Demand Heterogeneity and Policy Mix: A Consideration of the Effect of Macroeconomic Policy with the Disparity in Price Elasticity among Entities

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ABSTRACT

We introduce the disparity in price elasticity between government demand and consumption demand into a simple money-in-the-utility-function model. This extension demonstrates that fiscal policies have a positive, negative, or neutral effect on production. We show that the effect of a fiscal policy financed by seigniorage depends on the value of Marshallian k and the scale of seigniorage in addition to the disparity in price elasticity between economic entities. Moreover, the effect on production depends on how expansionary and contractionary policies are combined. We then demonstrate that the welfare effect of fiscal policy depends on the attitudes of household labour supply.

Keywords: demand heterogeneity, fiscal policy, monetary policy, policy mix

JEL Classification: E51, E52, E62, E63

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1. INTRODUCTION

Fiscal and monetary policies are the main interests of macroeconomics. Cash-in-advance and money-in-the-utility-function (MIU) models have recently been built for theoretical macroeconomic analyses with money. In classical models, the CES or Cobb–Douglas utility function is often used. Due to the weak separability of these utility functions, demand shocks have no room to exist under flexible pricing. In classical theories, only supply side shocks such as productivity shocks can affect output levels. Because of the Lehman shock, however, economic theories are expected to explain how monetary situations can affect real output. Consequently, the neo-classical analysis now includes an imperfection in money markets to consider the effectiveness of aggregate demand policies on output levels. On the other hand, Keynesian-type models use similar utility functions with price rigidity to examine the effects of aggregate demand policies.[1] In the conventional literature, the assumption of price rigidity or the imperfection in money markets is assumed to show that demand shocks affect output. However, a few analyses focus on the mechanism of demand shock affecting production through the price distortion in monopolistic competition instead of an imperfection in money markets or price rigidity.[2]

Firms or labour unions have the initiative in determining the level of production or real wage rates when competition is imperfect. For example, when firms have monopolistic power due to an imperfection in a goods market, the price and quantity of production are dependent on the value of the market's price elasticity. When price elasticity is low, firms have an incentive to produce less and set higher prices. When the price elasticity of goods is identical between buyers, firms do not care who buys but do care about demand size. However, if price elasticity is not identical across demand sectors, such as consumption and government spending, the demand share also becomes important for firms because reactions to price changes differ between consumers and governments. When the demand share with low price elasticity is high, the price elasticity of the whole market is low, giving firms great

[1] Under the assumption of price rigidity, New Keynesian studies indicate that a fiscal policy or tax increase is followed by labour supply changes due to the income or assets effect. The heterogeneity of goods or households with liquidity constraints under the price rigidity condition also leads to policy effectiveness.

[2] One of the few analyses is a series of studies by Otaki (2007, 2009, 2011) shows that an expansionary fiscal policy financed by seigniorage can increase consumption, producing ex post price rigidity via dynamic optimization.

monopolistic power. In this case, the firm sets its price high and production volume low. However, if the demand share with high price elasticity is large, the whole market price elasticity is high. Then, the more competitive market condition creates a low price and high production level. Therefore, the equilibrium output level depends on the share of government out of total demand. Dixon (1990), Dixon and Rankin (1994), and Jacobsen and Schultz (1994) conducted analyses in which fluctuations in price elasticity due to a change in demand share affect production.[3] When prices are high, households tend to give up spending, leading to a high price elasticity of consumption. Furthermore, as a government's expenditures follow its budget plan, it may purchase cheaper goods but rarely ceases purchasing altogether, leading to low price elasticity. These analyses show that increases in government expenditure negatively affect production when the price elasticity of government demand is lower than that of private demand because the price elasticity of the whole market declines. This corresponds to a non-Keynesian effect which is detected by many empirical analyses.[4,5]

This study extends the macro analysis by focusing on differences in price elasticity among entities that have not attracted much attentions. We consider the impacts of increasing the money supply carried out with fiscal policy simultaneously. If real government spending is constant in the MIU model with the assumption of price flexibility, the money is neutral and does not affect production. In case that nominal government spending is constant, however, an increase in the money supply increases the price levels, thus reducing the government's demand for goods. Therefore, the effect of an expansionary monetary policy is equal to that of a contractionary fiscal policy. Thus, the policies' effects may cancel each other out when occurring simultaneously. Japan has seen quantitative monetary easing and budget deficits for a long time, but its economic growth rate remains low. On the other hand, in developed countries such as Europe and the United States, contractionary fiscal policies and expansionary monetary policies have been implemented to reduce government budget deficits after the Lehman shock. However, an increased (not reduced) growth rate has been observed in these countries since the start of the fiscal consolidation.

This study considers fiscal policy by examining the mechanism arising from differences in price elasticity between economic entities without assuming an imperfection

[3] Gali (1994,1995) argued that private investment reflects fluctuations in price elasticity in the market which affects the dynamics of capital accumulation, indicating multiple steady states and equilibrium paths.

[4] In the non-Keynesian effect of fiscal policy, fiscal contraction induces increases in output.

[5] For example, Risquete and Hernandez (2015) identified the existence of the non-Keynesian effect in EU 15 countries. Afonso and Sousa (2012) showed that fiscal expenditures in Germany and Italy reduce production and consumption. Rzonca and Cizkowicz (2005) found that fiscal consolidation in the second half of the 1990s positively affected GDP and private expenditures in Hungary, Lithuania, Estonia, and Latvia.

in money markets or price rigidity, and investigates the effects of the monetary fiscal policy mix. This study introduces the disparity in price elasticity between government and consumption demand into a simple monopolistic competitive model with money, as constructed by Blanchard and Kiyotaki (1987) and Startz (1989).

First, we show that fiscal policy has positive, negative, or neutral effects on production in this simple model, though the Cambridge cash-balance equation is kept strictly under flexible pricing. Next, we show that expansionary monetary policies have effects opposite to those of expansionary fiscal policies under an identical condition. Moreover, the effect of a fiscal policy financed by seigniorage depends on the value of Marshallian k and the scale of money creation in addition to the disparity in price elasticity between economic entities. We also consider the effects of the monetary fiscal policy mix, finding that the effect on production depends on how expansionary and contractionary policies are combined. We further demonstrate that fiscal policy reduces the welfare of households who supply no labour when output increases. Focusing on interactions between monetary and fiscal policies arising from differences in price elasticity between economic entities, we also construct a simple model in which the other mechanisms generate nothing.

