A Theory of Slack

How Economic Slack Shapes Markets, Business Cycles, and Policies

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CHAPTER 18.

Fiscal policy

In chapter 17 we saw how monetary policy should respond when the economy is not at full employment. In various circumstances, it is either not possible or not desirable for monetary policy to eliminate the unemployment gap entirely. In that case, it is natural to wonder: can monetary policy be complemented by fiscal policy? As we see in this chapter, the answer to this question is yes.

The first case when fiscal policy might be useful is when monetary policy is impotent. This occurs at the zero lower bound on the nominal interest rate. Once the zero lower bound is reached, interest rates can no longer be reduced, so monetary policy can no longer be used to prop up the economy.

The second case when monetary policy cannot be used is under monetary unions. In a monetary union, monetary policy is decided at a higher level and cannot be controlled by the local government. One example of a monetary union is the United States; here, monetary policy is controlled by the Federal Reserve and not by individual states. States may be subject to local recessions that are not synchronized with national recessions and that are therefore not tackled by the Federal Reserve (Owyang, Piger, and Wall 2005). But states are able to determine how much they want to spend, how much they want to tax, and they can even issue bonds. Hence states are in complete control of their fiscal policy, and can use it to tackle local business cycles.

18.1. Social planner's problem

To study optimal fiscal policy, we follow the same approach we used to study the unemployment gap in chapter 13 and optimal monetary policy in chapter 17. We specify a generic framework and solve the social planner's problem in that framework, which we will use to derive a sufficient-statistic formula for optimal fiscal policy.

18.1.1. Economic slack

We assume that there is slack in the economy. This means that a share $u \in (0, 1)$ of the aggregate productive capacity $k > 0$ cannot be sold. As usual, we assume that slack is purely wasteful; this means that the unsold capacity does not contribute to welfare.

18.1.2. Fiscal policy

In the efficiency analysis of chapter 10, we simply assumed that the planner could pick the amount of slack in the economy to maximize welfare. Here, we are studying optimal fiscal policy, which means that our planner is more restricted: she can only affect slack indirectly, through fiscal policy.

Specifically, we assume that the planner determines the amount g of public goods and services provided to society. And we assume that, in addition to being valuable, public goods contribute to stabilization. That is, the amount of public goods provided affects the slack rate through a generic function $u(g)$.

18.1.3. Beveridge curve

Both the private sector and the government aim to purchase goods and services for private and public consumption. Purchasing goods and services requires posting help-wanted ads. In such a general framework, help-wanted ads represent many different things that households, firms, and the government do to purchase goods and services: they capture job vacancies posted to hire labor services, actual help-wanted ads posted online or in newspapers, requests for proposal or requests for tender posted to hire services or purchase goods, or any other actions or processes that buyers must follow to purchase goods or services.

With each help-wanted ad a buyer might purchase one good or service. The number of help-wanted ads advertised is v, and it is expressed as a share of the aggregate productive capacity. Moreover, a Beveridge curve $v(u)$ links the ad rate v to the slack rate u.

Why do help-wanted ads enter the planner's problem? Because ads require resources to be successful and translate into purchases. A matching cost $\kappa > 0$ measures the number of goods and services that have to be devoted to any one help-wanted ad per unit time.

These goods and services devoted to matching are not consumed by households, so they do not contribute to social welfare, although they are required to create new trades.

18.1.4. Usage of aggregate productive capacity

Let's summarize how aggregate productive capacity is used. We take productive capacity as exogenous—and in particular as unaffected by fiscal policy.

A share u of aggregate productive capacity is slack and therefore unused. A share κv is used for matching. We therefore have a share $1-(u+\kappa v)$ of aggregate productive capacity that constitutes goods and services that are consumed. There are two types of goods and services: private (purchased directly by households) and public (purchased and provided by the government). A share c of aggregate productive capacity constitutes private goods and services, while a share g constitutes public goods and services. Note that $c+g=1-(u+\kappa v)$ represents total consumption. Thus,

$$c=1-(u+\kappa v)-g, \tag{18.1}$$

where c is private consumption, g is public consumption, and $u+\kappa v$ is nonproductive use of capacity (matching and slack).

The government provides public goods that benefit everyone, and that can potentially reduce the amount of slack in the economy. However, there is a resource cost to providing public goods, since productive capacity used for public goods cannot be used for private goods: for instance, workers employed in the public sector cannot also be employed in the private sector. Productive capacity is finite, so the planner faces a tradeoff: it can divert more goods to the public sector, but then fewer goods are left for the private sector. So fiscal policy creates a distortion: it depletes resources from the private sector. This tradeoff is at the heart of the Samuelson (1954, 1955) framework.

18.1.5. Social welfare

Social welfare depends on both public and private goods and services. We denote by c the share of the economy's productive capacity that goes to private goods and services. As we saw earlier, g is the share of the economy's productive capacity that is allocated to public goods and services. Both private and public goods and services enter social welfare, $\mathcal{W}(c,g)$. We assume that $\mathcal{W}$ is strictly increasing in c and g, and that it is strictly concave so that the planner's optimization problem is well-behaved.

18.1.6. Planner's problem

We now formalize the social planner's problem. The planner's goal is to maximize welfare $\mathcal{W}(c, g)$ subject to the resource constraint (18.1). Substituting private consumption from the welfare function, and inserting the Beveridge curve $v(u)$ and stabilization function $u(g)$, the planner's problem simplifies to

$$\max_{g \geq 0}(\mathcal{W}(1-(u(g)+\kappa v(u(g)))-g, g)). \tag{18.2}$$

Here, we see the tradeoffs that the government faces. Increasing public goods raises welfare mechanically. But it also mechanically reduces private goods via the resource constraint. Moreover, public goods may contribute to stabilization because they affect the term $u(g)+\kappa v(u(g))$, which measures the nonproductive use of the economy's capacity, and which should ideally be as small as possible.

18.1.7. Solution to the planner's problem

We now start solving the social planner's problem, given by (18.2). We begin with the first-order condition of the problem.

