insignificant in recessions. Column (6) shows estimates that control for demand- and supply-side recessions, showing that in supply-side recessions the multiplier is higher at 1.80, and significant at 10 per cent, whereas it is negative at −1.98 and highly insignificant in demand-side recessions.

Fig. 6 investigates the relationship between conditional state dependence of tax cut multipliers and the horizon considered. In Panel (a), we do not condition on the source of fluctuations and simply distinguish between recessions and expansions: as one can see, very limited state dependence is detected in this case. However, once we condition on the source of fluctuations in Panel (b), the tax cut multiplier in supply-side recessions is consistently higher than the multiplier in demand-side recessions, as our theory predicts, except for 4- and 5-quarter horizons. Unlike the spending multiplier, con-

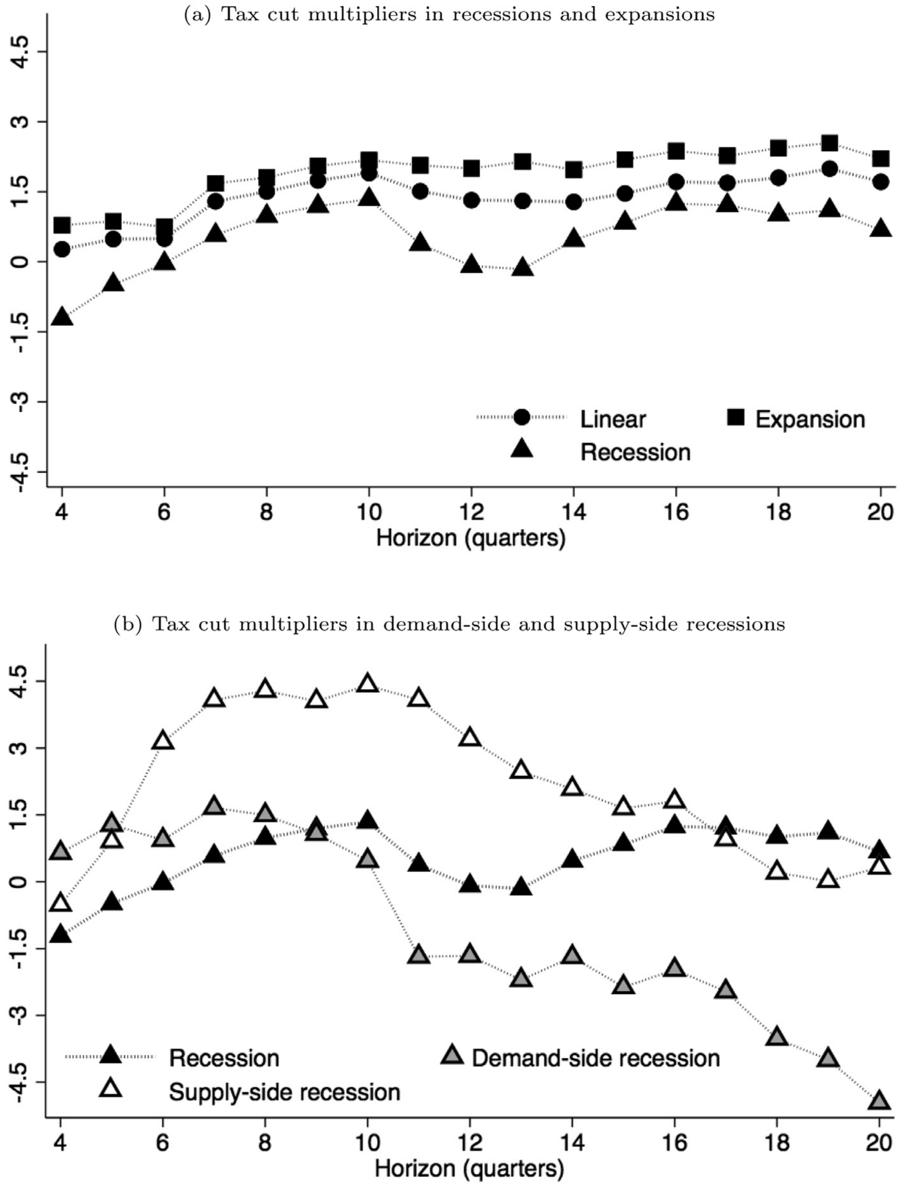

Fig. 6. Tax cut multipliers across horizons (US Romer–Romer narrative tax shocks, 1947–2007). *Notes:* Panel (a) shows tax cut multipliers estimated in recessionary $\mathbf{1}\{U_t \geq \bar{U}\}$ and expansionary $\mathbf{1}\{U_t < \bar{U}\}$ episodes as well as linear benchmarks for different horizons $4 \leq H \leq 20$; Panel (b) shows tax cut multipliers estimated in demand-side recessionary episodes $\mathbf{1}\{U_t \geq \bar{U}; \pi_t < \bar{\pi}_t\}$ and supply-side recessionary episodes $\mathbf{1}\{U_t \geq \bar{U}; \pi_t \geq \bar{\pi}_t\}$ as well as unconditional recessions $\mathbf{1}\{U_t \geq \bar{U}\}$, for different horizons $4 \leq H \leq 20$; we set $\bar{U} = 6.5\%$ in all estimations.

ditional state dependence of tax cut multipliers is not at its maximum at shorter horizons and instead is close to uniform after approximately 8 quarters. We formally test the restriction $\beta_H^{DR} = \beta_H^{SR}$, which implies that the source of fluctuations does not matter, and can reject it at the 10% level at 11- and 13-quarter horizons, and at 32% level for all horizons between 8 and 16 quarters, as well as at the 20-quarter horizon.

6.3.3. Robustness checks

In Appendix I, we perform further robustness checks, briefly outlined here. In particular, in Appendix I.4, we show that once one further distinguishes between demand- and supply-side expansions, our theory receives further empirical support: spending multipliers are higher in supply-side expansions, whereas multipliers out of tax cuts are larger in demand-driven economic upturns. In Appendix I.5, we show that our results are robust to using VAR-based fiscal shocks, following Blanchard and Perotti (2002). Finally, in Appendix I.6 we provide results where instead of measuring economic activity using unemployment, we are using detrended real GDP, a measure more consistent with our theory.