The rest of this paper proceeds as follows. Section 2 presents the static monopolistically competitive model on which our analysis is based. Section 3 describes the effect of macroeconomic policy according to financial resources, and the effect of the policy mix. Section 4 considers economic welfare. Section 5 summarizes our conclusions and considers several implications of the study.

2. MODEL

2.1. Structure of the model

We construct the static model of monopolistic competition following Blanchard and Kiyotaki (1987) and Startz (1989). A continuum of goods is indexed by $h \in [0,1]$, each variety of which is produced by monopolistically competitive firm h. Let us suppose that the firms' production functions are identical. The only factor of production, labour, is supplied by households indexed by $i \in [0,1]$. The government produces governmental goods distributed to households equally. Households make consumption and real money balance decisions and choose whether to supply one unit of labour or not. Households receive profits and wages from firms.

2.2. Government

Since goods supplied by the government such as compulsory education, childcare, and medical care, are characterized by excludability and competitiveness, they can be seen as

goods supplied by the private sector.[6] However, without government provision of those goods, total supply will not meet basic social welfare needs. Therefore, the government bears the cost of providing basic human needs of those goods to households. The government purchases varieties to produce the goods and distributes them to households equally. The government's production function is

$$X_G = \left[\int_0^1 \eta_h^{1-1/\sigma_g} dh \right]^{1/(1-1/\sigma_g)}, \quad \sigma_g > 1, \tag{1}$$

where σ_g is the elasticity of substitution among goods in composite goods production.[7] Denoting government spending by G, the government demand for good h, η_h is

$$\eta_h = G P_G^{\sigma_g - 1} p_h^{-\sigma_g}, \quad P_G = \left[\int_0^1 p_h^{1-\sigma_g} dh \right]^{1/(1-\sigma_g)}, \tag{2}$$

where P_G is the government's price index. Eq. (2) shows that σ_g is the price elasticity of government demand for each good. The government budget constraint is

$$\int_0^1 p_h \eta_h dh = P_G X_G = G = T + \Delta M, \tag{3}$$

where ΔM is the amount of newly issued currency and T is tax income from households. T takes a negative sign for lump-sum transfers to households.

2.3. Households

The utility function of household i is

$$u_i = (X_{Ci} + X_{Gi})^{\alpha} \left(\frac{M_{1i}}{P_C} \right)^{1-\alpha} - \delta_i \beta \theta_i, \tag{4}$$

$$X_{Ci} = \left[\int_0^1 c_{hi}^{1-1/\sigma_c} dh \right]^{1/(1-1/\sigma_c)}, \quad \sigma_c > 1,$$

where c_{hi} is the consumption of good h by household i, and X_{Gi} are the goods distributed to household i by the government. M_{1i} is the demand for the nominal money balance by household i, and σ_c is the household's elasticity of substitution among goods and identical across households.[8] P_C is the consumer's price index, defined as

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[6] These types of goods are not categorized as public goods by the standard definition. They are called 'merit goods' by Musgrave.

[7] For example, consider to provide the compulsory education service fulfilling the requirements. A government does not distribute desks textbooks and so on to each household but to produce educational services systematically by using them. In the case that the private sector fulfils the same educational requirement, it buys materials and composes them to consume. But the elasticity of substitution among goods in private sector σ_c would likely differ from that in government sector σ_g because the regulations and laws the government must follow differ from those the private must obey.

[8] The elasticity of substitution between goods is not important to the main result for policy effects because the real values depend on government share in goods demand, which is a function of the GM ratio. The appendix shows that the results do not change when X_G is assumed to be wasteful and not to be substituted for X_C.

$$P_C = \left[\int_0^1 p_h^{1-\sigma_c} dh \right]^{1/(1-\sigma_c)} . \tag{5}$$

δ_i is a definition function set to one when a household supplies labour and zero otherwise. The disutility from working for household i is equal to $\beta\theta_i$. Let us assume that θ_i follows the uniform distribution $n(\theta_i)$ below:

$$n(\theta_i) = I_{0,1} \quad . \tag{6}$$

An economy with a large β value experiences high disutility from work. Let us suppose that household utility functions are identical, except for θ_i. The nominal expenditure of household i E_i is then

$$E_i = \int_0^1 p_h c_{hi} dh + M_{1i} . \tag{7}$$

Household i's budget constraint is

$$E_i = \delta_i w + \int_0^1 \pi_{hi} dh - t_i + M_{0i} \tag{8}$$

where M_{0i} is the nominal money balance that household i originally held, π_{hi} denotes the profit of firm h distributed to household i, and t_i is the tax payment of household i expressed as

$$\int_0^1 t_i di = T . \tag{9}$$

Solving household's utility maximization problem produces the demand of good h, c_{hi}, and the demand of the real money balance M_{1i}/p:[9]

$$c_{hi} = X_{Ci} \left(\frac{p_h}{P_C} \right)^{-\sigma_c}, \qquad X_{Ci} = \alpha \frac{E_i}{P_C} - (1-\alpha) X_{Gi}, \tag{10}$$

$$\frac{M_{1i}}{P_C} = (1-\alpha) \left(\frac{E_i}{P_C} + X_{Gi} \right). \tag{11}$$

The price elasticity of consumption demand for each good is equal to σ_c, which is not always equal to the price elasticity of government demand σ_g.