We take the derivative of social welfare with respect to g to capture the different effects of public spending on welfare:

$$\frac{d\mathcal{W}}{dg} = \frac{\partial \mathcal{W}}{\partial g} - \frac{\partial \mathcal{W}}{\partial c} + \frac{\partial \mathcal{W}}{\partial c} \cdot \left[-u'(g)\right] \cdot \left[1+\kappa v'(u)\right]. \tag{18.3}$$

Here, we see all the ways through which public spending affects welfare. The first term tells us that having more public goods increases welfare, and the second term tells us that if more public goods are provided, fewer private goods are available, which depresses welfare. The third term reflects stabilization by public spending—it shows how public goods affects unproductive use of resources.

We now determine the optimal amount of public spending g. Optimal public spending maximizes $\mathcal{W}(c(g), g)$. We assume that the planner's problem is a well behaved so that it admits a unique extremum which is an interior maximum. The first-order condition is therefore necessary and sufficient to find the problem's solution. The first order condition simply is $d\mathcal{W}/dg = 0$, where the total derivative is given by (18.3). Dividing the first-order condition by the marginal utility of private consumption, we get

$$1 = \frac{\partial \mathcal{W}/\partial g}{\partial \mathcal{W}/\partial c} + \left[-u'(g)\right] \cdot \left[1+\kappa v'(u)\right]. \tag{18.4}$$

In the next section we start from this somewhat abstract condition and introduce several sufficient statistics to transform it into a usable formula for optimal fiscal policy.

18.2. Implicit formula for optimal fiscal policy

This section introduces several sufficient statistics that we will use to characterize optimal fiscal policy. We combine them into a first formula for optimal fiscal policy. This formula is only implicit. We use it as a stepping stone to then build an explicit formula for optimal fiscal policy.

18.2.1. Marginal rate of substitution between public and private goods

A first important statistic in the optimality condition (18.4) is the marginal rate of substitution between public and private services:

$$MRS(g/c) = \frac{\partial \mathcal{W}/\partial g}{\partial \mathcal{W}/\partial c} > 0. \tag{18.5}$$

The marginal rate of substitution tells us how people values public goods in terms of private goods. We assume that MRS is strictly decreasing in g/c so that when there are more public goods relative to private goods, the value of a public good relative to a private good decreases. We also assume that $MRS(g/c = 0) > 1$, meaning that when there are no public goods at all, a public good is more valuable than a private good. Under this assumption, it is desirable to provide some public goods, and so we conveniently have an interior solution to the planner's problem.

18.2.2. Fiscal multiplier

Another important statistic in the optimality condition (18.4) is the fiscal multiplier:

$$m = -u'(g). \tag{18.6}$$

The fiscal multiplier measures the decrease in the slack rate in percentage points when the share of aggregate capacity devoted to public production increases by 1 percentage point. In the special case $m = 0$, the slack rate does not respond to public spending. Although this is a possibility, empirical evidence from the United States suggests that the slack rate drops when public spending goes up: $m > 0$. Note that our framework also allows for $m < 0$, which would mean that the slack rate goes up when public spending increases. It's unclear how this would occur, but the sufficient-statistic approach allows for it nevertheless.

18.2.3. Inefficiency gauge

The third and final statistic to obtain an implicit formula for optimal fiscal policy is the inefficiency gauge:

$$IG(u) = 1 + \kappa v'(u). \tag{18.7}$$

The gauge describes how a change in the slack rate u affects the total amount unproductive resources in the economy, $u + \kappa v(u)$.

In effect, the sign of the inefficiency gauge tells us whether the economy is operating efficiently or is inefficiently slack or tight. Recall that when the economy operates efficiently, the slack rate u^* satisfies (10.3), which gives

$$IG(u^*) = 0.$$

So, when the economy operates efficiently, the inefficiency gauge is 0. Then, a change in the slack rate has no first-order effect on the amount of unproductive resources in the economy and thus social welfare.

In addition, the Beveridge curve is convex, so that $v'(u)$ is increasing in u. This implies that $u > u^*$ is equivalent to $v'(u) > v'(u^*)$, which itself is equivalent to $1+\kappa v'(u) > 1+\kappa\mathbf{v}'(u^*)$ or $IG(u) > 0$. By the same logic, $u < u^*$ is equivalent to $IG(u) < 0$.

Hence we have established that the sign of the inefficiency gauge $IG(u)$ determines the state of the economy: at $IG(u) = 0$ the economy is efficient; when $IG(u) < 0$ the economy is inefficiently tight, so slack is too low; and when $IG(u) > 0$ the economy is inefficiently slack, so slack is too high.

18.2.4. Implicit formula

We rewrite the abstract first-order condition (18.4) using the three statistics that we have just introduced. Inserting the statistics into the condition, we immediately obtain:

$$1 = MRS(g/c) + m \cdot IG(u). \tag{18.8}$$

This is our first formula for optimal fiscal policy. It says what the optimal amount of public spending, expressed as the ratio between public and private goods g/c, must satisfy in a world with slack.

The formula can be interpreted as the Samuelson rule plus a correction term. Indeed, the Samuelson rule says that public goods should be provided until the marginal utility from public goods equals the marginal utility from private goods—in other words, until the marginal rate of substitution between public and private goods equals 1. The Samuelson amount of public spending, denoted $(g/c)^*$, is therefore given by

$$1 = MRS((g/c)^*).$$

The correction term is $m \cdot IG(u)$. The fiscal multiplier m indicates how much public spending reduces slack. The inefficiency gauge $IG(u)$ indicates how much a reduction in slack improves welfare. So the correction term indicates how much public spending improves welfare through slack. The correction term is positive whenever public spending brings slack closer to its efficient level: either by lowering slack when it is too high ($m > 0$ and $IG > 0$), or by raising slack when it is too low ($m < 0$ and $IG < 0$).