7. Conclusion

This paper develops a general theory of state-dependent fiscal multipliers for a broad range of spending and taxation policies. The framework accounts for empirically relevant goods market frictions by incorporating idle productive capacity and unsatisfied households' demand into an otherwise standard general equilibrium setup. Our key novel finding is that cyclicality of fiscal multipliers is pinned down by the *source of economic fluctuations*, and we provide model-free econometric evidence that strongly supports our predictions.

Crucially, we establish that multipliers associated with fiscal instruments which stimulate aggregate demand, such as government spending and consumption tax cuts, are *countercyclical* under demand-driven fluctuations and *procyclical* under supply-driven fluctuations. On the other hand, multipliers associated with interventions that stimulate aggregate supply, such as reductions in taxes on firms' payroll, sales and households' labor income, are *countercyclical* under supply-driven fluctuations and *procyclical* under demand-driven fluctuations. In addition, our theoretical results establish a relevant role for fiscal austerity, implemented by a reduction in government consumption in severe *supply-driven recessions* and *demand-driven booms*, provided elasticities of labor supply and labor demand are sufficiently low.

Further, we develop and estimate a novel econometric specification that allows us to perform model-free evaluation of both spending and taxation multipliers in recessionary and expansionary episodes, *conditional* on those being either demand- or supply-driven in nature. Our empirical results detect substantial state dependence, *conditional* on the source of fluctuations, which is in line with the predictions of our theory. Such findings offer a resolution to the debate on state dependence of fiscal policy, on both empirical and theoretical grounds, and they provide guidance for the conduct of fiscal policy in the different phases of the business cycle.

Our analysis opens fruitful avenues for future research. First, in our dynamic framework, current changes in fiscal policy determine the future path of goods market tightness and thus constrain the effectiveness of policy in the future. Our framework can therefore be extended to study the intertemporal trade-offs and the *path dependence* of fiscal policy. Second, by extending the model to include heterogeneity in the goods markets, one can study how composition of spending and taxation policies may generate spillover effects of fiscal policy across sectors and the socially optimal distribution of such policies. We plan to investigate these issues in future research.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jmoneco.2022.09.003.