The indirect utility function iu is expressed as follows:

$$iu_i = A \left(\frac{\delta_i w + \int_0^1 \pi_{hi} dh - t_i + M_{0i}}{P_C} + X_{Gi} \right) - \delta_i \beta \theta_i , \qquad A = \alpha^{\alpha} (1-\alpha)^{1-\alpha} . \tag{12}$$

For each household, the supply/non-supply of labour becomes indifferent when the following equation holds:

[9] Because X_{Ci} and X_{Gi} are perfect substitute, each household regards the free receipt of government goods as income of the same value, as shown in Eq. (10).

$$A\left(\frac{w+\int_0^1 \pi_{hi}dh - t_i + M_{0i}}{P_C} + X_{Gi}\right) - \beta\theta_i = A\left(\frac{\int_0^1 \pi_{hi}dh - t_i + M_{0i}}{P_C} + X_{Gi}\right). \quad (13)$$

Then, the following equation is derived:

$$\theta_i = \frac{A}{\beta}\frac{w}{P_C}. \quad (14)$$

Consequently, each household's attitude to labour supply can be determined the using the equation below, depending on each household's value for θ_i:[10]

$$\theta_i \le \frac{A}{\beta}\frac{w}{P_C} \quad \Rightarrow \quad \delta_i = 1, \qquad \theta_i > \frac{A}{\beta}\frac{w}{P_C} \quad \Rightarrow \quad \delta_i = 0. \quad (15)$$

The total labour supply of economy L^s is

$$L^S = \int_0^1 \delta_i di = \frac{A}{\beta}\frac{w}{P_C} \le 1. \quad (16)$$

Eq. (16) shows that total labour supply depends positively only on the real wage rate. Income changes such as tax increases do not affect labour supply or production.

2.4. Firms

Firm h produces good h by increasing return technology. The production function of firm h is

$$l_h = \psi(y_h), \quad \psi' > 0, \quad \psi'' < 0, \quad (17)$$

where l_h is the amount of labour employed by firm h, and y_h is the output of firm h, which is equal to the sum of household and government demand, expressed as

$$y_h = c_h + \eta_h, \qquad c_h = \int_0^1 c_{hi} di. \quad (18)$$

The profits of Firm h, π_h, are expressed as

$$\pi_h = p_h(c_h + \eta_h) - w\psi(c_h + \eta_h). \quad (19)$$

Each firm sets a price to maximize its profits π_h. The first-order condition for profit maximization is

$$(1-g_h)(\sigma_c - 1) + g_h(\sigma_g - 1) = \frac{w}{p_h}\psi'\left[\sigma_c(1-g_h) + \sigma_g g_h\right], \qquad g_h = \frac{\eta_h}{c_h + \eta_h} \quad (20)$$

where g_h denotes the government's share of the demand for good h. Let us assume Eq. (21) as the production function satisfying Eq. (17):

$$l_h = {y_h}^a, \quad 0 < a < 1. \quad (21)$$

[10] Though the household is indifferent to working when equality holds, I assume that it supplies one unit of labour.

Then, a is a positive parameter indicating the degree of scale economy; the greater the value of a, the smaller the scale economy. The inverse demand function for labour is obtained as follows:

$$\frac{w}{p_h} = \frac{1}{a}\frac{\sigma_{mh}-1}{\sigma_{mh}} l_h^{\frac{1-a}{a}}, \qquad \sigma_{mh} = (1-g_h)\sigma_c + g_h\sigma_g, \tag{22}$$

where σ_{mh} is the price elasticity of the whole market for good h, defined by the average of σ_c and σ_g weighted by their market shares. Considering the production function, we obtain

$$wl_h = p_h y_h \frac{1}{a}\mu_{mh}, \qquad \mu_{mh} = \frac{\sigma_{mh}-1}{\sigma_{mh}}, \qquad 0 < \mu_{mh} < a, \tag{23}$$

$$\pi_h = p_h y_h \left(1 - \frac{1}{a}\mu_{mh}\right). \tag{24}$$

Here, μ_{mh}/a is the labour share. We assume that this condition is satisfied.[11] Moreover, μ_{mh} is a variable indicating the monopolistic power of firm h, which increases as μ_{mh} approaches zero and lower as it approaches one.

The clearing condition of the money market is

$$(1-\alpha)(E + P_C X_G) = M_1, \qquad E = \int_0^1 E_i di. \tag{25}$$

The household budget constraint in this economy as a whole is expressed as

$$E = wL^S + \prod - T + M_0, \qquad \prod = \int_0^1 \pi_h dh = \int_0^1 \pi_{hi} di. \tag{26}$$

Since all firms are symmetrical, $P_C = P_G = p_h$, indicated as p hereafter.

2.5. Equilibrium

The total labour demand of the economy is

$$L^D = \int_0^1 l_h dh = \left(\frac{w}{p}\frac{a}{\mu_m}\right)^{\frac{a}{1-a}}. \tag{27}$$

The equilibrium of labour is obtained by substituting Eq. (27) into Eq. (16):[12]

$$L^* = \left(\frac{A}{\beta a}\mu_m^*\right)^{\frac{a}{2a-1}} \qquad if \quad \left(\frac{A}{\beta a}\mu_m^*\right)^{\frac{a}{2a-1}} < 1 \tag{28a}$$

$$L^* = 1 \qquad if \quad \left(\frac{A}{\beta a}\mu_m^*\right)^{\frac{a}{2a-1}} \geq 1 \tag{28b}$$

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[11] $\mu_{mh} < a \Leftrightarrow \sigma_m(1-a) < 1$. When this inequality is not satisfied, Eq. (20) denotes the profit- minimizing condition because the scale of economy is too large.

[12] The sufficient condition for labour market stability $(\dot{w}/p) = (L^D - L^S) > 0$ is $a > 1/2$. It is assumed that this condition is satisfied hereafter.

Variables with * represent equilibrium values. Eq. (28b) indicates the case where all labour is employed. This section focuses on the case where not all labour is supplied, expressed by Eq. (28a). Eq. (28a) indicates that the equilibrium output level depends on μ_m, i.e., firms' monopolistic power. Given the symmetric equilibrium and definition of $g(=X_G/y)$, we obtain

$$g^* = \frac{X_G}{\left(L^*\right)^{1/a}}. \tag{29}$$

From Eqs. (21), (25), and (26) and the government's budget constraints, we obtain Eq. (30) at the equilibrium:

$$\frac{1-\alpha}{\alpha}\left(L^*\right)^{\frac{1}{a}} = M_1 / p^*. \tag{30}$$

Eq. (30) shows that a higher real money balance corresponds to a higher output level.