The implicit formula (18.8) simply says that when the provision of public goods is optimal, the marginal cost and benefits from public goods are equalized. The marginal cost of public goods is 1 private good, which appears on the left-hand side of the formula. Indeed, for a given amount of production, 1 good or service provided by the public sector cannot be provided by the private sector. The marginal benefits of public goods appear on the right-hand side of the equation. One benefit is that people value public goods, which is captured by the marginal rate of substitution between public and private goods, MRS. Another benefit appears when public spending brings slack closer to its efficient level; in that case the benefit is measured by $m \cdot IG > 0$. If public spending pushes slack away from its efficient level, it imposes a cost, or negative benefit measured by $m \cdot IG < 0$.

18.2.5. Optimal deviation from Samuelson spending

Let's see what we can learn from our implicit formula (18.8). It turns out that while the formula is only implicit, it is useful to understand how optimal public spending deviates from public spending under the Samuelson rule.

We see from formula (18.8) that when the economy operates efficiently, the Samuelson rule remains valid. This can be seen because when slack is efficient, $IG(u) = 0$, so the formula boils down to $1 = MRS(g/c)$, which is just the Samuelson rule. Although the Samuelson rule was originally derived in a neoclassical model, it remains valid in a model with slack as long as the amount of slack is efficient.

Intuitively, why does the Samuelson rule continue to apply when slack is present but efficient? Government spending affects welfare in two ways: directly by providing public goods to people, and indirectly by affecting the amount of production in the economy. In the neoclassical model, the economy is efficient, so changes in production have no first-order effects on welfare. In the slackish model, the economy is generally inefficient, but when it is efficient, then changes in slack have no first-order effects on welfare. In both cases—neoclassical and efficient slackish models—the only first-order effect of public spending on welfare is through the provision of public goods, so the formulas are the

TABLE 18.1. Optimal deviation from Samuelson rule when slack is inefficient

	Fiscal multiplier		
Economic slack	$m < 0$	$m = 0$	$m > 0$
$u > u^*$	$g/c < (g/c)^*$	$g/c = (g/c)^*$	$g/c > (g/c)^*$
$u = u^*$	$g/c = (g/c)^*$	$g/c = (g/c)^*$	$g/c = (g/c)^*$
$u < u^*$	$g/c > (g/c)^*$	$g/c = (g/c)^*$	$g/c < (g/c)^*$

The optimal deviations from the Samuelson rule are derived from the formula (18.8).

same.

Another case in which the Samuelson rule remains valid despite the presence of slack is when the fiscal multiplier is 0. Indeed, with $m = 0$, the formula boils down again to the Samuelson rule $1 = MRS(g/c)$. The reason is that when the fiscal multiplier is 0, public spending has no effect on slack, so it does not affect welfare through production, which brings us back to the neoclassical case.

There is an extra term in formula (18.8), however, which appears because we are no longer in a neoclassical model. We are considering a world with slack, and the amount of slack is generally inefficient, and public spending generally affects slack. When slack is indeed inefficient, and public spending affects it, an extra term appears in the formula ($m{\cdot}IG$). The term describes the effect of public spending on welfare through its contribution to stabilization.

The main lesson from formula (18.8) is that whenever public goods are more beneficial than envisioned by the Samuelson rule, we should provide more of them than stipulated by rule. Public goods are more beneficial when they bring slack closer to its efficient level. This appears with $m \cdot IG(u) > 0$ in the formula, which then requires $MRS(g/c) < 1$. As the marginal rate of substitution is decreasing in g/c, this indeed requires $g/c > (g/c)^*$.

Overall, formula (18.8) shows that it is optimal to raise public spending over Samuelson spending when public spending brings slack closer to its efficient level; conversely, it is optimal to lower public spending below Samuelson spending whenever public spending pushes slack away from its efficient level.

Thus, optimal public spending satisfies the Samuelson rule only if the fiscal multiplier is zero or if slack is at an efficient level. In all other situations, optimal public spending deviates from the Samuelson rule. Based on this logic, table 18.1 describes how optimal public spending deviates from Samuelson spending. It separates the different scenarios to consider, depending on the sign of the fiscal multiplier and the amount of slack in the economy.

Table 18.1 displays an important and interesting insight: it is not optimal for public spending to deviate from the Samuelson rule so as to completely fill the slack gap. We saw in the case of monetary policy that with divine coincidence, it was optimal for monetary policy to completely fill the slack gap (chapter 17). That is because monetary policy does not create any distortions when the divine coincidence holds. Fiscal policy does create distortions: it distorts the consumption basket by providing more or less public consumption than what the Samuelson rule recommends. Because of the welfare cost of the distortion, it is not optimal to eliminate the slack gap. This result appears in the table, as when the slack gap is 0 public spending ought to be at the Samuelson level. The result also appears in equation (18.8). The equation must hold when fiscal policy is optimal. If optimal fiscal policy eliminates the slack gap, the right-hand side of the equation is 0. So the left-hand side of the equation should also be 0—which would not be possible if public spending had deviated from Samuelson spending.

18.3. Sufficient-statistic formula for optimal fiscal policy

One limitation of formula (18.8) that appears immediately is that it is only implicit. The right-hand side of the formula, $MRS + m \cdot IG$, is determined by public spending g, so indeed the formula determines the optimal level of public spending. But public spending does not appear explicitly in the formula, so it's not possible to plug in some parameter values and compute the optimal amount of spending.

In this section, we introduce a few sufficient statistics that will help us understand how the marginal rate of substitution MRS depends on g, how the inefficiency gauge IG depends on the slack rate u and then how the slack rate itself depends on g. Once we have understood this dependence, we will construct a sufficient-statistic formula, from which we will be able to compute optimal public spending directly.

18.3.1. Elasticity of substitution between public and private goods

We are now in a position to introduce the first sufficient statistic that appears in the formula for optimal fiscal policy. The statistic is the elasticity of substitution between public and private services, σ, defined as the inverse of the positive elasticity of the marginal rate of substitution with respect to the ratio g/c:

$$\frac{1}{\sigma} = -\frac{(g/c)}{MRS(g/c)} \cdot \frac{dMRS}{dg/c}. \tag{18.9}$$

Since MRS is strictly decreasing in g/c, the definition (18.9) ensures that $\sigma > 0$. There are three different possibilities. First, when $\sigma < 1$, public and private services are complements. Second, when $\sigma = 1$, public and private services are independent. Last, when $\sigma > 1$, public and private services are substitutes.

