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FISCAL STIMULUS AND ENDOGENOUS FIRM ENTRY IN A MONOPOLISTIC COMPETITION MACROECONOMIC MODEL

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This paper sets up a monopolistic competition model featuring the returns to production specialization. Some novel results are derived from the analysis. First, the effect of a fiscal stimulus on consumption may be positive or negative, depending crucially upon whether the production function is characterized by increasing or decreasing returns to production specialization. Second, following a fiscal expansion, increasing returns to specialization lead to a positive linkage between real wages and aggregate output, while decreasing returns to specialization result in a negative relationship between real wages and aggregate output. Third, a fiscal expansion may raise social welfare, provided that the degree of increasing returns to production specialization is sufficiently large.
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1. Introduction

According to the standard real business cycle (RBC) models with perfect competition and constant returns-to-scale technology, a positive fiscal shock financed by a lump-sum tax leads to a negative wealth effect, which reduces both consumption and real wages, but increases output.[1] However, this prediction concerning (i) the responses of consumption and real wages and (ii) the countercyclicality between output and consumption (or real wages) from the standard RBC models is not consistent with the empirical evidence.

In terms of consumption, the standard RBC models predict the crowding-out effect on consumption in response to a fiscal expansion, while the empirical findings are inconclusive. Some studies (Blanchard and Perotti, 2002; Fatas and Mihov, 2002; and Gali *et al.*, 2007) find a positive consumption effect, but others (Ahmed, 1986; Ramey and Shapiro, 1998; Ho, 2001) find a negative effect. This inconsistency has been dubbed the fiscal policy puzzle (see e.g. Ganelli and Tervala, 2009). In terms of real wages, most theoretical studies (e.g. Baxter and King, 1993; Cardia, 1995; Edelberg *et al.*, 1999; Burnside *et al.*, 2004) predict that real wages are negatively correlated with aggregate output. However, empirical studies refer to a mixed comovement between real wages and output. Real wages are procyclical to aggregate output in the USA (Solon *et al.*, 1994; Kandil, 2005; Hart *et al.*, 2009), but they are countercyclical in Canada (Messina *et al.*, 2009).

In this paper, we attempt to provide a theoretical reconciliation of the inconsistency between the theoretical predictions and the empirical observations. To this end, we build a modified one-sector RBC model of monopolistic competition with endogenous firm entry and, hence, product diversification. The endogenously-determined number of

[1] See Rebelo (2005) for a survey on the properties of RBC models.

goods (or firms) renders the increasing/decreasing returns to production specialization, governing the impacts of government spending on private consumption and real wages. Conceptually, the increasing/decreasing returns to production specialization are similar to the classical notion of economies/diseconomies of scope (see Holtz-Eakin and Lovely (1996) and Blancard *et al.* (2011)).[2] It is predictable that a unified expansion in the government spending may end up with different consumption and wage effects if product diversification could result in higher efficiency due to increasing returns to specialization or lower efficiency due to decreasing returns to specialization.

Our main findings are as follows. While a fiscal expansion stimulates aggregate output, it may have a positive effect (in the presence of increasing returns to production specialization) or a negative effect (in the presence of decreasing returns to production specialization) on consumption and real wages. The economic reasoning for the results can be explained by shedding light on two conflicting effects: the traditional wealth effect and the output-enhancing effect stemming from endogenous product diversification. A fiscal expansion financed by a lump-sum tax raises the tax burden on households. This *negative wealth effect* leads households to decrease their consumption and leisure. Because households provide more labour supply, the real wage falls accordingly. By contrast, the *output-enhancing effect* indicates that an increase in labour hours gives rise to a beneficial effect on capital accumulation, which, in turn, enhances aggregate output. This output enhancement, on the one hand, increases consumption and, on the other hand, it also decreases labour supply, which, in turn, increases the real wage. Of particular importance, the magnitude of the output-enhancing effect depends on whether the returns to production specialization are increasing (economies of scope) or decreasing (diseconomies of scope). A fiscal expansion increases firms' profits and, hence, attracts more new firms to enter the market. Once product variety increases, the output-enhancing effect is reinforced (respectively, attenuated) in the presence of increasing (respectively, decreasing) returns to production specialization. Therefore, in the presence of increasing (respectively, decreasing) returns to production specialization a fiscal expansion has a positive (respectively, negative) effect on consumption and real wages and, accordingly, there is a positive (respectively, negative) comovement between output and consumption as well as real wages.

We also perform a simple welfare analysis. We show that in the presence of increasing returns to production specialization a fiscal expansion may not necessarily be desirable in terms of welfare, even though it stimulates consumption. If the degree of increasing returns to specialization is substantially large, a fiscal expansion can yield a double dividend by not only enhancing consumption (and output) but also by improving social welfare. However, if the degree of increasing returns to specialization is only moderate, a fiscal expansion increases consumption but decreases social welfare.

2. The model

The economy we consider consists of three types of agents: households, firms and a government. The production side of the economy consists of two sectors: the perfectly competitive final good sector and the monopolistically competitive intermediate goods

[2] To be more specific, economies of scope describe a production pattern that occurs if it is less costly to combine more product lines in one firm, while diseconomies of scope occur otherwise.

sector. The households derive utility from consumption and leisure. The government levies a lump-sum tax to finance its expenditure.

2.1 Firms

There are N kinds of intermediate goods y_i, $i \in [0, N]$, which are used by a perfectly competitive firm to produce a final good Y.[3] Following Pavlov and Weder (2012), final output is produced with the following technology:

$$Y = N^{\alpha+1-1/\lambda}\left(\int_0^N y_i^{\lambda}\,\mathrm{d}i\right)^{1/\lambda}. \tag{1}$$

As we will explain later, the parameter $\lambda \in (0, 1)$ measures the degree of monopoly of the intermediate good firms, and the parameter α ($\gtreqless 0$) measures the extent of the returns to production specialization.

The production function reported in Equation (1) displays a generalized form of increasing (or decreasing) returns to production specialization in the sense that the larger the number of intermediate firms, the higher (lower) the amount of final output obtained.[4] To be more precise, if all intermediate goods are hired in the same quantities, namely y, then final output is given by $Y = N^{\alpha+1}y$. Thus, an expansion in the number of firms raises more (less) than proportionally the final goods production if $\alpha > 0$ ($\alpha < 0$). As stressed by Aghion and Howitt (1998, p. 407), "[f]or while having more products definitely opens up more possibilities for specialization and of having instruments more closely matched with a variety of needs, it also makes life more complicated and creates greater chance of error". The former statement refers to the so-called production-enhancing effect, while the latter statement refers to the so-called production-complexity effect (Bucci, 2013). Thus, the scenario $\alpha > 0$ in our model corresponds to a situation in which the production-enhancing effect dominates the production-complexity effect, and vice versa.