In this model, the Cambridge cash-balance equation is held strictly where $(1-\alpha)/\alpha$ represents Marshallian k. Eqs. (28a),(29), and (30) show that the equilibrium values of government share, output level, and real money supply depend on supply of government goods X_G, while price depends on the nominal money supply M_1. X_G and M_1 are policy variables––the model parameters. As shown in Eq. (30), a change in government spending X_G affects government share g^*. Eq. (23) shows that μ_m is a positive function of σ_m, which is the average of σ_c and σ_g weighted by their market share. Unless the price elasticity of the government's demand σ_g is equal to that of consumption σ_c, changes in the share of the government's demand g^* influences monopolistic power and alters output.

FIGURE 1.

3. POLICY EFFECTS

This section first checks how fiscal policies financed by taxes affect the share of the government's demand g^*, then investigates the effect on output. Next, we consider monetary policies with constant nominal government spending G. We also investigate the effects of fiscal policies financed by money creation and tax. Finally, the effects of a monetary fiscal policy mix are examined.

3.1. Effect of increased government goods supply financed by taxes

The effects of an increase in the supply of government goods X_G occur in two stages. The first affects government share g^*, and the second produces changes in g^* on the firm's monopolistic power. The effect of increased government goods supply financed by taxes on

government share g^* are as follows:

$$\left(\frac{dg}{dX_G}\right)^* = \frac{1}{\left[1-\left(\sigma_c-\sigma_g\right)g^*B\right]y^*} > 0, \qquad B = \frac{1}{\left(2a-1\right)\left(\sigma_m-1\right)\sigma_m} > 0. \tag{31}$$

The brace in the denominator of Eq. (31) expresses a multiplier of a change in government share g^*; we assume that $1>|(\sigma_c-\sigma_g)B|$.[13] Because this condition is fulfilled, the increased government goods increases government share g^*.

An increased government goods supply financed by taxes has the following effects:

$$\frac{dL^*}{dX_G} = -aL^*B\left(\sigma_c-\sigma_g\right)\left(\frac{dg}{dX_G}\right)^* \gtreqless 0 \quad \Leftrightarrow \quad \sigma_c-\sigma_g \lesseqgtr 0, \tag{32}$$

$$\frac{dp^*}{dX_G}\frac{X_G}{p^*} = \left(\sigma_c-\sigma_g\right)BX_G\left(\frac{dg}{dX_G}\right)^* \gtreqless 0 \quad \Leftrightarrow \quad \sigma_c-\sigma_g \gtreqless 0. \tag{33}$$

An increased supply of government goods X_G increases the share of government demand g^*. When $\sigma_g>\sigma_c$, the firm's monopolistic power declines (as μ_m rises). The firm increases its output level and cuts its prices. By contrast, when $\sigma_g<\sigma_c$, the increase in the government share strengthens firm's monopolistic power (as μ_m falls). Firms raise prices and reduce output, thus displaying the non-Keynesian effect of fiscal policy.

The mechanism of the supply of government goods X_G affecting output levels in this analysis is based on changes in firms' monopolistic power due to a change in the composition of goods demand. This is a different mechanism of changes in productivity or income or in asset effects that alter the labour supply. When $\sigma_g=\sigma_c$, this transmission mechanism does not. The production level does not change, and consumption is crowded out; thus, the classical case occurs. Therefore, fiscal policy has positive, negative, or neutral effects on production in this simple model, though the Cambridge cash-balance equation is kept strictly under flexible pricing. These results were ontained by Dixon (1990), Dixon and Rankin (1994), and Jacobsen and Schultz (1994).

The policy's effect on consumption is

$$\frac{dX_C^*}{dX_G} = -\frac{1+\left(1-g^*\right)\left(\sigma_c-\sigma_g\right)B}{1-\left(\sigma_c-\sigma_g\right)g^*B} < 0. \tag{34}$$

When $\sigma_g=\sigma_c$, consumption is crowded out completely ($-dX_C=dX_G$) because output does not

[13] When $\sigma_g\neq\sigma_c$, an increase in government share g changes the firm's monopolistic power (μ_m), causing a change in output. This proceeds further changes in g. Therefore, a multiplier process occurs. The condition on which this multiplier process converges is that the absolute value of common ratio $|(\sigma_c-\sigma_g)gB|$ is less than one. We assume that one of its sufficient conditions $|(\sigma_c-\sigma_g)B|$ is satisfied hereafter. With this condition, a multiplier process induced by an increase in X_C via a change in income converges as well.

change. In this case, direct crowding out occurs due to perfect substitutability between X_G and X_C.[14] When $\sigma_g<\sigma_c$, consumption declines more than the increase in government goods supply ($-dX_C>dX_G$) because output decreases. By contrast, when $\sigma_g>\sigma_c$, the firm increases its output and consumption is partially crowded out. Consumption declines less than the increase in government goods supply ($-dX_C<dX_G$). In this case, $dX_C+dX_G>0$. Because X_C and X_G are perfect substitutes, households' utility level may increase. Section 4 considers the policies' welfare effects.

TABLE 1. Effects of fiscal policy financed by taxes

3.2. Monetary policy with constant nominal government spending

A change in nominal money supply M_1 with a constant supply of government goods X_G does not change the government share in goods market g^*, while prices rise. Therefore, the production level is unchanged.[15] Monetary policy has no effect in this model. However, in case that the nominal money supply increases under constant nominal government spending G, government purchase quantity decreases, affecting g^* via price changes. As preparation for the analysis of a policy mix, let us investigate the effects of an increase in nominal money supply under constant nominal government expenditure. We can rewrite Eq. (29) as follows:

$$g^* = \frac{1-\alpha}{\alpha}\frac{G}{M_1}. \tag{35}$$

Therefore, an increase in the nominal money supply M_1 with constant nominal government spending G reduces the government share g^*:

$$\left(\frac{dg}{dM_1}\right)^* = \frac{-g^*}{M_1} < 0. \tag{36}$$

As shown in Eq. (38), an increase in M_1 raises prices. With constant nominal government spending, the government's goods market share declines because the government's purchase quantity decreases.

Changes in the nominal money supply with a constant G affect output and prices as follows:

$$\frac{dL}{dM_1} = \frac{aL^*\left(\sigma_c-\sigma_g\right)g^*B}{M_1}\gtrless 0 \quad \Leftrightarrow \quad \sigma_c \gtrless \sigma_g \quad , \tag{37}$$

$$\frac{dp}{dM_1}\frac{M_1}{p} = \left[1-\left(\sigma_c-\sigma_g\right)g^*B\right] > 0. \tag{38}$$

[14] Although X_{Gi} is wasteful in the model in the appendix, the fiscal policy crowds out consumption completely. This crowding out that is induced by an increase in goods prices is indirect.