The elasticity of substitution admits a few interesting special cases. When $\sigma \to 0$, public and private services are perfect complements. In this case, both c and g are required to generate welfare, and we have a Leontief welfare function:

$$\mathcal{W}(c, g) = \min(c, g).$$

Another special case is when $\sigma = 1$ so that public and private services are independent. Then, we would have a Cobb-Douglas welfare function:

$$\mathcal{W}(c, g) = c^{1-\sigma} g^{\sigma}.$$

The last special case is when $\sigma \to \infty$: then public and private goods are perfect substitutes. In this case, c and g indistinguishably generate welfare, so the welfare function is linear:

$$\mathcal{W}(c, g) = c + g.$$

The elasticity of substitution describes the shape of marginal rate of substitution, and how it varies with the ratio g/c. It is helpful here because it allows us to express how the marginal rate varies when g/c varies, which will then allow us to introduce g/c explicitly in the formula for optimal fiscal policy.

Indeed, we take a first-order approximation of $MRS(g/c)$ around Samuelson spending $(g/c)^*$, we get:

$$MRS = MRS((g/c)^*) + \frac{dMRS}{dg/c} \cdot \left[g/c - (g/c)^*\right].$$

As we have seen, $(g/c)^*$ is the amount of public spending implied by the Samuelson rule so $MRS((g/c)^*) = 1$. Given the definition of the elasticity of substitution (18.9), this approximation simplifies to:

$$1 - MRS = \frac{1}{\sigma} \cdot \frac{g/c - (g/c)^*}{(g/c)^*}, \tag{18.10}$$

where σ is the elasticity of substitution evaluated at $(g/c)^*$, so

$$\frac{1}{\sigma} = -\frac{(g/c)^*}{MRS((g/c)^*)} \cdot \frac{dMRS}{dg/c} = -(g/c)^* \cdot \frac{dMRS}{dg/c}.$$

A new but key term appearing in (18.10) is the relative deviation between optimal public spending and the Samuelson level of spending: $[g/c - (g/c)^*]/(g/c)^*$. It indicates how much optimal spending deviates from Samuelson spending, as a share of Samuelson spending. We refer to this relative deviation as the amount of stimulus spending. So for instance, a stimulus spending of 10% means that optimal public spending is 10% higher than Samuelson spending.

18.3.2. Beveridge curvature

The second sufficient statistic that appears in the formula for optimal fiscal policy is the positive elasticity of the slope of the Beveridge curve:

$$\beth = -\frac{u}{v'(u)} \cdot v''(u). \tag{18.11}$$

We refer to this elasticity as the Beveridge curvature: it describes how the slope of the Beveridge curve is changing with the slack rate; specifically, it describes how sharply the amplitude of the slope declines as the slack rate increases. It is helpful here because it allows us to express how the inefficiency gauge varies when the slack rate varies, which will then allow us to introduce the slack rate u explicitly in the formula for optimal fiscal policy.

If the Beveridge curve is isoelastic (as in the US labor market), the Beveridge curvature is directly related to the Beveridge elasticity:

$$\beth = 1 + \beta.$$

Indeed, when the Beveridge curve is isoelastic, $v(u) = A \cdot u^{-\beta}$, so $v'(u) = -\beta \cdot A \cdot u^{-(\beta+1)}$, and $v''(u) = -(\beta + 1) \cdot v'(u)/u$. So, clearly, $\beth = 1 + \beta$.

Using the Beveridge curvature, we take a first-order approximation of $IG(u)$ around the efficient slack rate u^*. We get:

$$IG(u) = IG(u^*) + IG'(u^*) \cdot (u - u^*).$$

Recall that $IG(u^*) = 0$. Moreover,

$$IG'(u) = \kappa v''(u) = -\kappa \beth \cdot \frac{v'(u)}{u}.$$

The efficiency condition (10.3) implies that $-v'(u^*) = 1/\kappa$, so at u^* the derivative of the efficiency gauge simplify to

$$IG'(u^*) = \frac{\beth}{u^*}.$$

From that, we see that the first-order approximation of $IG(u)$ around u^* simply is

$$IG(u) = \beth \cdot \frac{u - u^*}{u^*}. \tag{18.12}$$

A key term appearing in (18.12) is the relative deviation between optimal slack rate and the efficient slack rate: $[u - u^*]/u^*$. It indicates how much the optimal slack rate (the slack rate under optimal fiscal policy) deviates from the efficient slack rate (the slack rate minimizing the nonproductive use of capacity), as a share of the efficient slack rate. We refer to this relative deviation as the slack gap. So for instance, a slack gap of 10% means that the optimal sack rate is 10% higher than the efficient slack rate.

18.3.3. The fiscal multiplier again

At this point, by inserting the results given by (18.10) and (18.12) into the first-order condition (18.8), we obtain the following formula for optimal fiscal policy

$$\frac{g/c - (g/c)^*}{(g/c)^*} = \daleth\sigma m \cdot \frac{u - u^*}{u^*}. \tag{18.13}$$

In formula (18.13), optimal public spending g/c appears explicitly in the left-hand side, so it might appear that the issue of (18.8) has been addressed: optimal public spending is not implicit anymore. However, success is only illusory here: the slack rate u depends on g/c itself, so g/c appears in the right-hand side too, and the formula does not explicitly give optimal public spending.

However, thanks to the fiscal multiplier, we can make the dependence between slack and fiscal policy explicit, and thus rewrite the formula so that it actually explicitly quantifies optimal fiscal policy. Given that the fiscal multiplier m gives the effect of public spending g on the slack rate u, the main challenge is really to link changes in g/c to changes in g. Because the marginal rate of substitution between public and private goods depends on g/c, the ratio is in formula (18.13), but the multiplier (18.6) only involves the effect of g on u, so we must determine how changes in g/c and g are connected. This is mostly boring algebra, but which is greatly simplified by the fact that formula (18.13) is obtained around the efficient slack rate u^* and Samuelson spending $(g/c)^*$. The share of capacity devoted to private consumption is just the share of aggregate capacity that's productive and not devoted to public consumption:

$$c(g) = 1 - [u(g) + \kappa\nu(u(g))] - g.$$

Hence, the derivative of c with respect to g is

$$c'(g) = -u'(g) \cdot [1 + \kappa\nu'(u)] - 1.$$

But at the efficient slack rate, the nonproductive share of capacity is minimized, so as (10.3) shows, $1 + \kappa\nu'(u^*) = 0$. So private consumption simply moves one-for-one with public consumption: $c'(g) = -1$.