Assuming that the final good is the numéraire, the profit-maximization problem for the final good firm can be expressed as:

$$\underset{y_i}{\mathrm{Max}}\ \pi^f = N^{\alpha+1-1/\lambda}\left(\int_0^N y_i^{\lambda}\,\mathrm{d}i\right)^{1/\lambda} - \int_0^N p_i y_i\,\mathrm{d}i,$$

where p_i is the relative price of intermediate good i. Accordingly, the corresponding first-order condition is given by:

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[3] To simplify the notation, in what follows the time subscript of all variables is omitted except in cases where it should be brought to the reader's attention.

[4] The importance of production specialization has been extensively discussed in the literature (e.g. Chang *et al.*, 2007, 2011; Pavlov and Weder, 2012; Bucci, 2013). Empirically, Kasahara and Rodrigue (2008) use detailed plant-level Chilean manufacturing panel data from 1979 to 1996, showing that an increase in the use of intermediate goods leads to a rise in the firm's productivity. This positive relationship between the use of intermediate goods and firms' production can be referred to as increasing returns to production specialization. While there are no direct estimates based on product variety, the overall external increasing returns vary across countries and industries. They can be as high as 0.621 when estimated based on US electrical machinery plants by Lee (2007), or 0.44 when estimated based on Chilean plants by Levinsohn and Petrin (1999). They can also be so low as to be negative values (i.e. decreasing returns to production specialization), as in the case of the petroleum refining industry in the USA.

$$p_i = N^{\lambda(\alpha+1\ -\ 1/\lambda)} y_i^{\lambda-1} Y^{1-\lambda}. \tag{2}$$

Equation (2) is the demand function for the ith intermediate good, which is characterized by a constant price elasticity $1/(1 - \lambda)$. A larger λ implies a higher price elasticity of demand for intermediate good i. Thus, λ measures the degree of monopoly power of the intermediate good firms.[5]

Intermediate good producers operating in a monopolistic market use capital and labour to produce their product and sell it to the final good producers at the profit-maximizing price. The production technology for the ith intermediate good is given by:

$$y_i = Ak_i^a h_i^{1-a} - \varphi, \tag{3}$$

where k_i and h_i, respectively, represent capital and labour hired by the ith intermediate good producer, $a \in (0, 1)$ is the share of capital, A is a constant technology parameter and φ represents an overhead cost.

Let w and r, respectively, denote the market wage and capital rental rate. Based on the demand function in Equation (2) and the production function in Equation (3), the optimization problem of the ith intermediate good producer can be expressed as:

$$\underset{h_i\ k_i}{\text{Max}} \quad \pi_i^m = p_i y_i - wh_i - rk_i, \tag{4}$$

$$\text{s.t.} \quad y_i = Ak_i^a h_i^{1-a} - \varphi \quad \text{and} \quad p_i = N^{\lambda(\alpha+1\ -\ 1/\lambda)} y_i^{\lambda-1} Y^{1-\lambda}.$$

The first-order conditions with respect to h_i and k_i are:

$$w = \lambda(1 - a)p_i(y_i + \varphi)/h_i, \tag{5}$$

$$r = \lambda a p_i(y_i + \varphi)/k_i. \tag{6}$$

Then, substituting Equations (5) and (6) into Equation (4) allows us to derive the profit of the ith intermediate good producer:

$$\pi_i^m = p_i[(1 - \lambda)y_i - \lambda\varphi]. \tag{7}$$

We confine the analysis to a symmetric equilibrium under which $p_i = p$, $y_i = y$, $k_i = k$ and $h_i = h$ for all i. Let K and H denote the aggregate capital stock and aggregate labour hired by the intermediate good firms. Then, we have: $K = Nk$ and $H = Nh$. From the zero-profit condition for the final good sector, we obtain:

$$p = N^\alpha. \tag{8}$$

[5] See also Lewis (2009), Etro and Colciago (2010) and Braun and Nakajima (2012).

Moreover, free entry guarantees zero profits for each intermediate good producer. Thus, from Equation (7) the quantity of each intermediate good produced in equilibrium is given by:[6]

$$y = \lambda\varphi/(1-\lambda). \tag{9}$$

From Equations (3) and (9), we can obtain the variety of intermediate goods in equilibrium:

$$N = (1-\lambda)AK^{a}H^{1-a}/\varphi. \tag{10}$$

By inserting Equations (9) and (10) into Equation (1), we can further derive the aggregate production function of the final good:

$$Y = \lambda((1-\lambda)/\varphi)^{\alpha}\left(AK^{a}H^{1-a}\right)^{1+\alpha}. \tag{11}$$

It is clear from Equation (11) that the aggregate production function exhibits increasing returns to scale when $\alpha > 0$, while exhibiting decreasing returns to scale when $\alpha < 0$.

Based on Equation (11), we impose the following condition that the externality is not sufficiently strong to generate sustained growth:

Condition NSG (the Non-Sustained Growth Condition).

$$0 < a(1+\alpha) < 1. \tag{11a}$$

Moreover, it is clear from Equation (11) that the following condition should be imposed to ensure a positive but diminishing marginal productivity of labour:[7]

Condition DMPL (the Diminishing Marginal Productivity of Labour Condition).

$$0 < (1-a)(1+\alpha) < 1. \tag{11b}$$

2.2 Households

Consider an economy populated by a unit measure of identical, infinitely-lived households. The representative household derives utility from consumption C and incurs disutility from labour supply H. The lifetime utility of the representative household U can be expressed as:

6 It should be noted that an individual firm's output in equilibrium is no longer fixed if the overhead cost is related to the number of firms (rather than being fixed). Because it is not qualitatively relevant to our main result, we omit this specification. The detailed proof is available from the authors upon request.

