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財政政策與景氣波動：不完全競爭總體模型之分析

Fiscal Policy and Business Cycles: An Analysis of Imperfectly Competitive Macroeconomic Model

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本論文係張振維君（學號 D95323010）在國立臺灣大學經濟學系完成之博士學位論文，於民國 101 年 7 月 30 日承下列考試委員審查通過及口試及格，特此證明

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張俊仁　　洪福聲

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自 2006 年 9 月進入台大經濟研究所迄今，時光匆匆的過了六個寒暑春秋。在這六年的歲月裡，儘管忙碌地埋首研究，日子卻過得相當充實，並且順利地完成了博士論文。回憶這六年來的點點滴滴，雖然過程是如此崎嶇難行，沒有半點燈光，但卻在蛻變後才發現，人生的挫折是讓自己茁壯的試金石，所以要化悲憤為力量，這樣方能從經驗與教訓中吸取成長的養分。

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摘要

總體經濟模型結合了不完全競爭的市場特性，為市場造成了扭曲。80 年中期以後，「不完全競爭的總體經濟理論」發展至今多如恆河沙數，本篇論文試圖將產業經濟的特質與市場的調整機制納入模型設定中，從新檢視不完全競爭的市場特性將如何影響景氣波動與最適財政政策，希冀對不完全競爭的總體經濟模型，有更深刻的了解與認識。

在第一篇文章，我們將不完全競爭的市場結構與傳統實質景氣循環模型結合，並向兩個方向延伸：第一，我們結合產業經濟的觀點，考慮專業化分工是否具有規模報酬的特性；第二，我們考慮進入成本的擁擠效果－在產業經濟研究中，市場中既有的廠商家數越多，廠商的進入成本將越高，例如廣告成本。將這兩種效果引入模型，我們發現，專業化分工的程度與進入成本的擁擠效果將左右經濟體系複均衡的存在性。另外，專業化分工的效果支配著消費性政府支出對私人消費與實質工資的影響。最後，考慮進入成本的擁擠效果，我們發現隨著政府支出增加，個別廠商的生產將會提高，而並非一個常數。

在第二篇文章，我們假設個別廠商的生產技術具有規模報酬遞增的特性。另外，依循公共財政學的觀點，我們將政府支出的生產性功能納入模型，同時也考慮政府的生產性支出所衍生的擁擠效果。最後，為了充分了解獨占力指數與專業化分工程度對經濟體系的影響效果，我們將獨占力指數與專業化分工程度用兩個參數分別代表。在這個架構下，我們發現幾個結論。第一，經濟體系複均衡的存在性與專業化分工程度有關但與獨占力指數無關。第二，在具有比例式相對擁擠效果下，政府的生產性支出彈性將無法左右經濟體系複均衡的存在。第三，個別廠商規模報酬遞增的程度越大，則經濟體系越難出現複均衡現象。第四，我們以實質景氣循環模型所採用的參數值進行分析，結果發現，在單純具有比例式絕對擁擠效果情況下，資本產出彈性趨近於零，勞動產出彈性趨近於一，而這結果與

實證資料相吻合。

在第三篇文章，我們分析當市場同時存在消費外部性與生產外部性的情況下，政府如何制定最適的財政政策。另外，我們亦考量生產專業化具有規模報酬遞增的特性與個別廠商的生產技術具有規模報酬遞增的特性。藉由市場調整機制的不同，我們發現幾個結論。第一，若政府同時具有消費稅與所得稅兩項政策工具，則消費稅是用來矯正消費外部性最適的政策工具，而所得稅是用來矯正生產外部性最適的政策工具。第二，最適所得稅的制定將會因市場調整機制的不同而有所改變。第三，當市場中的廠商家數固定不變，則最適的政府支出佔所得的比例將等於政府支出的生產彈性，相反的，當市場中的廠商家數可以自由調整，則最適的政府支出佔所得的比例將不等於政府支出的生產彈性。第四，當生產專業化具有規模報酬遞增而且報酬遞增的程度夠大，則市場自由進出之下所決定的廠商家數有可能低於社會最適的廠商家數。

關鍵字：不完全競爭、複均衡、財政政策、外部性、景氣循環

Abstract

When imperfect competition is introduced to a general equilibrium macroeconomic model, the market allocation mechanism ceases to be efficient. Since the mid-1980s, there have been a vast number of articles that have been discussed in the context of imperfectly competitive macroeconomic models. This thesis attempts to introduce the features of both industry organization and adjustment mechanisms to our analysis, and in so doing reviews how the business fluctuations and government policies are affected by the imperfectly competitive market structure. It is hoped that we can arrive at a better understanding of imperfectly competitive macroeconomic equilibrium models.

In the first essay, we introduce two features to our analysis. First, in line with the viewpoint of industry organization, we consider the feature of returns to production specialization. Second, we consider the congestion effect of the start-up cost. In the industry organization, the greater the number of firms, the greater is the cost of product differentiation. This implies that the cost of initial advertising to make consumers aware of a new brand is greater. By introducing these effects into our model, several main findings emerge from the analysis. First, we find that the necessary and sufficient condition for equilibrium indeterminacy is closely related to the extent of production specialization and the congestion effect of the start-up cost. Second, the effects of government spending on consumption and real wages depend on the extent of production specialization. Third, the output level of an individual firm is positively related to fiscal expansions, provided that the congestion effect of the start-up cost exists.