References

Alesina, A., Favero, C., Giavazzi, F., 2015. The output effect of fiscal consolidation plans. J. Int. Econ. 96, S19–S42. doi:10.1016/j.jinteco.2014.11.003. http://www.sciencedirect.com/science/article/pii/S0022199614001238
Auerbach, A., Gorodnichenko, Y., Murphy, D., McCrory, P.B., 2022. Fiscal multipliers in the COVID-19 recession. J. Int. Money Finance 126, 102669.
Auerbach, A.J., Gorodnichenko, Y., 2012. Measuring the output responses to fiscal policy. Am. Econ. J. 4 (2), 1–27. doi:10.1257/pol.4.2.1. https://www.aeaweb.org/articles?id=10.1257/pol.4.2.1
Auerbach, A.J., Gorodnichenko, Y., 2013. Fiscal Multipliers in Recession and Expansion. University of Chicago Press. https://chicago.universitypressscholarship.com/view/10.7208/chicago/9780226018584.001.0001/upso-9780226018447-chapter-03
Baek, C., McCrory, P.B., Messer, T., Mui, P., 2021. Unemployment effects of stay-at-home orders: evidence from high-frequency claims data. Rev. Econ. Stat. 103 (5), 979–993.
Bai, Y., Rios-Rull, J.-V., Storesletten, K., 2012. Demand Shocks as Productivity Shocks.
Barnichon, R., Debortoli, D., Matthes, C., 2021. Understanding the size of the government spending multiplier: it's in the sign. Rev. Econ. Stud. doi:10.1093/restud/rdab029.
Barro, R., Grossman, H., 1971. A general disequilibrium model of income and employment. Am. Econ. Rev. 61 (1), 82–93. https://EconPapers.repec.org/RePEc:aea:aecrev:v:61:y:1971:i:1:p:82-93
Bayoumi, T., Eichengreen, B., 1992. Shocking Aspects of European Monetary Unification. Technical Report. National Bureau of Economic Research.
Blanchard, O., Perotti, R., 2002. An empirical characterization of the dynamic effects of changes in government spending and taxes on output. Q. J. Econ. 117 (4), 1329–1368. http://www.jstor.org/stable/4132480
Boehm, C., Pandalai-Nayar, N., 2020. Convex Supply Curves. Technical Report. National Bureau of Economic Research.
Boneva, L.M., Braun, R.A., Waki, Y., 2016. Some unpleasant properties of loglinearized solutions when the nominal rate is zero. J. Monet. Econ. 84, 216–232.
Brzustowski, T., Petrosky-Nadeau, N., Wasmer, E., 2018. Disentangling goods, labor, and credit market frictions in three European economies. Labour Econ. 50, 180– 196. doi:10.1016/j.labeco.2016.05.006. http://www.sciencedirect.com/science/article/pii/S0927537116300203
Canzoneri, M., Collard, F., Dellas, H., Diba, B., 2016. Fiscal multipliers in recessions. Econ. J. 126 (590), 75–108. doi:10.1111/ecoj.12304. https://onlinelibrary.wiley.com/doi/abs/10.1111/ecoj.12304
Chetty, R., 2006. A new method of estimating risk aversion. Am. Econ. Rev. 96 (5), 1821–1834. https://www.jstor.org/stable/30034997
Christiano, L., Eichenbaum, M., Rebelo, S., 2011. When is the government spending multiplier large? J. Polit. Econ. 119 (1), 78–121. doi:10.1086/659312.
Cloyne, J.S., Jordà, Ò., Taylor, A.M., 2020. Decomposing the Fiscal Multiplier. Technical Report. National Bureau of Economic Research.
Coenen, G., Erceg, C.J., Freedman, C., Furceri, D., Kumhof, M., Lalonde, R., Laxton, D., Lindé, J., Mourougane, A., Muir, D., Mursula, S., de Resende, C., Roberts, J., Roeger, W., Snudden, S., Trabandt, M., in't Veld, J., 2012. Effects of fiscal stimulus in structural models. Am. Econ. J. 4 (1), 22–68. doi:10.1257/mac.4.1.22.
Cox, L., Müller, G., Pasten, E., Schoenle, R., Weber, M., 2020. Big G. Technical Report. National Bureau of Economic Research.
Crafts, N., Mills, T.C., 2013. Rearmament to the rescue? New estimates of the impact of "Keynesian" policies in 1930s' Britain. J. Econ. Hist. 73 (4), 1077–1104. doi:10.1017/S0022050713000880. https://www.cambridge.org/core/journals/journal-of-economic-history/article/rearmament-to-the-rescue-new-estimates-of-the-impact-of-keynesian-policies-in-1930s-britain/B99D48196CDA1B1091FB3AB001FD1276
Den Haan, W.J., 2013. Inventories and the Role of Goods-Market Frictions for Business Cycles. CEPR Discussion Paper No. DP9628.
Eskandari, R., 2019. State-dependent macroeconomic effects of tax changes. Available at SSRN 3374984.
Faria-e-Castro, M., 2019. Fiscal Multipliers and Financial Crises. Technical Report. Federal Reserve Bank of St. Louis. https://ideas.repec.org/p/fip/fedlwp/2018-023.html