With this result, we easily compute $d(g/c)/dg$ around $[u^*, (g/c)^*]$:

$$\frac{d(g/c)}{dg} = \left(\frac{1}{c^*} - \frac{g^*}{(c^*)^2} \cdot c'(g^*)\right) = (g/c)^* \cdot \left(\frac{1}{g^*} + \frac{1}{c^*}\right), \tag{18.14}$$

where c^* and g^* are the share of aggregate capacity devoted to private and public consumption at $[u^*, (g/c)^*]$.

We can now link the slack rate u to fiscal policy g/c in (18.13). We assume that public spending is at the Samuelson level $(g/c)^*$ and slack is at an inefficient rate $u_0 \neq u^*$. We have in mind the following scenario. Initially everything is going well: slack is efficient, and public spending satisfies the Samuelson rule. Then a shock occurs, pushing slack to the inefficient level u_0. In response, public spending deviates from the Samuelson level to reach its optimal level. As it does so, it affects slack too, which does not stay at the initial rate u_0.

The goal here is to express the slack gap $[u - u^*]/u^*$ as a function of the initial slack gap $[u_0 - u^*]/u^*$ as well as stimulus spending $[g/c - (g/c)^*]/(g/c)^*$, and then make (18.13) completely explicit. We start by writing the first-order approximation of $u(g)$ and $(g/c)(g)$ around the initial $[u_0, g^*]$situation. We get:

$$u = u_0 + \frac{du}{dg} \cdot (g - g^*)$$
$$(g/c) = (g/c)^* + \frac{d(g/c)}{dg} \cdot (g - g^*).$$

Let's rewrite both first-order approximation to introduce the terms we are interested in:

$$u - u^* = u_0 - u^* - m \cdot (g - g^*)$$
$$g - g^* = \frac{1}{1/g^* + 1/c^*} \cdot \frac{(g/c) - (g/c)^*}{(g/c)^*}.$$

Here we could introduce the fiscal multiplier because $m = -du/dg$, and we used result (18.14) to replace $d(g/c)/dg$.

Combining these results we link the change in the slack rate u to the change in public spending g/c:

$$\frac{u - u^*}{u^*} = \frac{u_0 - u^*}{u^*} - \frac{m}{u^*} \cdot \frac{1}{1/g^* + 1/c^*} \cdot \frac{(g/c) - (g/c)^*}{(g/c)^*}. \tag{18.15}$$

We have now linked the current slack gap to the initial slack gap as well as stimulus spending and the fiscal multiplier. By plugging this result in the intermediate formula (18.13), we will obtain our final sufficient-statistic formula.

18.3.4. Sufficient-statistic formula

We have now expressed the slack gap using the initial slack gap, our sufficient statistics, and stimulus spending. We now plug expression (18.15) into the right-hand side of formula

(18.13) to make it explicit:

$$\frac{g/c-(g/c)^*}{(g/c)^*} = \beth\sigma m\cdot\frac{u_0-u^*}{u^*} - \frac{\beth\sigma m^2}{u^*}\cdot\frac{1}{1/g^*+1/c^*}\cdot\frac{(g/c)-(g/c)^*}{(g/c)^*}.$$

Collecting the stimulus-spending terms on the left-hand side, we obtain our explicit, sufficient-statistic formula for optimal fiscal policy:

$$\frac{g/c-(g/c)^*}{(g/c)^*} = \frac{\beth\sigma m}{1+z\beth\sigma m^2}\cdot\frac{u_0-u^*}{u^*}, \tag{18.16}$$

where the constant z is given by

$$z=\frac{1}{u^*}\cdot\frac{1}{\frac{1}{g^*}+\frac{1}{c^*}}.$$

Recall that m is the fiscal multiplier, defined by (18.6), σ is the elasticity of substitution between g and c, defined by (18.9), and $\beth$ is the Beveridge curvature, defined by (18.11). Hence, the optimal amount of fiscal policy, given by formula (18.16), depends on four sufficient statistics: initial slack gap u_0-u^*, elasticity of substitution between public and private goods σ, fiscal multiplier m, and Beveridge curvature $\beth$.

We saw in table 18.1 that it is not optimal to completely fill the slack gap with fiscal policy. The question, then, is: how much of the initial slack gap should we fill and how does that depend on our sufficient statistics? For an initial slack gap u_0-u^*, we showed that the resulting slack gap $u-u^*$ after public spending is given by (18.15). We have also just seen that optimal public spending given some initial slack gap u_0-u^* is given by (18.16). Combining optimal public spending (18.16) with the effect of public spending on slack as described by (18.15), we are able to compute how much of the initial slack gap is left once public spending is optimal:

$$\frac{u-u^*}{u^*}=\frac{u_0-u^*}{u^*}-\frac{z\beth\sigma m^2}{1+z\beth\sigma m^2}\cdot\frac{u_0-u^*}{u^*},$$

and which leads to

$$u-u^*=\frac{1}{1+z\beth\sigma m^2}\cdot(u_0-u^*). \tag{18.17}$$

This formula tells us that the optimal slack gap—the slack gap achieved through optimal fiscal policy—is a share $1/(1+z\beth\sigma m^2)\in(0,1)$ of the initial slack gap. As the share is less than 1, optimal fiscal policy reduces the original slack gap. But the share is strictly positive, so optimal fiscal policy never eliminates the slack gap entirely—it only reduces it.

18.3.5. Role of the slack gap

We first look at the role of the initial slack gap on the design of optimal fiscal policy. We consider a positive fiscal multiplier for concreteness ($m > 0$).