7 To maintain comparability to the standard RBC models, we only focus on cases where the linear approximation solution of the model exhibits saddle-point stability. Based on this, the condition ensures that positive externalities are not sufficiently strong to generate multiple equilibria. See, for example, Benhabib and Farmer (1994), Lai and Chin (2010) and Chang *et al.* (2011).

$$U = \int_0^\infty u(C_t, H_t)e^{-\rho t}\mathrm{d}t, \tag{12a}$$

where the instantaneous utility function is:

$$u(C_t, H_t) = \ln C_t - BH_t. \tag{12b}$$

Here, $\rho > 0$ represents the constant rate of time preference, $B > 0$ measures the disutility from labour, and t is the time index. This utility is characterized by the indivisibility of labour.[8]

The representative household faces the following budget constraint:[9]

$$\dot{K}_t = w_t H_t + r_t K_t + \Pi_t - C_t - T_t, \tag{13}$$

where $\Pi_t (= \int_0^{N_t} \pi_{it}^m \,\mathrm{d}i)$ is distributed aggregate profits from firms and T_t is a lump-sum tax imposed by the government.

The household maximizes the discounted sum of life utilities reported in Equation (12a) subject to the budget constraint reported in Equation (13) and the initial capital stock K_0. Performing the optimization problem leads to the optimum conditions:

$$1/C = \mu, \tag{14}$$

$$B = \mu w, \tag{15}$$

$$\mu r = -\dot{\mu} + \mu\rho, \tag{16}$$

together with Equation (13) and the transversality condition $\lim_{t\to\infty} \mu K e^{-\rho t} = 0$, where μ is the shadow price of physical capital.

Combining Equations (14) with (16) yields the standard Keynes–Ramsey Rule:

$$\dot{C} = (r - \rho)C. \tag{17}$$

In addition, the aggregate consistency condition refers to:

$$w = (1 - a)Y/H, \tag{18}$$

$$r = aY/K. \tag{19}$$

2.3 The government

At any point in time, the government levies a lump-sum tax to finance its public expenditure. Accordingly, the government's budget constraint can be expressed as:

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8 As stressed by Hansen (1985) and Rogerson (1988), the households can work either a fixed number of hours or not at all. Moreover, the formulation of indivisible labour would be able to explain the fact that the sum of employed workers is much more variable than individual working hours. See Heer and Mauβner (2008) for more discussions.

9 For simplicity and without loss of generality, the depreciation rate of physical capital is set to zero.

$$G = T. \tag{20}$$

2.4 The competitive equilibrium

By substituting Equations (7), (18), (19) and (20) into Equation (13), we obtain the economy-wide resource constraint:

$$\dot{K} = Y - C - G. \tag{21}$$

Based on Equations (14), (15) and (18), we can derive:

$$BC = w = (1 - a)Y/H. \tag{22a}$$

By substituting Equation (11) into (22a), the instantaneous relationship of employment is given by:

$$H = (B/(1-a)\lambda)^{1/\Omega}(\varphi/(1-\lambda))^{\alpha/\Omega}\left(C\Big/A^{1+\alpha}K^{a(1+\alpha)}\right)^{1/\Omega}, \tag{22b}$$

where $H_K(=\partial H/\partial K) = -a(1+\alpha)H/\Omega K > 0$, $H_C(=\partial H/\partial C) = H/\Omega C < 0$ and $\Omega = (1 - a)(1 + \alpha) - 1 < 0$.

3. The fiscal effect on consumption and the real wage

In this section we examine the effects of government spending. By substituting Equations (11) and (19) into Equations (17) and (21), the dynamic system of the economy can be expressed as:

$$\dot{K} = \lambda((1-\lambda)/\varphi)^{\alpha}A^{1+\alpha}K^{a(1+\alpha)}H^{(1-a)(1+\alpha)} - C - G, \tag{23}$$

$$\dot{C} = \left[a\lambda((1-\lambda)/\varphi)^{\alpha}A^{1+\alpha}K^{a(1+\alpha)-1}H^{(1-a)(1+\alpha)} - \rho\right]C, \tag{24}$$

where H is given by Equation (22b).

Before performing a comparative analysis, we need to check the saddle-point stability of the dynamic system. In Appendix I, we show that the economy's dynamic system in terms of C and K is featured by saddle-point stability and equilibrium uniqueness. Accordingly, we can obtain the following proposition:

Proposition 1: *Under Conditions NSG and DMPL, the dynamic system displays saddle-point stability and equilibrium uniqueness.*

Proof. See Appendix I.

It is useful to employ phase diagrams for a better understanding of the mechanisms to derive our results. From Equation (A5), the slopes of the loci $\dot{K} = 0$ and $\dot{C} = 0$ in the (K,C) space are, respectively:

$$\left.\frac{\partial C}{\partial K}\right|_{\dot{K}=0} = \frac{(1+\alpha)\rho\tilde{C}}{\left[(1-a)(1+\alpha)G+\tilde{C}\right]} > 0 \quad \text{and} \quad \left.\frac{\partial C}{\partial K}\right|_{\dot{C}=0} = \frac{\alpha\tilde{C}}{(1-a)(1+\alpha)\tilde{K}} \gtrless 0 \quad \text{if } \alpha \gtrless 0.$$

This indicates that the $\dot{K}=0$ locus is unambiguously upward-sloping, while the $\dot{C}=0$ locus can be horizontal, upward-sloping or downward-sloping, depending on whether α is zero, positive or negative. Let the loci *SS* and *UU* represent the stable and unstable branches, respectively. Thus, in Figure 1 we draw the phase diagrams of our dynamic system. In the case of $\alpha > 0$, the equilibrium determinacy (the saddle-path stability) requires that the $\dot{K}=0$ locus be steeper than the $\dot{C}=0$ locus, as shown in Appendix I. Accordingly, Figure 1 shows that for each case there exists a unique steady-state Q_0, which is locally determinate.