Fazzari, S.M., Morley, J., Panovska, I., 2014. State-dependent effects of fiscal policy. Stud. Nonlinear Dyn. Econom. 19 (3), 285–315. doi:10.1515/snde-2014-0022. https://www.degruyter.com/view/j/snde.2015.19.issue-3/snde-2014-0022/snde-2014-0022.xml
Fernald, J., 2014. A Quarterly, Utilization-Adjusted Series on Total Factor Productivity. Federal Reserve Bank of San Francisco.
Fernández-Villaverde, J., Gordon, G., Guerrón-Quintana, P., Rubio-Ramírez, J.F., 2015. Nonlinear adventures at the zero lower bound. J. Econ. Dyn. Control 57, 182–204. doi:10.1016/j.jedc.2015.05.014. http://www.sciencedirect.com/science/article/pii/S0165188915000949
Fernández-Villaverde, J., Mandelman, F., Yu, Y., Zanetti, F., 2019. Search Complementarities, Aggregate Fluctuations, and Fiscal Policy. NBER Working Papers. https://ideas.repec.org/p/nbr/nberwo/26210.html
Fernández-Villaverde, J., Mandelman, F., Yu, Y., Zanetti, F., 2021. The "Matthew effect" and market concentration: search complementarities and monopsony power. J. Monet. Econ. 121 (C), 62–90. doi:10.1016/j.jmoneco.2021.04. https://ideas.repec.org/a/eee/moneco/v121y2021icp62-90.html
Ghassibe, M., Zanetti, F., 2020. State Dependence of Fiscal Multipliers: The Source of Fluctuations Matters. Economics Series Working Papers. University of Oxford, Department of Economics. https://ideas.repec.org/p/oxf/wpaper/930.html
Gordon, R.J., Krenn, R., 2010. The End of the Great Depression 1939-41: Policy Contributions and Fiscal Multipliers. NBER Working Papers doi:10.3386/w16380. http://www.nber.org/papers/w16380
Gourio, F., Rudanko, L., 2014. Customer capital. Rev. Econ. Stud. 81 (3), 1102–1136. https://ideas.repec.org/a/oup/restud/v81y2014i3p1102-1136.html
Hagedorn, M., Manovskii, I., Mitman, K., 2019. The Fiscal Multiplier. Technical Report. National Bureau of Economic Research.
Jing, X., Lewis, M., 2011. Stockouts in online retailing. J. Mark. Res. 48 (2), 342–354. https://www.jstor.org/stable/23033435
Jo, Y.J., Zubairy, S., 2022. State Dependent Government Spending Multipliers: Downward Nominal Wage Rigidity and Sources of Business Cycle Fluctuations. Technical Report. National Bureau of Economic Research.
Jordà, Ò., 2005. Estimation and inference of impulse responses by local projections. Am. Econ. Rev. 95 (1), 161–182. https://www.jstor.org/stable/4132675
Keynes, J.M., 1936. The General Theory of Employment, Interest, and Money. Macmillan, London.
Landais, C., Michaillat, P., Saez, E., 2018. A macroeconomic approach to optimal unemployment insurance: applications. Am. Econ. J. 10 (2), 182–216. doi:10.1257/pol.20160462. https://www.aeaweb.org/articles?id=10.1257/pol.20160462
Lindé, J., Trabandt, M., 2018. Should we use linearized models to calculate fiscal multipliers? J. Appl. Econom. 33 (7), 937–965.
Mattersion, R., 2001. Telecom Churn Management. APDG Publishing, NC.
Mertens, K.R.S.M., Ravn, M.O., 2014. Fiscal policy in an expectations-driven liquidity trap. Rev. Econ. Stud. 81 (4), 1637–1667. doi:10.1093/restud/rdu016. https://academic.oup.com/restud/article/81/4/1637/1574585
Michaillat, P., 2014. A theory of countercyclical government multiplier. Am. Econ. J. 6 (1), 190–217. doi:10.1257/mac.6.1.190. https://www.aeaweb.org/articles?id=10.1257/mac.6.1.190