As we discussed above, if the economy operates efficiently and the slack rate is efficient, the optimal policy is to keep public spending at the Samuelson level.

On the other hand, if the slack gap is positive ($u_0 > u^*$), optimal stimulus spending is positive ($g/c > (g/c)^*$). Fiscal policy therefore reduces but does not completely fill the slack gap ($u_0 > u > u^*$).

This result is simple to understand. At the Samuelson rule, an increase in public spending has no first-order effect on welfare when we ignore its effect on slack. Now, when the fiscal multiplier is positive, an increase in public spending lowers slack; and when the slack gap is positive, slack is inefficiently high, so lowering slack raises welfare. Hence, overall, an increase in public spending generates a positive first-order effect on welfare. It is therefore optimal to increase public spending above the Samuelson rule.

If the slack gap is negative ($u_0 < u^*$), optimal stimulus spending is negative ($g/c < (g/c)^*$). Fiscal policy therefore reduces but does not completely eliminate the slack gap ($u_0 < u < u^*$).

We see in formula (18.16) that optimal stimulus spending is larger when the slack gap is larger. This makes sense because a larger slack gap means there is more inefficient slack, which must be tackled with more spending.

18.3.6. Role of the fiscal multiplier

Next, we look at the role of the fiscal multiplier. The relationship between the fiscal multiplier and stimulus spending is a little more interesting—the function is hump-shaped. Specifically, when the fiscal multiplier is 0, there is no stimulus spending: public spending should be at the Samuelson level. Stimulus spending then increases and reaches a peak value at:

$$m^* = \frac{1}{\sqrt{z \beth \sigma}}.$$

This is the value of m that maximizes stimulus spending, by maximizing the function

$$m \mapsto \frac{\beth \sigma m}{1 + z \beth \sigma m^2}$$

Optimal stimulus spending then decreases when $m > m^*$, and it reaches 0 when $m \to \infty$.

What is the intuition behind the hump shape? When public spending is optimal, the marginal social cost from consuming too many public services and too few private services equals the marginal social value from reducing slack. This marginal social value is determined by two factors: the current fiscal multiplier, which measures how much slack can be reduced by additional expenditure, and the current slack gap, which measures the social value from lower slack. For a given amount of stimulus spending and a given initial slack gap, a larger initial multiplier has conflicting effects on the two factors: it means a larger current multiplier (a higher marginal social value) but a smaller current slack gap (a lower marginal social value). The first effect advocates for more spending, the second for less spending.

It turns out that for small multipliers, the first effect dominates, so optimal stimulus spending is increasing in the multiplier; for large multipliers, the second effect dominates, so optimal stimulus spending is decreasing in the multiplier. In fact, for very large multipliers, it becomes optimal to nearly entirely fill the unemployment gap. Naturally, less spending is required to fill the gap when the multiplier is larger, so optimal stimulus spending is decreasing in the multiplier.

Hence, the bang-for-the-buck logic often used in policy discussions—the view that a larger multiplier entails a larger stimulus spending—is not generally valid. Stimulus skeptics usually believe in small multipliers and infer that stimulus spending should be small in slumps. Similarly, stimulus advocates usually believe in large multipliers and infer that stimulus spending should be large in slumps. We have just seen that this bang-for-the-buck logic holds for small multipliers but not for large ones: a large multiplier is not a justification for a large stimulus. Instead, since the relationship between multiplier and optimal stimulus spending is hump-shaped, optimal stimulus spending is similar for some small and large multipliers.

18.3.7. Role of the elasticity of substitution

The policy debate on fiscal policy often revolves around unemployment gaps and multipliers. Formula (18.16) confirms that optimal fiscal policy is indeed a function of the unemployment gap and the fiscal multiplier. Yet, these statistics are not sufficient to measure the effect of public expenditure on welfare because an increase in public expenditure also modifies the composition of households' consumption. Consequently, optimal fiscal policy also depends on the elasticity of substitution between public and private consumption; this statistic should probably play a more prominent role in the policy debate.

What exactly is the role of the elasticity of substitution? We see that stimulus spending is increasing in σ. When there is higher substitutability, the stimulus package is larger. At $\sigma = 0$, there is no stimulus spending, and at $\sigma \to \infty$, we have that

$$\frac{g/c - (g/c)^*}{(g/c)^*} = \frac{1}{zm} \cdot \frac{u_0 - u^*}{u^*}.$$

What is the intuition behind the case $\epsilon \to 0$? In this case, additional public services have zero value: additional public workers dig and fill holes in the ground. Then, optimal stimulus spending is zero, irrespective of the slack rate and multiplier. Intuitively, above the Samuelson level, public consumption has no value, but it crowds out private consumption; therefore, it cannot be optimal to provide more public consumption than the Samuelson level.

But for any $\epsilon > 0$, public services have some value, and optimal stimulus spending is nonzero as long as the economy is inefficient and the multiplier is nonzero. This result clarifies the link between usefulness of public expenditure and optimal stimulus spending. A concern of stimulus skeptics is that additional public expenditure could be wasteful. It is true that when the elasticity of substitution between public and private consumption is zero, public expenditure should remain at the Samuelson level. But in the more realistic case where the elasticity of substitution is positive, some stimulus spending remains desirable in slumps.

18.3.8. Stabilization from optimal fiscal policy

The general pattern is that optimal public expenditure deviates from the Samuelson rule to partially fill the initial slack gap. To understand these results, imagine that public expenditure satisfies the Samuelson rule, the fiscal multiplier is positive, and slack is inefficiently high. Keeping total consumption constant, increasing public consumption reduces private consumption one-for-one. Since the marginal utilities of public and private consumption are equal at the Samuelson rule, the increase in public consumption has no first-order effect on welfare so far. Now, since the fiscal multiplier is positive, increasing public consumption lowers slack; and since slack is inefficiently high, reducing slack raises total consumption. Hence, through its effect on slack, the increase in public consumption raises welfare. It is therefore optimal to increase public consumption above the Samuelson rule, and thus reduce the slack gap.