With these phase diagrams, we further analyse both the long-run steady-state and short-run transition effects of government spending. In the steady state, the economy is characterized by $\dot{K}=\dot{C}=0$. Let $\tilde{H}$, $\tilde{K}$ and $\tilde{C}$ be the stationary values of H, K and C, respectively. Then, from Equations (22b), (23) and (24) we can infer the following results:

$$\frac{\partial\tilde{H}}{\partial G} = \frac{[1-a(1+\alpha)]\tilde{H}}{[(1-a)(1+\alpha)\tilde{Y}-\alpha\tilde{C}]} > 0, \tag{25}$$

$$\frac{\partial\tilde{K}}{\partial G} = \frac{(1-a)(1+\alpha)\tilde{K}}{[(1-a)(1+\alpha)\tilde{Y}-\alpha\tilde{C}]} > 0, \tag{26}$$

$$\frac{\partial\tilde{C}}{\partial G} = \frac{\alpha\tilde{C}}{[(1-a)(1+\alpha)\tilde{Y}-\alpha\tilde{C}]} \gtrless 0; \quad \text{if } \alpha \gtrless 0. \tag{27}$$

Equations (25)–(27) indicate that a fiscal expansion has a positive effect on both labour hours and physical capital, while it has an ambiguous effect on private consumption. While the effects of government spending on labour hours and capital accumulation are straightforward, the consumption effect is novel, providing a new insight to the literature.

The economic intuition behind the ambiguous effect of consumption can be well understood by analysing the following three scenarios. The first scenario is the $\alpha = 0$

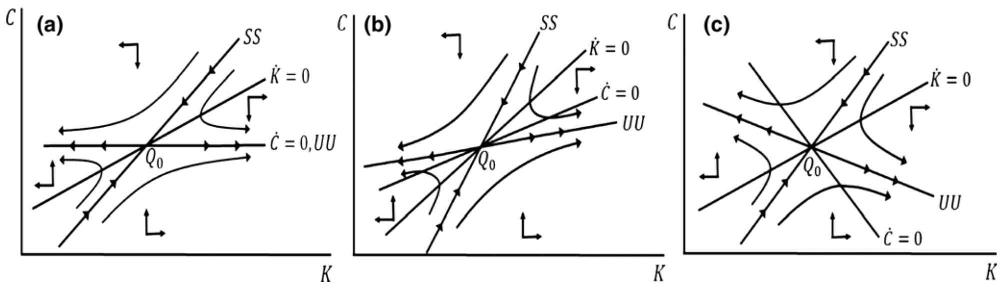

FIGURE 1. Phase diagram: (a) $\alpha = 0$, (b) $\alpha > 0$ and (c) $\alpha < 0$

case shown in Figure 2a, which can be treated as a benchmark case, and is intended for comparison with the other two scenarios. An increase in government spending (from G_0 to G_1) financed by a lump-sum tax raises the tax burden on households. This gives rise to a "negative wealth effect" that reduces the households' consumption. As shown in Figure 2a, the economy will instantly jump from point Q_0 to Q_{0^+}: consumption falls from $\tilde{C}_0$ to C_{0^+}, while capital remains at its initial level $\tilde{K}_0$. However, the households also react to this negative wealth effect by providing more labour supply and accumulating more capital stock. Thus, as shown in Figure 2a, the $\dot{K} = 0$ locus shifts rightwards and thereby the aggregate output rises accordingly. The "output-enhancing effect" increases the households' consumption along the stable arm, $SS(G_1)$. It turns out that an increase in government expenditure leads to a reduction in consumption from the beginning (the negative wealth effect), but later on this reduction is exactly offset by a rise in aggregate output (the output-enhancing effect). In a traditional RBC model, because the number of firms is assumed to be fixed, the output-enhancing effect is dominated by the negative wealth effect, resulting in a negative consumption effect. By contrast, in our model the number of firms is endogenous and increased by government spending. As a result, the output-enhancing and negative wealth effects cancel each other out, provided that the returns to production specialization are absent ($\alpha = 0$).[10]

The second scenario we deal with is the $\alpha > 0$ case where increasing returns to production specialization (i.e. the production-enhancing effect is dominating) are present. A fiscal expansion increases the intermediate goods firms' profits and leads to a rise in the number of intermediate goods. Compared with the benchmark case ($\alpha = 0$), the increase in N gives rise to an additional production enhancement (i.e. the increasing returns to production specialization), which reinforces the output-enhancing effect of government spending. Thus, Figure 2b indicates that the amplified output-enhancing effect dominates the negative wealth effect and, hence, a fiscal expansion *crowds in* private consumption.

Some recent studies have been devoted to solving the fiscal policy puzzle. Chen *et al.* (2005) shed light on the role of productive public expenditure, and find that fiscal expansions lead to significant increases in consumption if public infrastructure and labour are technical complements and the degree of complementarity is sufficiently large. Linnemann (2006) considers the nonseparability between consumption and leisure in the utility function and consumption and leisure are substitutes for the representative

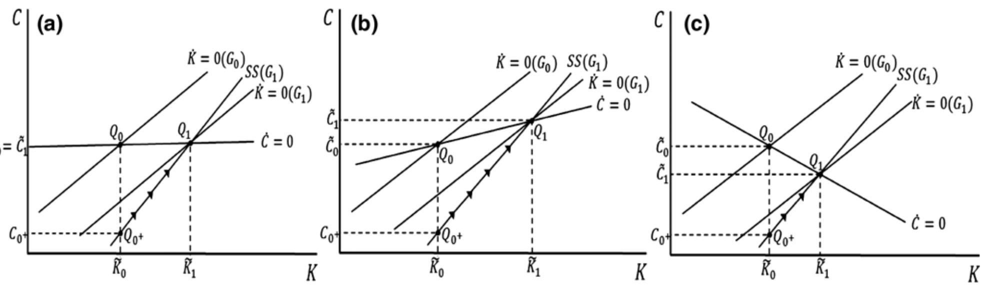

FIGURE 2. A permanent fiscal shock: (a) $\alpha = 0$, (b) $\alpha > 0$ and (c) $\alpha < 0$

[10] As shown in Equation (1), the increase in N has a beneficial effect on the aggregate output.

agent. Based on the assumption of a strong intra-temporal substitution effect between consumption and leisure, Linnemann (2006) finds that government expenditure can boost private consumption.[11] Moreover, by introducing public consumption into the household's utility function and considering nonseparability between the public and private consumption, Ganelli and Tervala (2009) show that, in association with a high degree of public–private consumption complementarity, a fiscal expansion is more likely to generate a positive effect on private consumption. In departing from these studies, the present paper instead emphasizes the importance of Aghion and Howitt's (1998) production-enhancing effect of entry. In the presence of varied expansion in production, increasing returns to production specialization can serve as a plausible vehicle to explain the positive response of consumption to fiscal shocks found in empirical studies.