[15] Therefore, money is neutral.

When $\sigma_g=\sigma_c$, the output level is unchanged because the government's share does not affect firms' monopolistic power. The price's change rate is equal to that of the nominal money supply. In this case, the classical case occurs.

When $\sigma_g\neq\sigma_c$, employment and output change, and the price's change rate differs from that of the nominal money supply. Because government share g^* decreases, when $\sigma_g>\sigma_c$, firms' monopolistic power is enhanced (as μ_m falls), reducing output. The change rate of prices is greater than that of the nominal money supply. By contrast, when $\sigma_g<\sigma_c$, firms' monopolistic power declines (as μ_m rises), increasing firms' output. Prices' change rate is smaller than that of the nominal money supply. Production changes arise because the government purchases fewer goods due to increased good market prices. Therefore, the way of expansionary monetary policy affects output under a constant G is equal to that of contractionary fiscal policy financed by taxes.

TABLE 2. Effects of monetary policy with constant nominal government spending

Tables 1 and 2 show how the effects of expansionary monetary policies are opposite to those of expansionary fiscal policies financed by taxes under identical conditions.

3.3. Fiscal policy financed by seigniorage and taxes

A fiscal policy financed by seigniorage is equal to the simultaneous implementation of an expansionary fiscal policy financed by taxes and an expansionary monetary policy with a constant G because government spending increases with an expansion of the nominal money supply. As shown, when the values of price elasticity differ between economic entities, the effects of an expansionary monetary policy under a constant G are equal to those of a contractionary fiscal policy financed by taxes. Therefore, a fiscal policy financed by seigniorage is equal to the joint implementation of expansionary and contractionary fiscal policies. This subsection investigates which effect dominates when fiscal policy is financed by both money creation and taxes. For calculative convenience, we consider nominal government spending $G(=pX_G)$ instead of the supply of government goods X_G.

Proportion τ of fiscal policy costs are financed by taxes and proportion $1-\tau$ by seigniorage.

$$d\left(pX_G\right)=dG=dT+dM_1=\tau dG+\left(1-\tau\right)dG .$$

The analysis in the previous subsection is the case where $\tau=1$. The case where $\tau=0$ reflects a fiscal policy financed by seigniorage only.

Eq. (35) shows that government share g^* is expressed as a product of the GM ratio and Marshallian k. First, the effects of an increase in government spending financed by seigniorage and taxes on government share g^* are

$$\left(\frac{dg}{dG}\right)^* = \frac{k - g^*(1-\tau)}{M_1} \quad . \tag{39}$$

When τ=1, that is fiscal policy is financed by taxes, the increase in nominal government spending (dG) raises government share g^*, thus k/M_1. The increase in the nominal money supply ($(1-\tau)dG$) reduces g^*, thus $-g^*(1-\tau)/M_1$. The effect of an increase in government spending financed by seigniorage on government share g^* is equal to the sum of the effects of the two joint policies: a tax-financed fiscal policy and the increase in nominal money supply. When the fiscal policy's effect dominates (i.e. $k>g^*(1-\tau)$), government share g^* increases. When the effect of the increase in nominal money supply dominates (i.e. $k<g^*(1-\tau)$), g^* decreases.

A fiscal policy financed by seigniorage and tax has the following effects:

$$\frac{dL^*}{dG} = -\frac{aL^*B}{M_1}(\sigma_c - \sigma_g)\{k - g^*(1-\tau)\} \gtreqless 0 \quad \Leftrightarrow \quad [k - g^*(1-\tau)](\sigma_c - \sigma_g) \lesseqgtr 0 , \tag{40}$$

$$\frac{dp^*}{dG} = \frac{p^*}{M_1}\left[(1-\tau) + \{k - g^*(1-\tau)\}(\sigma_c - \sigma_g)B\right]$$

$$\Leftrightarrow \quad [k - g^*(1-\tau)](\sigma_c - \sigma_g) > 0 . \tag{41}$$

When the expansionary fiscal policy's effect dominates (i.e. $k>g^*(1-\tau)$), the effect on output is equal to the effect of fiscal policy financed by taxes (see Table 1). By contrast, when the effect of the increase in nominal money supply dominates (i.e. $k<g^*(1-\tau)$), the effect on output is equal to the effect of monetary policy with fixed nominal government spending (see Table 2). Therefore, under simultaneous expansionary fiscal and expansionary monetary policies (as in Japan after the Lehman shock), a change in production may be small because the policies' effects cancel each other out.[16] Moreover, a non-Keynesian effect of fiscal policy will occur when $\sigma_g>\sigma_c$ aside from when $\sigma_g<\sigma_c$. The classical case occurs not only when $\sigma_g=\sigma_c$ but also when $k=g^*(1-\tau)$, where the monetary and fiscal policies' effects are cancelled out completely. These results are summarized in Table 3.

The impact of the government spending increase on prices depends on the relative effects of inflation due to the increase in the nominal money supply, shown in the first term in the bracket on the right-hand side of Eq. (41), and the change in the firm's monopolistic power, shown in the second term in the bracket. When monopolistic power increases, prices tend to rise. In this case, then, prices rise through both effects. If $\sigma_g=\sigma_c$ as well, the price's change rate is equal to that of the nominal money supply.

As the change rate of nominal government spending is divided into the rates of prices and government goods supply, we obtain the latter as follows:

[16] Section 5 briefly discusses policy mixes in Japan and U.K after the Lehman shock and in the U.S. in the early days of Reaganomics.

$$\frac{dX_G}{dG}\frac{G}{X_G}=\frac{1}{k}\left\{k-g^*(1-\tau)\right\}\left\{1-(\sigma_c-\sigma_g)g^*B\right\}\gtreqless 0 \quad \Leftrightarrow \quad k\gtreqless g^*(1-\tau). \qquad (42)$$

When the effect of fiscal policy dominates (i.e. $k>g^*(1-\tau)$), government goods supply increases. By contrast, when the effect of the increase in nominal money supply dominates (i.e. $k<g^*(1-\tau)$), government goods supply declines.