In the second essay, we suppose that the production technology for individual

firms exhibits the feature of internal increasing returns to scale in imperfectly competitive industries. In line with the literature in the public finance field, we consider the role of productive government spending that is subject to the congestion effect. In addition, in order to clarify whether the crucial factor for the local indeterminacy is production specialization or monopoly power, we specify two distinct parameters to reflect the returns to production specialization and the degree of monopolistic competition. Equipped with these features, several interesting results are derived from our analysis. First, the necessary condition for equilibrium indeterminacy is independent of the monopoly power. Second, in the presence of proportional relative congestion, the equilibrium indeterminacy disappears even if productive government expenditures are incorporated. Third, when the production technology of a private firm possesses the feature of internal increasing returns, the possibility of the emergence of local indeterminacy is negatively related to the extent of the internal increasing returns to scale. Fourth, we adopt the parameters set in the existing RBC works, finding that under the situation where public services are subject to purely proportional absolute congestion, the output elasticity of capital is close to zero and the output elasticity of labor is close to one. This result is consistent with the empirical findings.

In the third essay, we analyze the optimal fiscal policies in the presence of consumption and production externalities and consider both the role of the extent of increasing returns to specialization and the role of internal increasing returns to scale. By introducing three differential types of adjustment mechanisms, several main findings emerge. First, if both consumption and income taxes are available to the government, the consumption tax should be utilized to correct consumption externalities and the income tax should be utilized to remedy production externalities. Second, the inclusion of three different types of adjustment mechanism plays an

important role in governing the implementation of optimal income taxes. Third, the optimal ratio of government expenditure is solely determined by the extent of production externalities if the number of firms is constant, while the result should be modified if the free entry and exit of firms is brought into the picture. Fourth, free entry in the competitive equilibrium may result in under entry, provided that the degree of increasing returns to specialization is sufficiently strong.

Keywords: Imperfect competition; Indeterminacy; Fiscal policy; Externalities; Business cycles

Content

Chapter 1

Introduction

Many recent studies in macroeconomics, such as Startz (1989), Rotemberg and Woodford (1992), Chang et al. (2007), Lai et al. (2010) and Bilbiie et al. (2012), to mention just a few, have focused on macroeconomic policies in the presence of imperfect competition. As this literature has developed, it has become clear that the degree of monopoly power (the price markup) in the analysis crucially governs the results compared to the perfect competition. Under imperfect competition, all firms set a price as a markup over marginal cost and, as a result, enjoy non-negative profits, provided that the number of firms is given exogenously. However, if we relax the assumption that the number of firms is fixed, the model itself instead endogenously determines the equilibrium number of firms by the zero-profit condition due to free entry.

In an influential paper, Startz (1989) shows that a higher degree of monopoly power tends to result in more profits and hence increase the households' disposable income. As a result, the degree of monopoly power can govern the transitional dynamics of the economy by way of this so-called feedback effect. Once free entry is allowed, it will result in zero profits in equilibrium and, of course, cut off the feedback effect from monopoly profits. This prompts Startz (1989) to conclude that the short-run output multiplier exceeds the long-run multiplier. By endogenizing the number of firms, Devereux et al. (1996) introduce both imperfect competition and increasing returns to production specialization to the real business cycle (RBC) model. Based on this framework, 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 [labor supply elasticity] (p. 244)." Second, fiscal spending may raise private consumption, provided that the degree of monopoly power is large. However, in their paper, the extent of monopoly power and the degree of increasing returns to specialization are governed by the same parameter. A question thus naturally arises in their analysis: Does the positive linkage between government spending and private consumption stem from the returns to production specialization or the degree of monopoly power? The first purpose of chapter 2 is to clarify which one is the key factor for the volatility of private consumption.

Empirical evidence on the co-movement between real wages and aggregate output are mixed. On the one hand, Solon et al. (1994) and Kandil (2005) find that real wages are strongly pro-cyclical in the U.S. On the other hand, Gärtner (2009) finds that Canadian real wages experience countercyclical behavior. However, the standard real business cycle models derive a result that a positive fiscal shock financed by a lump-sum tax leads to a fall in real wages. In other words, the co-movement between real wages and aggregate output could not be exhibited in the RBC framework. Thus, the second purpose of this chapter is to provide a new channel to reconcile the discrepancy from the empirical observations.

Furthermore, as stated by Devereux et al. (1996, p. 239), "with our specification, all variation in aggregate output is due to entry and exit, as output per firm is unaffected by changes in the aggregate state … [and] this implication is, of course, at odds with the fact that output per firm does vary over time." However, empirical observation, such as that by Basu (1995), finds that "the quantities of intermediate goods used should be pro-cyclical." Based on this cognition, the third purpose of this chapter is to bridge the discrepancy between the theoretical analysis and empirical evidence. That is, we provide a new channel to show that the output per firm is no longer fixed in the long run.