Why is it not optimal to completely fill the slack gap? Why is it only optimal to reduce the slack gap, when it exists? If the government did that, we would reach a situation where increasing public consumption reduces private consumption one-for-one (since crowding out is one-for-one when the slack gap is zero), but extra public consumption is less valuable than extra private consumption (since public consumption is above the Samuelson level). The situation is clearly suboptimal: welfare can be improved by reducing public consumption.

Essentially, even though fiscal policy can be used for stabilization, it creates some distortion. When the government decides to increase spending by providing more public goods, it distorts the provision of goods in the economy away from private goods. While private goods can be substituted for public goods—public schools and hospitals can replace private schools and hospitals—they are generally not perfect substitutes. Due to these

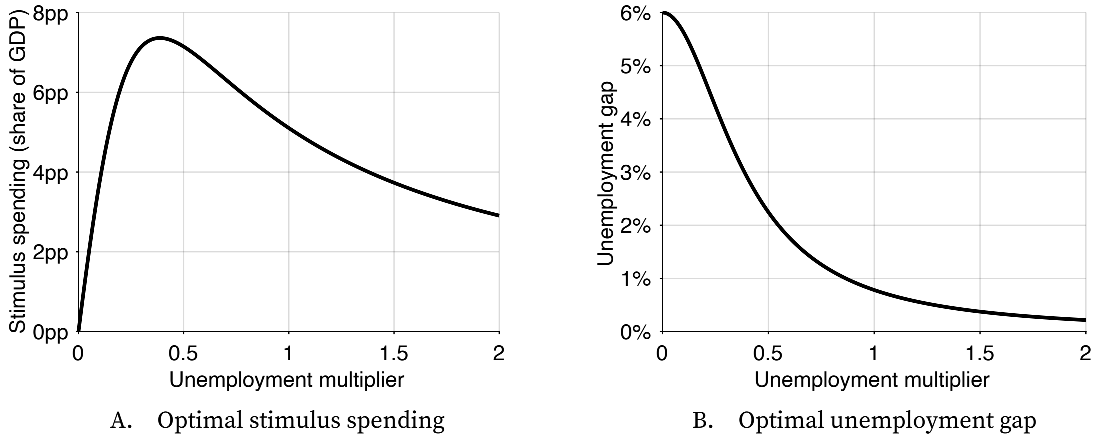

FIGURE 18.1. Optimal fiscal policy for an initial unemployment gap of 6pp

Optimal fiscal policy is given by the explicit sufficient-statistic formula (18.16). The optimal unemployment gap is given by formula (18.17).

distortions, fiscal policy is not able to bring the economy all the way to the efficient allocation. Therefore, it is not optimal to stabilize the economy perfectly with fiscal policy alone: it is not optimal to close the slack gap entirely.

An interesting special case is that the final slack gap converges to 0 when the goods are indeed perfect substitutes: $\sigma \to \infty$. In this case, public consumption perfectly substitutes for private consumption, and optimal fiscal policy completely fills the slack gap. This result holds even if the multiplier is very small and public expenditure severely crowds out private consumption. Intuitively, public consumption and private consumption are interchangeable, so it is optimal to maximize total consumption, irrespective of its composition. This is achieved by completely filling the slack gap.

18.4. Application to the Great Recession

We now complement our theoretical results with a numerical application. We calibrate our sufficient-statistic formula and compute optimal fiscal policy at the onset of the Great Recession in the United States. This exercise illustrates how much optimal public expenditure may deviate from the Samuelson rule.

The motivation is that monetary policy hit the zero lower bound and became ineffective in 2009 (Board of Governors of the Federal Reserve System 2025), while the unemployment gap reached 5.9pp in the same year (figure 1). There was therefore a broad scope for fiscal policy in the form of public spending at the time. So according to our formulas, how much should the government have spent in 2009?

18.4.1. Calibration of the sufficient statistics

We set the Samuelson level of spending to $(g/c)^* = 19.7\%$, which is its 25-year average. To construct g/c, we set g to the seasonally adjusted employment level in the government industry and c to the seasonally adjusted employment level in the private industry. Both series constructed are by the Bureau of Labor Statistics from the Current Employment Statistics survey. Over the 1990–2014 period, the average public expenditure satisfies $g/c = 19.7\%$.

To estimate the elasticity of substitution between public and private consumption, the empirical strategy is to isolate variations in the ratio of public-consumption price to private-consumption price and to assess their impact on the ratio of public consumption to private consumption. For example, if the consumption ratio stays constant in spite of secular variations in the price ratio, then the elasticity of substitution is about one. Applying this approach to US data, Amano and Wirjanto (1997, 1998) estimate elasticities of 0.9 and 1.56. Hence, we pick a midrange value for the elasticity of substitution: $\epsilon = 1$.

Next, we determine plausible values for the fiscal multiplier. The fiscal multiplier is estimated by measuring the percentage-point change in the unemployment rate when public expenditure increases by one percent of GDP. Monacelli, Perotti, and Trigari (2010, pp. 533–536) estimate a structural vector autoregression on US data and find fiscal multipliers between 0.2 and 0.6. Ramey (2013, pp. 40–42) also estimates structural vector autoregressions on US data with various identification schemes and sample periods. She finds fiscal multipliers between 0.2 and 0.5, except in one specification where the multiplier is 1. In sum, the average fiscal multiplier is estimated to be in the 0.2–1 range.

The multiplier entering our formula could be larger if multipliers are larger when slack is higher, as we find in slackish models (chapters 9 and 14). To account for the uncertainty about the exact value of the multiplier in bad times, we compute optimal fiscal policy for a range of fiscal multipliers: $0 < m < 2$.

The last step before using the formulas is calibrating the constant z. We calibrate it just as above: we set $(g/c)^* = 19.7\%$, $(g/y)^* = 16.5\%$, $(c/y)^* = 1 - (g/y)^* = 83.5\%$, $u^* = 4\%$, which implies $z = 6.67$.

18.4.2. Calculation with sufficient-statistic formulas

Figures 18.1A and 18.1B display optimal fiscal policy as a deviation from Samuelson spending expressed share of GDP ($g/y - (g/y)^*$), and unemployment rate under optimal fiscal policy.[1] Several observations stand out.