The effect on consumption is as follows:

$$\frac{dX_C{}^*}{dG}=-y^*\left(\frac{dg}{dG}\right)^*\left[1+(1-g^*)(\sigma_c-\sigma_g)B\right] \quad . \qquad (43).$$

Because the sign in the bracket on the right-hand side of Eq. (43) is positive, the effect on consumption is opposite to that on government goods supply. When $k>g^*(1-\tau)$, consumption decreases. When $k<g^*(1-\tau)$, consumption increases. When fiscal policy is financed by taxes only, consumption decreases. However, when government covers the expenses of fiscal policy for not only taxation but for money creation, consumption increases under some conditions. The disparity in price elasticity between government demand and consumption demand affects only the scale of consumption changes.

TABLE 3. Effects of fiscal policy financed by seigniorage and taxes

$1-\tau$ expresses the scale of monetary policy to that of fiscal policy. When $1-\tau>1$, the scale of expansionary monetary policy is larger than that of fiscal policy. When $1-\tau<0$, an expansionary fiscal policy and a contractionary monetary policy are carried out simultaneously.[17] When a contractionary fiscal policy ($dG<0$) and expansionary monetary policy ($1-\tau<0$) are carried out simultaneously (as in the U.K. and U.S. during fiscal consolidation after the Lehman shock), the government share falls. When $\sigma_g<\sigma_c$, as is common, output increases. In the reverse combination, under a simultaneous expansionary fiscal policy and contractionary monetary policy (as in the early stages of Reaganomics), the government share rises and output decreases if $\sigma_g<\sigma_c$.

4. WELFARE ANALYSIS

When production changes as a result of fiscal policy, real wages and real profits also change. As shown clearly in Eq. (16), an increase in labour supply raises real wages.[18] As seen in Eq. (24), on the other hand, the ratio of distribution to profits decreases when

[17] As $1-\tau$ expresses the scale of monetary policy to that of fiscal policy, $\tau=-3$ in the case of monetary relaxation at twice the scale of government expenditure $dG<0$.

[18] Since labour demand depends on real wages and the firm's monopolistic power μ_m, the labour demand curve shifts according to the change in μ_m. Therefore, no one-to-one correspondence occurs between real wages and employment amounts.

production increases. Whether real profits increase or not depends on the monopolistic power of a firm. Where the firm's monopoly power is low (i.e. $\mu_m > 1/2$), real profits fall. Where monopoly power is high (i.e. $\mu_m < 1/2$), real profits increase. Therefore, the welfare effect of a fiscal policy differs between households that supply labour to receive profits and wages and households that do not supply labour but receive only profits. This section compares economic welfare effects between such households.

Considering Eqs. (12), (23), and (24) and the government's budget constraint, the change in the economic welfare of households supplying labour is shown as Eq. (44), and that in the economic welfare of households who do not supply labour is shown as Eq. (45).

$$\frac{d(iu)}{dG} = -Ay^* B(\sigma_c - \sigma_g)\left(\frac{dg}{dG}\right)^*\left[1-\mu_m{}^* + \left(\frac{1}{L^*}-1\right)\mu_m{}^* + k\right], \qquad (44)$$

$$\frac{d(iu)}{dG} = -Ay^* B(\sigma_c - \sigma_g)\left(\frac{dg}{dG}\right)^*\left(1-2\mu_m{}^* + k\right). \qquad (45)$$

The right-hand sides of Eqs. (44) and (45) are the same except within the brackets. The sign of the bracket on the right-hand side of Eq. (44) is always positive. Therefore, when production increases ($(\sigma_c-\sigma_g)(dg/dG)^*<0$), the economic welfare of households providing labour increases. On the other hand, in Eq. (45), the sign of the bracket is either positive or negative. In the positive case, the change in economic welfare is the same as that for labour-supply households; in the negative case, the change in welfare is reversed. When $\mu_m{}^*<1/2$, where the firm's monopoly power is high, the sign in parentheses is positive, and welfare increases due to the increase in production regardless of whether labour is supplied or not. On the other hand, when $\mu_m{}^*>1/2$, in the case that real profits decline, the sign of the bracket in Eq. (45) is positive and welfare rises only when the value of k is sufficiently large. This happens because the price decrease accompanying the increase in production is large, and the real money balance increases, which exceeds the decrease in real profits.[19] Output increases along with a high value of k only when $(dg/dG)>0$ and $\sigma_c<\sigma_g$. Therefore, other than in this case, welfare declines, and the policy has opposed beneficial impacts depending on the household's decision about whether to supply labour or not.

The results in this section depend largely on the assumption that X_G and X_C are perfect substitutes. As shown in the appendix, under the assumption that X_G is wasteful and not substitutable with X_C, households' utility level is highly likely to decline even if production increases due to an increased supply of government goods.

5. CONCLUSION

[19] From Eq. (29), $d(M_1/p)/dy=k$; the larger k is, the more price decrease (increases in the real money supply) accompany y increases.

We demonstrate that a macroeconomic policy affects production if we introduce the disparity in price elasticity between government demand and consumption demand. Our main findings are as follows.

We show in a model that fiscal policies have positive, negative or neutral effects on production even if the Cambridge cash-balance equation is held strictly under flexible pricing, except when price elasticity values are equal between economic entities. Moreover, under a given nominal government spending, the effect of an expansionary monetary policy is equal to that of a contractionary fiscal policy because an increase in prices reduces government demand. Therefore, monetary and fiscal policies have opposite effects on production under the same condition. When fiscal policy is financed by money creation, the policy's effect depends on the difference in price elasticity, as well as the relative scale of seigniorage $g(1-\tau)$ and Marshallian k. Depending on the relative scale, the influence on output is positive or negative, or the effects are cancelled. The effect of a policy mix on production depends on how expansionary and contractionary policies are combined. If $\sigma_g<\sigma_c$, as is common, output increases when a contractionary fiscal policy and expansionary monetary policy are implemented simultaneously. In the reverse combination, output decreases. The welfare of households that supply labour is linked to changes in output, but the welfare of households that do not supply labour is reversed in some cases.