In their previous study, Devereux *et al.* (1996) also specify a parameter to capture both the returns to production specialization and the degree of monopolistic competition. With such a specification, they obtain two important results. First, "the impact of government spending on long-run consumption [crucially] depends not only on the markup, but also on the [labour supply elasticity]" (p. 244). Second, fiscal expenditure may raise private consumption provided that the degree of monopoly power is sufficiently large. To compare our results with those of Devereux *et al.* (1996), differentiating Equation (27) with respect to λ gives rise to:

$$\frac{\partial(\partial\tilde{C}/\partial G)}{\partial\lambda} = \frac{\alpha(1-a)(1+\alpha)(1-\lambda-\alpha\lambda)\tilde{C}\tilde{Y}(\tilde{Y}-\tilde{C})}{\lambda(1-\lambda)[(1-a)(1+\alpha)\tilde{Y}-\alpha\tilde{C}]^3} \gtrless 0. \tag{28}$$

It is found from Equation (28) that a higher degree of monopoly may either intensify or dampen the fiscal crowding-in effect on consumption. To be more specific, if the degree of increasing returns to specialization is relatively strong (i.e. $\alpha > (1-\lambda)/\lambda$), we obtain $\partial(\partial\tilde{C}/\partial G)/\partial\lambda < 0$. This situation reveals that a larger markup (a lower λ) reinforces the fiscal crowding-in effect on consumption. By contrast, if the degree of increasing returns to specialization is relatively small (i.e. $\alpha < (1-\lambda)/\lambda$), we obtain $\partial(\partial\tilde{C}/\partial G)/\partial\lambda > 0$, implying that a larger markup mitigates the fiscal crowding-in effect on consumption. Consequently, by assigning two distinct parameters to reflect the returns to production specialization and the degree of monopoly power, we find that the degree of increasing returns to specialization plays an important role in governing the effects of a fiscal stimulus on private consumption, while the extent of imperfect competition serves to strengthen or weaken this positive effect of the fiscal stimulus.

Figure 2c refers to the third scenario ($\alpha < 0$) where decreasing returns to production specialization (i.e. the production-complexity effect is dominating) are present. Being just the opposite of the second scenario, the increase in N followed by a fiscal expansion weakens the output-enhancing effect of government spending. Therefore, the output-enhancing effect is dominated by the negative wealth effect and, hence, a fiscal expansion crowds out, rather than crowds in, private consumption, as shown in Figure 2c. As mentioned above, the Ahmed (1986) and Ho (2001) empirical studies find a negative effect of government spending on private consumption. As is obvious, the empirical result that an increase in government spending generates the fiscal

[11] Bilbiie (2009) specifies a general non-separable preference, and finds that higher government spending can stimulate private consumption if and only if the consumption good is inferior.

crowding-out effect on private consumption could be explained in our analysis if the role of decreasing returns to production specialization is brought into the picture.

The above discussion can be summarized by the following proposition:[12]

Proposition 2: *In the presence of increasing returns to specialization ($\alpha > 0$), private consumption increases in response to fiscal expansions. By contrast, in the presence of decreasing returns to specialization ($\alpha < 0$), private consumption decreases in response to fiscal expansions.*

With regard to transitional dynamics, one point is worth noting. Figure 2b,c indicate that in response to an increase in government spending, consumption exhibits a mis-jump (respectively, overshooting) adjustment pattern in the sense that the short-run response of consumption misadjusts from (respectively, overshoots) its long-run response if the returns to production specialization are increasing, $\alpha > 0$ (respectively, decreasing, $\alpha < 0$). For any case, public spending crowds out private consumption in the short run. In particular, this effect is robust to a "temporary" instead of a permanent fiscal shock.[13] We use the case where $\alpha > 0$ as an example.[14] Figure 3 shows that in response to a temporal fiscal expansion (say, the government increases its spending at $t = 0$ and recovers it to the initial level at $t = T$), the negative wealth effect decreases consumption on impact from point Q_0 to Q_{0^+} (or to Q'_{0^+} if T is longer). Afterwards, consumption increases in response to the output-enhancing effect. It is evident from Figure 3 that, even though the fiscal shock is temporary, it still generates a crowding-out effect on short-run consumption, but a crowding-in effect on long-run consumption in the presence of increasing returns to production specialization ($\alpha > 0$). Apparently, the short-run consumption effect is similar to the standard RBC result.

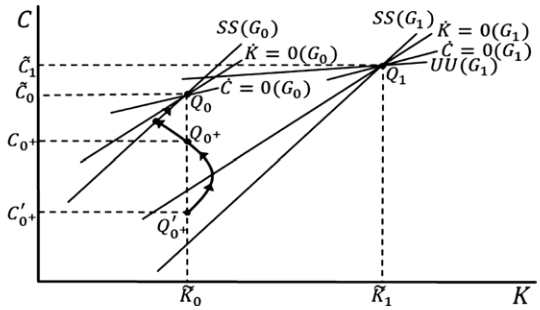

FIGURE 3. A temporary fiscal shock

12 This ambiguous consumption effect qualitatively holds if we adopt a constant relative risk aversion function in labour (leisure), such as $u(C_t, H_t) = \ln C_t - BH_t^{1+\eta}/(1+\eta)$ with $\eta \geq 0$. Under this functional form, the consumption effect of government spending turns out to be $\partial\tilde{C}/\partial G \gtreqless 0$; *if* $\alpha \gtreqless (1-a)\eta/(1+a\eta)$. Apparently, the intertemporal elasticity of substitution in labour ($1/\eta$) will play a role in affecting the effect of a fiscal stimulus on consumption. If $\eta = 0$, it recovers the results of Proposition 2.

13 We are grateful to an anonymous referee for bringing this dynamics viewpoint to our attention.

14 Because in the cases in association with both $\alpha = 0$ and $\alpha < 0$, the dynamic adjustments are very similar, here we only restrict our focus to the case where $\alpha > 0$.

We in turn analyse the effects of a fiscal expansion on real wages. It follows from Equations (21) and (27) that the output effect of government spending is given by:

$$\frac{\partial \tilde{Y}}{\partial G} = \frac{(1-a)(1+\alpha)\tilde{Y}}{[(1-a)(1+\alpha)\tilde{Y} - \alpha\tilde{C}]} > 0. \tag{29}$$

Moreover, from Equation (18) we can further derive the real wage effect as follows:

$$\frac{\partial \tilde{w}}{\partial G} = \frac{\alpha B\tilde{C}}{[(1-a)(1+\alpha)\tilde{Y} - \alpha\tilde{C}]} \gtrless 0; \quad \text{if } \alpha \gtrless 0. \tag{30}$$

Equation (30) reveals that a fiscal expansion leads to an ambiguous effect on real wages, depending crucially upon the degree of the returns to production specialization α.