First, even with small multipliers, optimal stimulus spending is significant. For example, take a tiny multiplier of 0.05: optimal stimulus spending is 2.0 points of GDP. For a

[1]To obtain public spending as a share of GDP from (18.16), we use the identity $g/y = (g/c)/(1 + g/c)$.

small multiplier of 0.1, optimal stimulus spending is 3.7 points of GDP. And for a modest multiplier of 0.2, optimal stimulus spending is 6.1 points of GDP.

Second, the multiplier warranting the largest stimulus is fairly modest. The largest stimulus, which is 7.4 points of GDP, occurs at a multiplier of 0.39.

Third, optimal stimulus spending is the same for small and large multipliers. For instance, optimal stimulus spending is the same, at 3.7 points of GDP, for a small multiplier of 0.1 and a large multiplier of 1.5. Of course the resulting unemployment rates are very different.

Fourth, for small multipliers, the unemployment gap barely falls below the initial value of 6pp although optimal stimulus spending is large. For example, with a multiplier of 0.1, the unemployment gap only falls by 0.4pp to 5.6pp. This is because public spending has little effect on unemployment when the multiplier is small.

Fifth, with a multiplier above 1, optimal stimulus spending almost brings back unemployment to its efficient level, so the unemployment gap almost vanishes. Indeed, when the multiplier is above 1, the remaining unemployment gap is less than 0.8pp. And when the multiplier reaches 2, the remaining unemployment gap is just 0.2pp.

Finally, we calculate optimal fiscal policy at the onset of the Great Recession using midrange values for the fiscal multiplier of 0.5. Under this calibration, optimal stimulus spending is 7.1 points of GDP, and the unemployment gap is projected to fall by 3.8pp to 2.2pp. US GDP in 2009 is $14.5 trillion (BEA 2026). Hence, optimal stimulus spending is $1.0 trillion. How does this optimal stimulus package compare to the actual stimulus package? The outlays from the American Recovery and Reinvestment Act, enacted into law in February 2009, are estimated to be $663 billion between 2009 and 2019 (CBO 2015, table 1). This is two-thirds of the optimal stimulus spending, but spread over a decade.

18.5. Robustness to distortionary taxation

In this chapter, we assume that taxation is nondistortionary: it does not affect workers' decisions to participate or not in the labor force. But in fact, the results are unaffected if taxation is distortionary, as Michaillat and Saez (2019) show.

Consider a model in which productive capacity is endogenous, as in chapter 8, and assume that public spending is financed by a linear income tax, which of course distorts participation to production and thus productive capacity. Following the argument by Michaillat and Saez (2019), we would find that while Samuelson spending is lower with the linear income tax, the correction to the Samuelson rule remains the same. Accordingly, the sufficient-statistic formula developed in this chapter remains valid even with tax distortions.

Hence, the theory alleviates a common concern of stimulus skeptics. They worry that output is too low in slumps, and that increasing public spending would further reduce output through tax distortions. But our theory shows that if it is only because of tax distortions that public spending reduces output, then stimulus spending should be positive in slumps. Indeed, public spending affects output through two channels: the slack channel (public spending reduces slack) and the aggregate-supply channel (more public spending leads to higher taxes, which reduces productive capacity). Then, starting from the Samuelson rule, a small increase in public spending reduces slack, reduces aggregate supply, and increases public consumption, which are all good for welfare; but it reduces output and thus private consumption, which is bad for welfare. By construction, at the Samuelson rule, the cost of lower private consumption offsets the benefits of higher public consumption and lower aggregate supply; the only remaining effect on welfare is the positive effect from lower slack. Therefore, increasing public spending above the Samuelson rule is desirable. The key is that the Samuelson rule takes into account the negative welfare effect caused by the reduction in output stemming from lower aggregate supply, but not the positive welfare effect caused by the increase in output stemming from lower slack.

18.6. Summary

In this chapter we studied how fiscal policy should be adjusted when slack is inefficient. We found that optimal public spending deviates from the Samuelson rule to reduce, but not eliminate, the slack gap. The amplitude of the deviation—which corresponds to the amount of stimulus spending—depends on four sufficient statistics: slack gap, fiscal multiplier, elasticity of substitution between public and private goods, and Beveridge curvature. Since the slack gap is countercyclical, optimal public spending is also countercyclical. That is, the government should spend more in bad times and less in good times.

In the chapter we highlight three main results. The first is that when the fiscal multiplier and slack gap are positive, optimal stimulus spending is positive. This is because an increase in public spending reduces slack, which is inefficiently high, so it generates a positive effect on welfare that is not accounted for by the Samuelson rule and that warrants raising public spending above the Samuelson rule. The second result is that optimal stimulus spending is zero for a zero multiplier, increasing in the multiplier for small multipliers, maximized for a moderate multiplier, and decreasing in the multiplier for larger multipliers. The monotonicity breaks down because when the multiplier is large, it is optimal to fill the slack gap nearly entirely, and then less spending is required to fill the gap when the multiplier is larger. The third result is that optimal stimulus spending is increasing in the elasticity of substitution between public and private consumption. This result is natural: a higher elasticity of substitution means that extra public goods are more valuable, making stimulus spending more desirable.

Given that it is optimal to adjust public spending to the prevailing slack gap, it would be beneficial to have an institution that constantly monitors and adjusts public spending, just like there are institutions in place to constantly adjust monetary policy. In the United States, the Federal Reserve constantly monitors the economy so that they can respond quickly to fluctuations in the business cycle. On the other hand, fiscal policy is determined by the Congress and is heavily influenced by political factors. This makes it harder for the legislative branch to act quickly in stabilizing the economy—although fiscal policy, just like monetary policy, should respond to any deviation from full employment. It would be beneficial to develop an agency that adjusts fiscal policy around some average level determined by Congress, so as to stabilize the economy better. The average level of spending ensures that public goods are provided at an appropriate level. The cyclical adjustments allow public spending to pick up the slack in private spending in bad times, and to make room for private spending in good times, which stabilizes the amount of employment and consumption over the business cycle (even though the public/private mix of consumption varies slightly).

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