This model shows that, when an expansionary fiscal policy and monetary policy are carried out simultaneously, most of their effects may cancel each other out. One example of this process is Japanese government's substantial quantitative monetary easing and budget deficits since the collapse of Japan's bubble in the first half of the 1990s. In particular, over the nine years after the collapse of Lehman Brothers (2008-2016), the money supply (M1) increased 1.4 times, net government debt increased 1.5 times, and the debt's percentage of GDP increased from 85 % in 2008 to 120% in 2016.[20] However, the average annual rate of GDP growth over the nine years was 0.21%. Thus, the expansion effect of both policies was extremely slight.[21] The government share of Japan's GDP gradually declined from 38.8% in 2009 after the Lehman shock to 36.8% in 2016, and GDP increased by 4.4% and the GDP deflator fell by 1.25% over the same period. If $\sigma_g<\sigma_c$, as is generally the case, a decline in government share will accompany a production increase and price reduction in our model. It is interesting that the experience of the Japanese economy is the same as in this case.

In the U.K., M1 increased 1.6 times, and net government debt increased 2.7 times over the nine years between the Lehman shock and 2016. However, since the beginning of fiscal

[20] Data on real GDP, and the GDP deflator, the M1change rate are taken from International Financial Statistics (IMF), and data on government debt and the ratio of government expenditure to GDP are taken from the World Economic Database (IMF) or arrived at by my own calculations using it. Data on M1 for the U.K. are taken from Monthly Monetary and Financial Statistics (OECD).

[21] The average annual growth rate of GDP in the same period is 0.7% in the US and 0.7% in the U.K.; Japan's growth rate is less than one-third of those. In Japan, the GDP deflator has declined, but it has raised 0.8% in the US and 0.9% in the U.K. in the same period.

consolidation in 2010, the government share decreased to 39% in 2016 from its 2010 maximum value of 44.5%. The growth rate was negative before the start of fiscal rebuilding but turned positive after 2010. A declining government share and increasing output were observed in the U.K. as well. On the other hand, tax cuts and high interest rate policies were followed in the early days of Reaganomics, from 1981 to 1982. At that time, the government share rose from 16.7% in 1980 to 17.5% in 1982, while the growth rate was sluggish and became negative in 1982.

Because this model is a simple static model in which the bond market and investment are omitted, it can explain only a part of the whole. However, it provides an important viewpoint from which to interpret several aspects of national economies.

Concerning fiscal policy, our findings suggest that the budget implementation rule affects output levels. Under a hard-and-fast rule on fiscal spending usage, the elasticity of substitution (i.e., price elasticity of demand) is low. On the other hand, under a flexible rule, the elasticity of substitution may be high. Thus, the fiscal rule may affect production.

Appendix

We assumed in the main model that X_{Gi} and X_{Ci} are perfect substitutes for households, as is shown in Eq.(4). The results for policy effects obtained in the main body may depend greatly on this assumption. In this appendix, we compare the model in the main body with a model in which government goods and consumer goods are not substitutable and show that the difference in the suppositions about substitution does not affect the equilibrium value or policy effects.

If government goods are wasteful and do not affect the utility of households, the utility function of household i is expressed as follows:

$$u_i = \left(X_{Ci}\right)^{\alpha}\left(\frac{M_{1i}}{P_C}\right)^{1-\alpha} - \delta_i\beta\theta_i .$$

The demand of each good h c_{hi}, and the demand of real money balance M_{1i}/P_C are as follows:

$$c_{hi} = X_{Ci}\left(\frac{p_h}{P_C}\right)^{-\sigma_c}, \qquad X_{Ci} = \alpha\frac{E_i}{P_C} ,$$

$$\frac{M_{1i}}{P_C} = \left(1-\alpha\right)\frac{E_i}{P_C} .$$

The price elasticity of consumption demand for each good is σ_c, which is equal to that of the model in the main body. The indirect utility function is expressed as follows:

$$iu_i = A\left(\frac{\delta_i w + \int_0^1 \pi_{hi}dh - t_i + M_{0i}}{P_C}\right) - \delta_i\beta\theta_i .$$

The condition that the supply/non-supply of labour is indiscriminate for households is not influenced by the change of the model and is represented by Eq. (14). The total labour supply L^s is also given by Eq. (16). There are no changes regarding firms or government. Therefore, the equilibrium of labour L is obtained as in Eqs. (28a) and (28b) in the main body. On the other hand, from Eqs. (21), (25), and (26) and the government's budget constraint, the following equation holds in equilibrium:

$$\left(1-g'\right)\frac{1-\alpha}{\alpha}p'\left(L'\right)^{\frac{1}{a}} = M_1 .$$

Variables with ′ indicate the equilibrium value of the cases where government goods are wasteful. Marshallian k' in this case is $k'=(1-g)(1-\alpha)/\alpha=(1-g)k$, which varies according to the change in the private sector share.

Let us first compare equilibrium values between the case of perfect substitution and the case of wastefulness, when σ_c is equal to σ_g. Because $\sigma_c=\sigma_g$, the price elasticity of the market as a whole σ_m is equal to $\sigma_c(=\sigma_g,)$, and this value is the same for both models. Thus, monopolistic power also has the same value in both models. Thus, employment and output

will be equal ($y^*=y'$) in both cases. With the same X_G, the government share is equal ($g^*=g'$). However, considering Eq. (43), the price level is higher than in the case of perfect substitution, $p'=p^*/(1-g')$. Unlike in the wasteful case, in the case of a complete substitution, when households receive government goods, households purchase fewer goods and the price level falls.

TABLE A1. Equilibrium values in the case that $\sigma_g=\sigma_c$

From definition of the government share, g′ is obtained as follows:

$$g' = \frac{X_G}{y'} = \frac{X_G}{M_1/(k'p')} = \frac{1-\alpha}{\alpha}\frac{G}{M_1}.$$

The government share g′ in the appendix model is expressed as a product of the GM ratio and k ($=(1-\alpha)/\alpha$).

Next, in the case where σ_c is slightly higher than σ_g, we compare how the value of government share g changes in each case. They are the same, as expressed as follows:[22]

$$\frac{dg^*}{d\sigma_g} = \frac{dg'}{d\sigma_g} = \frac{-g^2B}{\left[1-(\sigma_c-\sigma_g)gB\right]}.$$

Thus, the same equilibrium value is obtained in both cases even if $\sigma_c \neq \sigma_g$.