Michaillat, P., Saez, E., 2015. Aggregate demand, idle time, and unemployment. Q. J. Econ. 130 (2), 507–569. https://ideas.repec.org/a/oup/qjecon/v130y2015i2p507-569.html
Michaillat, P., Saez, E., 2019. Optimal public expenditure with inefficient unemployment. Rev. Econ. Stud. 86 (3), 1301–1331. doi:10.1093/restud/rdy030. https://academic.oup.com/restud/article/86/3/1301/5034183
Miyamoto, W., Nguyen, T.L., Sergeyev, D., 2018. Government spending multipliers under the zero lower bound: evidence from Japan. Am. Econ. J. 10 (3), 247–277. doi:10.1257/mac.20170131. https://www.aeaweb.org/articles?id=10.1257/mac.20170131
Petrosky-Nadeau, N., Wasmer, E., Zeng, S., 2016. Shopping time. Econ. Lett. 143, 52– 60. doi:10.1016/j.econlet.2016.02.003. http://www.sciencedirect.com/science/article/pii/S0165176516300246
Ramey, V.A., 2019. Ten years after the financial crisis: what have we learned from the renaissance in fiscal research? J. Econ. Perspect. 33 (2), 89–114.
Ramey, V.A., Shapiro, M.D., 1998. Costly capital reallocation and the effects of government spending. Carnegie-Rochester Conf. Ser. Public Policy 48, 145–194. doi:10.1016/S0167-2231(98)00020-7. https://www.sciencedirect.com/science/article/pii/S0167223198000207
Ramey, V.A., Zubairy, S., 2018. Government spending multipliers in good times and in bad: evidence from US historical data. J. Polit. Econ. 126 (2), 850–901. doi:10.1086/696277.
Reinhart, C.M., Rogoff, K.S., 2010. Growth in a time of debt. Am. Econ. Rev. 100 (2), 573–578. doi:10.1257/aer.100.2.573. http://www.aeaweb.org/articles?id=10.1257/aer.100.2.573
Rendahl, P., 2016. Fiscal policy in an unemployment crisis. Rev. Econ. Stud. 83 (3), 1189–1224. doi:10.1093/restud/rdv058. https://academic.oup.com/restud/article/83/3/1189/2461240
Roldan-Blanco, P., Gilbukh, S., 2020. Firm dynamics and pricing under customer capital accumulation. J. Monet. Econ. doi:10.1016/j.jmoneco.2020.01.011. http://www.sciencedirect.com/science/article/pii/S0304393220300143
Romer, C.D., Romer, D.H., 2010. The macroeconomic effects of tax changes: estimates based on a new measure of fiscal shocks. Am. Econ. Rev. 100 (3), 763–801. doi:10.1257/aer.100.3.763. http://www.aeaweb.org/articles?id=10.1257/aer.100.3.763
Roulleau-Pasdeloup, J., 2020. The Government Spending Multiplier in a Deep Recession. Technical Report. National University of Singapore.
Shen, W., Yang, S.-C. S., 2018. Downward nominal wage rigidity and state-dependent government spending multipliers. J. Monet. Econ. 98, 11–26.
Sims, E., Wolff, J., 2018. The state-dependent effects of tax shocks. Eur. Econ. Rev. 107, 57–85. doi:10.1016/j.euroecorev.2018.05.002. http://www.sciencedirect.com/science/article/pii/S0014292118300746
Taylor, J.C., Fawcett, S.E., 2001. Retail on-shelf performance of advertised items: an assessment of supply chain effectiveness at the point of purchase. J. Bus. Logist. 22 (1), 73–89. doi:10.1002/j.2158-1592.2001.tb00160.x.
van Wijnbergen, S., 1987. Government deficits, private investment and the current account: an intertemporal disequilibrium analysis. Econ. J. 97 (387), 596–615. http://www.jstor.org/stable/2232926
Ziegenbein, A., 2017. Can Tax Cuts Restore Economic Growth in Bad Times? Mimeo. University of Vienna.