We then use a simple labour market diagram to explain this ambiguous wage effect. It follows from Equation (22a) that due to the indivisibility of labour, the labour supply curve, denoted by H^s, is horizontal, while the labour demand curve, denoted by H^d, is downward sloping.[15] In response to a fiscal expansion, not only does the household's tax burden, T, increase (the negative wealth effect), but his/her income, Y, also increases (the output-enhancing effect). In the case where $\alpha = 0$, the household's disposable income remains unchanged, because the output-enhancing and negative wealth effects cancel each other out. Therefore, government spending has no impact on consumption and, hence, labour supply (see the first equality of Equation 22a), as shown in Figure 4a.[16] In addition, a fiscal expansion increases the firm's profits, which attract more new firms to enter the market. Because the demand for labour increases, the H^d curve shifts rightwards.[17] As a result, Figure 4a indicates that real wages remain intact at the initial level and the real wage effect is irresponsive to a fiscal shock.

In the case where $\alpha > 0$, because the output-enhancing effect dominates the negative wealth effect, an expansionary fiscal policy increases the household's disposable income. A higher disposable income motivates households to increase their consumption and leisure. Thus, the labour supply declines, leading to an upward shift in the H^s curve. This

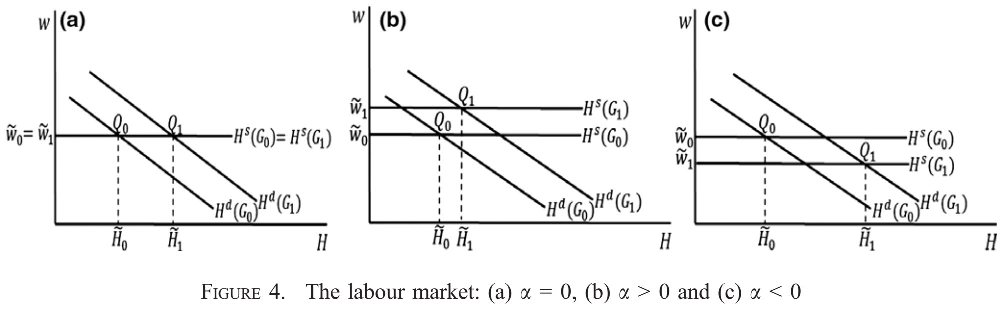

FIGURE 4. The labour market: (a) $\alpha = 0$, (b) $\alpha > 0$ and (c) $\alpha < 0$

[15] Based on Equation (22a), the slopes of H^s and H^d are $\partial w/\partial H|_{H^s} = 0$ and $\partial w/\partial H|_{H^d} = [(1-a)(1+\alpha) - 1]\tilde{w}/\tilde{H} < 0$, respectively.

[16] $\partial w/\partial G|_{H^s} = B \cdot \partial C/\partial G \gtrless 0$ if $\alpha \gtrless 0$.

[17] $\partial H/\partial G|_{H^d} = a(1-a)(1+\alpha)^2\tilde{H}\Big/[1-(1-a)(1+\alpha)][(1-a)(1+\alpha)\tilde{Y} - \alpha\tilde{C}] > 0.$

effect, together with a strong demand for labour, raises real wages, as shown in Figure 4b. This theoretical result can be viewed as a possible route to explain the empirical finding that cyclical changes in government spending are associated with positive responses of real wages. By contrast, in the case where $\alpha < 0$, the output-enhancing effect is dominated by the negative wealth effect, resulting in a reduction in the household's disposable income. Because consumption and leisure decrease in response to a lower level of disposable income, the labour supply increases, shifting the H^s curve downward. Thus, as shown in Figure 4c, a fiscal expansion reduces real wages if the production function is characterized by decreasing returns to specialization. This result also provides an alternative channel to explain the empirical finding of a negative relationship between real wages and aggregate output (e.g. Messina *et al.*, 2009).

Proposition 3 summarizes the discussion above:[18]

Proposition 3: *If the production function is characterized by increasing returns to production specialization, a fiscal stimulus leads to a positive relationship between real wages and aggregate output. However, if the production function is characterized by decreasing returns to production specialization, a fiscal stimulus results in a negative relationship between real wages and aggregate output.*

One point should be mentioned. By introducing the role of production specialization into an otherwise standard RBC model, our study predicts that a country where a fiscal stimulus boosts consumption tends to have pro-cyclicality of real wages, given that the increasing returns to production specialization ($\alpha > 0$) create the output-enhancing effect, which raises both consumption and real wages. This prediction is somewhat consistent with empirical observations. First, the output-enhancing effect is supported by empirical observations in the sense that there is a positive relationship between the use of intermediate goods and firms' production performance. For example, Kasahara and Rodrigue (2008) use detailed plant-level Chilean manufacturing panel data from 1979 to 1996, showing that an increase in the use of intermediate goods leads to a rise in the firm's productivity. Second, by using OECD data, Ho (2001) indicates that in Germany, Japan and the UK private consumption reacts positively to an increase in government spending. Moreover, Messina *et al.* (2009) provide evidence on real wages over the business cycle across OECD countries, finding that these countries are also characterized by procyclical real wages. In line with our theoretical prediction, in these countries where a fiscal expansion increases consumption there tends to be procyclicality of real wages.[19]

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[18] Note that this result is robust to a constant relative risk aversion function in labour (leisure): $u(C_t, H_t) = \ln C_t - BH_t^{1+\eta} \big/ (1+\eta)$ with $\eta \geq 0$.

[19] It should be noted that some countries may experience outcomes, such as where a fiscal expansion increases consumption but results in countercyclical real wages, which are inconsistent with our model's predictions. This result can be further explained as follows. As is well known, the effects of government spending on the economy can also be governed and determined by other mechanisms, such as utility complementarity between private consumption and public consumption, or that government spending has a positive effect on private production that are present in other contributions, such as Chen *et al.* (2005), Linnemann (2006) and Ganelli and Tervala (2009).