Whether government goods are wasteful or fully substitute for consumer goods does not affect the equilibrium of labour employment or output level because firms decide on output levels according to the value of the elasticity in the goods market.

Next, let us compare the effect of increasing the supply of government goods. The effect of an increase in the supply of government goods X_G financed by taxes on the government share and employment are obtained as follows:

$$\frac{dg'}{dX_G} = \frac{1}{\left[1-(\sigma_c-\sigma_g)gB\right]y},$$

$$\frac{dL'}{dX_G} = \frac{-aLB(\sigma_c-\sigma_g)}{\left[1-(\sigma_c-\sigma_g)gB\right]y}.$$

These equations are equivalent to the effects in the case of the fully substitutive case shown in Eqs. (32) and (33). The effect of fiscal policy on consumption is expressed by Eq. (34) in Section 1 and is not affected by changes in assumptions because the equilibrium output is proportional to the GM ratio.

The effect on prices is given below:

$$\frac{dp'}{dX_G} = p'\frac{1+(1-g)(\sigma_c-\sigma_g)B}{(1-g)\left[1-(\sigma_c-\sigma_g)gB\right]y} > p^*\frac{(\sigma_c-\sigma_g)B}{\left[1-(\sigma_c-\sigma_g)gB\right]y}.$$

This differs between a wasteful case and a completely substitute case. In the case of perfect substitution, because households receive government goods, households' demand for goods

[22] The same is true for cases where σ_g is slightly higher than σ_c.

declines, and the price level falls.

The effect on consumption is obtained as follows, exactly as in Eq. (34).

$$\frac{dX_C{}'}{dX_G} = -\frac{1+(1-g')(\sigma_c-\sigma_g)B}{1-(\sigma_c-\sigma_g)g'B}.$$

In the appendix model, though government good X_G is wasteful and no substitution with X_C is assumed, the price increases due to fiscal policy and consumption are completely crowded out. This crowding out is thus indirect.

On the other hand, the welfare effect of households who do not supply labour on economic welfare is expressed by the following equation:

$$\frac{d(iu)}{dG} = -Ay'\left(\frac{dg}{dG}\right)'\left[B(\sigma_c-\sigma_g)\left(1-2\mu_m{}'+k(1-g')-g'\right)+(1+k)\right].$$

When production increases, the effects on welfare are 1) changes in profits in addition to 2) reduction in welfare (as government goods are wasteful) and 3) positive asset effects due to a price decrease. The total effect depends on the effects' relative magnitudes. The lower the GM ratio, the greater the effect of 3), and welfare is likely to improve. As in the model in the main body, the welfare of households who supply labour is likely to increase more than that of households who do not because the real wage rate rises.

Therefore, the degree of substitution of goods does not affect real values, only nominal values. However, the effect on economic welfare is more ambiguous than it is in the model used in the main body.

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FIGURE 1.

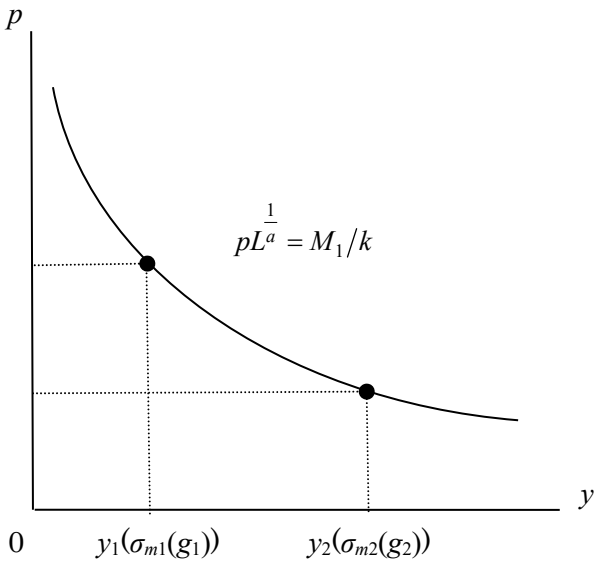

TABLE 1. Effects of fiscal policy financed by taxes

$\sigma_g > \sigma_c$			$\sigma_g = \sigma_c$			$\sigma_g < \sigma_c$		
dL/dX_G	dp/dX_G	dX_C/dX_G	dL/dX_G	dp/dX_G	dX_C/dX_G	dL/dX_G	dp/dX_G	dX_C/dX_G
+	–	Larger than –1	0	0	–1	–	+	Smaller than –1

TABLE 2. Effects of monetary policy with constant nominal government spending

$\sigma_g > \sigma_c$		$\sigma_g = \sigma_c$		$\sigma_g < \sigma_c$	
dL/dM	(*dp/dM*)*M/p*	*dL/dM*	(*dp/dM*)*M/p*	*dL/dM*	(*dp/dM*)*M/p*
–	Larger than 1	0	1	+	Smaller than 1

TABLE 3. Effects of fiscal policy financed by seigniorage and taxes

	$\sigma_g > \sigma_c$			$\sigma_g = \sigma_c$			$\sigma_g < \sigma_c$		
	$\frac{dL}{dG}$	$\frac{dp}{dG}\frac{M}{p}$	$\frac{dX_C}{dG}$	$\frac{dL}{dG}$	$\frac{dp}{dG}\frac{M}{p}$	$\frac{dX_C}{dG}$	$\frac{dL}{dG}$	$\frac{dp}{dG}\frac{M}{p}$	$\frac{dX_C}{dG}$
$k > g(1-\tau)$	+	?	–	0	$1-\tau$	–	–	Larger than $1-\tau$	–
$k = g(1-\tau)$	0	$1-\tau$	0	0	$1-\tau$	0	0	$1-\tau$	0
$k < g(1-\tau)$	–	Larger than $1-\tau$	+	0	$1-\tau$	+	+	Smaller than 1	+

TABLE A1. Equilibrium values in the case that $\sigma_g=\sigma_c$

$\sigma_m{}^* = \sigma_m$'	$L^* = L'$	$g^* = g'$	$p^* < p' = p^*/(1-g)$