4. Welfare analysis

In this section, we examine the effects of government spending on welfare. The welfare analysis enables us to ask a question of whether an expansionary fiscal policy is really desirable in terms of welfare although private consumption may be positively related to public spending. Analytically, it is, however, very difficult (if not impossible) to fully account for the transition effect in the welfare analysis. Therefore, here we evaluate the welfare effect of government spending in the steady state.

In the steady state, the social welfare is assumed to be bounded and can be computed from Equation (12a) as follows:

$$\tilde{U} = [\ln \tilde{C} - B\tilde{H}]/\rho. \tag{31}$$

From Equations (25), (27) and (31) we can derive:

$$\frac{\partial \tilde{U}}{\partial G} = \frac{1}{\rho}\left[\frac{1}{\tilde{C}}\underset{(?)}{\frac{\partial \tilde{C}}{\partial G}} - B\underset{(+)}{\frac{\partial \tilde{H}}{\partial G}}\right] \gtrless 0;\ \text{if}\ \ \alpha \gtrless \hat{\alpha}, \tag{32}$$

where $\hat{\alpha} = (1-a)^2 \big/ [a(1-a) + \tilde{C}/\tilde{Y}] > 0$.

There are two effects in terms of governing social welfare: the consumption effect and the labour disutility effect. As shown in the previous section, a fiscal expansion unambiguously increases labour hours, but it has an ambiguous effect on consumption, depending on the sign of α. Equation (32) indicates that if the degree of increasing returns to specialization is sufficiently large (i.e. $\alpha > \hat{\alpha} > 0$), the consumption effect is positive and stronger than the negative labour disutility effect, thereby improving social welfare.[20] More interestingly, in the presence of a moderate degree of increasing returns to specialization (i.e. $\hat{\alpha} > \alpha > 0$), government spending can increase consumption but lower social welfare. Intuitively, when the marginal product of labour is higher (i.e. a higher (1 - a)), which encourages households to work harder, the negative labour disutility effect turns out to be more pronounced. Because the critical level of $\hat{\alpha}$ becomes higher, we need a higher degree of increasing returns to specialization α to achieve an improvement in social welfare. This result is summarized in the following proposition:

Proposition 4: *In the presence of increasing returns to production specialization ($\alpha > 0$),*

(i) *under the condition $\alpha > \hat{\alpha} > 0$, a fiscal expansion not only increases consumption but also improves social welfare;*
(ii) *under the condition $\hat{\alpha} > \alpha > 0$, a fiscal expansion increases consumption but decreases social welfare.*

[20] It should be noted that even though a fiscal expansion could raise social welfare in the long run, it would lead to a decrease in social welfare in the short run. This is because, in the short run, a fiscal expansion will result in a decrease in private consumption and an increase in labour hours, both of which lead to a negative welfare effect.

5. Conclusion

Most recent empirical studies have pointed out that both consumption and real wages exhibit either a positive or negative comovement with fiscal spending. However, the standard RBC models are incapable of explaining these empirical findings. The present paper has developed a monopolistic competition model featuring returns to production specialization.

Equipped with this feature, several interesting findings have emerged. First, in the presence of increasing returns to production specialization, private consumption will increase in response to a fiscal stimulus. By contrast, in the presence of decreasing returns to production specialization, private consumption will decrease in response to an expansion in fiscal spending. Second, a fiscal expansion leads to a positive linkage between real wages and aggregate output if the production function is characterized by increasing returns to production specialization. By contrast, a fiscal expansion leads to a negative linkage between real wages and aggregate output if the production function is characterized by decreasing returns to production specialization. Third, a fiscal expansion may raise social welfare, provided that the degree of increasing returns to production specialization is sufficiently large.

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Appendix I

In the steady state, $\dot{K} = \dot{C} = 0$. Then, inserting Equations (22b) and (24) into Equation (23) yields:

$$(\rho/a)^{a(1+\alpha)}(B/(1-a))^{(1-a)(1+\alpha)}(\varphi/(1-\lambda))^{\alpha}\tilde{C}^{(1-a)(1+\alpha)}\Big/\lambda A^{1+\alpha} = \left(\tilde{C}+G\right)^{\alpha}. \quad \text{(A1)}$$

We can use Equation (A1) to determine the stationary value of $\tilde{C}$. For ease of exposition, we refer to the left-hand side of Equation (A1) and the right-hand side of Equation (A1) as *LHS* and *RHS*, respectively. That is:

$$LHS = (\rho/a)^{a(1+\alpha)}(B/(1-a))^{(1-a)(1+\alpha)}(\varphi/(1-\lambda))^{\alpha}\tilde{C}^{(1-a)(1+\alpha)}\Big/\lambda A^{1+\alpha}, \quad \text{(A2)}$$

$$RHS = \left(\tilde{C}+G\right)^{\alpha}. \quad \text{(A3)}$$

A graphical presentation will be helpful to our understanding of the determination regarding the stationary value of $\tilde{C}$. In Appendix Figure A1, the *LL* curve traces all pairs of *LHS* and $\tilde{C}$ that satisfy Equation (A2), while the *RR* curve depicts all combinations of *RHS* and $\tilde{C}$ that satisfy Equation (A3). As indicated in Equations (A2) and (A3) and all panels in Appendix Figure A1, given that $G > 0$, $LHS = 0$ and $RHS = G^{\alpha} > 0$ in association with $\tilde{C} = 0$. Moreover, it is quite easy to infer from Equation (A2) that *LHS* is increasing and concave in $\tilde{C}$ under Condition DMPL (i.e. $0 < (1 - a)(1 + \alpha) < 1$), implying that the *LL* curve is positively sloping and concave downward. Moreover, it follows from Equation (A3) that *RHS* is constant, increasing or decreasing in $\tilde{C}$, depending on whether α is zero, positive or negative. Accordingly, the *RR* curve has a zero, positive or negative slope in association with $\alpha = 0$, $\alpha > 0$ or $\alpha < 0$. One point involving the case of $\alpha > 0$ should be noted here. Under $\alpha > 0$, both Condition NSG in Equation (11a) and Condition DMPL in Equation (11b) impose the restriction $\alpha < (1 - a)(1 + \alpha) < 1$, indicating that the *LL* curve is positively sloping and steeper than the *RR* curve.[21] Consequently, as exhibited in Appendix Figure A1(a), A1(b), and A1(c), the *LL* curve intersects the *RR* curve once at point Q_0, which determines a unique stationary interior $\tilde{C}_0$ such that Equation (A1) is satisfied.

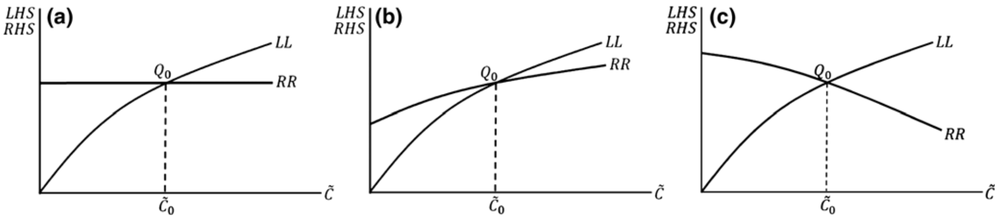

FIGURE A1. Existence and uniqueness of steady state: (a) $\alpha = 0$, (b) $\alpha > 0$ and (c) $\alpha < 0$

Equipped with Equation (23), the steady-state level of $\tilde{K}$ is then uniquely determined by:

$$\tilde{K} = \left[(\varphi/(1-\lambda))^{\alpha}(B/(1-a))^{(1-a)(1+\alpha)}\tilde{C}^{(1-a)(1+\alpha)}\left(\tilde{C}+G\right)^{1-(1-a)(1+\alpha)}\Big/\lambda A^{1+\alpha}\right]^{1/a(1+\alpha)}. \tag{A4}$$

Next, given an initial government expenditure G_0, linearizing Equations (23) and (24) around the steady state $(\tilde{K}, \tilde{C})$ yields:

$$\begin{pmatrix}\dot{K}\\ \dot{C}\end{pmatrix} = \begin{pmatrix}J_{11} & J_{12}\\ J_{21} & J_{22}\end{pmatrix}\begin{pmatrix}K-\tilde{K}\\ C-\tilde{C}\end{pmatrix} + \begin{pmatrix}-1\\ 0\end{pmatrix}(G-G_0), \tag{A5}$$

where $J_{11} = -a(1+\alpha)\tilde{Y}/\Omega\tilde{K} > 0$, $J_{12} = (1-a)(1+\alpha)\tilde{Y}/\Omega\tilde{C} - 1 < 0$, $J_{21} = -a\alpha\tilde{C}\tilde{Y}\Big/\Omega\tilde{K}^2 \gtrless 0, J_{22} = a(1-a)(1+\alpha)\tilde{Y}/\Omega\tilde{K} < 0$.

Based on Equation (A5), we can infer the trace and determinant of the Jacobian:

$$Tr(J) = S_1 + S_2 = -a^2(1+\alpha)\tilde{Y}/\Omega\tilde{K}, \tag{A6}$$

[21] Under $\alpha > 0$, we can derive from Equations (A2) and (A3) that the slopes of loci *LL* and *RR* are: $\partial LHS/\partial\tilde{C}\big|_{LL} = (1-a)(1+\alpha)LHS/\tilde{C} > 0$ and $\partial RHS/\partial\tilde{C}\big|_{RR} = \alpha RHS/(\tilde{C}+G) > 0$. Moreover, given $G > 0$, Equation (A1), the restriction $\alpha < (1 - a)(1 + \alpha) < 1$, and the steady-state equilibrium condition $LHS = RHS$, we can infer the result: $\partial LHS/\partial\tilde{C}\big|_{LL} > \partial RHS/\partial\tilde{C}\big|_{RR}$.

$$Det(J) = S_1 S_2 = a[(1-a)(1+\alpha)\tilde{Y} - \alpha\tilde{C}]\tilde{Y} \Big/ \Omega\tilde{K}^2, \tag{A7}$$

where S_1 and S_2 are two characteristic roots of the dynamic system. We can infer that $(1-a)(1+\alpha)\tilde{Y} - \alpha\tilde{C} = \alpha(\tilde{Y} - \tilde{C}) + (1 - a - a\alpha)\tilde{Y} > 0$ by using Condition NSG. Thus, the numerator of *Det*(*J*) is positive. Furthermore, by using Condition DMPL (i.e. $\Omega = (1 - a)(1 + \alpha) - 1 < 0$), we can infer the following results:

$$Tr(J) > 0 \text{ and } Det(J) < 0. \tag{A8}$$

As pointed out in the literature on dynamic rational expectations models, such as Burmeister (1980), Buiter (1984) and Turnovsky (2000), there exists a unique perfect foresight equilibrium solution if the number of unstable (positive) roots equals the number of jump variables. Because C is the only jump variable in this dynamic system, the steady-state equilibrium is locally determinate if the system has only one real positive root and this implies that the determinant value of the Jacobian is negative (i.e. $Det(J) < 0$).

Appendix II

This appendix derives the slopes of the loci *SS* and *UU*. For expository convenience, we assume that $S_1 < 0 < S_2$. It follows from Equation (A5) that the general solution for K and C can be described by:

$$K = \tilde{K}(G) + A_1 e^{S_1 t} + A_2 e^{S_2 t}, \tag{A9}$$

$$C = \tilde{C}(G) + [(S_1 - J_{11})/J_{12}]A_1 e^{S_1 t} + [(S_2 - J_{11})/J_{12}]A_2 e^{S_2 t}, \tag{A10}$$

where A_1 and A_2 are unknown parameters.

Given $A_2 = 0$ in Equations (A9) and (A10), we can derive the slope of the locus *SS*:

$$\left.\frac{\partial C}{\partial K}\right|_{SS} = \frac{S_1 - J_{11}}{J_{12}} > 0. \tag{A11}$$

Thus, the locus *SS* is upward-sloping. Moreover, given $A_1 = 0$ in Equations (A9) and (A10), we can derive the slope of the locus *UU*:

$$\left.\frac{\partial C}{\partial K}\right|_{UU} = \frac{S_2 - J_{11}}{J_{12}} \gtreqless 0. \tag{A12}$$

From Equation (A12), we can infer the following relationship:

$$(S_2 - J_{11})/J_{12} = J_{21}/(S_2 - J_{22}) \gtreqless 0; \text{ if } \alpha \gtreqless 0. \tag{A13}$$

Accordingly, the locus *UU* is horizontal, upward-sloping or downward-sloping, depending on the sign of α ($\gtreqless 0$).

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