It should be noted that the notion of production specialization originates from industry organization, namely, economies of scope. Economies of scope constitute an important issue in the production process in industry organization theory. As stated by Panzar and Willig (1981), "there are economies of scope where it is less costly to combine two or more product lines in one firm than to produce them separately..., and diseconomies of scope if the [situation] is reversed." Based on this, in chapter 2, we make a distinction between production specialization and monopoly power and specify a generalized specification of production specialization to capture the observations in the industry organization. Furthermore, as stated by Das and Das (1996, p. 218), "[entry] costs would arise .... An example would be the cost of initial advertising to make consumers aware of a new brand. The greater the number of entrants the greater is the cost of product differentiation." Therefore, in line with Das and Das (1996), Kim (1997) and Chen et al. (2005), our model supposes that the start-up cost is positively related to the number of firms.

By introducing these features into our model, several main findings emerge from the analysis. First, we show that the necessary and sufficient condition for local indeterminacy is independent of the monopoly power but closely related to the degree of returns to specialization and the congestion effect of the start-up cost. Second, private consumption and the real wage are pro-cyclical in relation to aggregate output in the presence of increasing returns to specialization. By contrast, consumption and the real wage are counter-cyclical in relation to aggregate output in the presence of decreasing returns to specialization. Finally, output per firm will increase in response to an expansion in government spending, provided that the congestion effect of the start-up cost exists.

In an influential paper, Benhabib and Farmer (1994) show that if the production function is featured with increasing returns to scale and the degree of the increasing returns is sufficiently strong, a self-fulfilling equilibrium driven by the agents' optimistic expectations can be generated in a one-sector RBC model. However, the empirical evidence, such as Burnside (1996), suggests that private production externalities at the aggregate level are much smaller. Motivated by this counterfactual inconsistency in the literature, subsequent research over the last two decades has tended to proceed in two distinct directions. One line of research has incorporated several elements into the Benhabib and Farmer (1994) model in order to push down the required degree of increasing returns in order to generate local indeterminacy.[1] The other line of research has highlighted the importance of rules (regimes) to investigate the emergence of local indeterminacy.[2]

For example, by endogenizing the number of firms in the Benhabib and Farmer (1994) model, Chang et al. (2011) show that imperfect competition leads aggregation increasing returns to variety, which pushes down the required degree of increasing returns for generating local indeterminacy. However, it is worth noting that although the work done by Chang et al. (2011) is valuable, they assume that the extent of monopoly power and the degree of returns to specialization are governed by the same parameter. As such, it is inconvenient for us to precisely understand which one is the key factor for the equilibrium indeterminacy condition. Thus, by making a distinction between returns to specialization and monopoly power, one purpose of this chapter is inclined to clarify whether the crucial factor for the local indeterminacy is production specialization or monopoly power.

Besides, Guo and Harrison (2008) make an attempt to shed light on the

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[1] See also, for example, Wen (1998, 2008), Chang et al. (2011) and Chen and Zhang (2011), among others.

[2] See also, for example, Schmitt-Grohé and Uribe (1997), Guo and Harrison (2004, 2008) and Chin et al. (2009), among others.

importance of productive public expenditures in governing the dynamic behavior of the economy. However, in their framework they only consider a special case of the pure public goods. As claimed by Thompson (1974) and Barro and Sala-i-Martin (1992), all publicly provided services, such as transport, public utilities and possibly national defense, are characterized by some degree of congestion. This motivates us to take the congestion effect into account to test whether the result in Guo and Harrison (2008) still holds.

Some existing RBC studies find a puzzling fact: capital services seem to play no role in explaining cyclical fluctuations in output while the estimated labor output elasticity exceeds one.[3] Based on this, Wen (1998) incorporates capacity utilization into the standard real business cycle model with production externalities and thus provides a possible explanation for this empirical puzzle. With the channel of the productive government spending that is subject to the congestion effect, this paper tries to provide a new channel to solve the puzzle.

By using firm-level panel data, Chirinko and Fazzari (1994) suggest that the production technologies for the competitive firms are increasing returns in imperfectly competitive industries. The theoretical studies, such as Ambler and Cardia (1998), Weder (2000) and Dos Santos Ferreira and Lloyd-Braga (2008), focus attention on discussing the role of internal increasing returns to scale in relation to various topics. Based on this, in chapter 3, we set up a monopolistically competitive model with internal increasing returns to scale. Besides, we extend not only the Chang et al. (2011) model to make a distinction between returns to production specialization and monopoly power, but also the Guo and Harrison (2008) model to include the congestion effect stemming from government spending.

Equipped with these straightforward extensions, several interesting results are

[3] See, for example, Bernanke and Parkinson (1991), Burnside et al. (1995) and Wen (1998).

derived from our analysis. First, under the scenario where public services are subject to purely proportional absolute congestion, the output elasticity of capital is close to zero and the output elasticity of labor is close to one. This result is confirmed by Wen (1998) who stresses that "the estimated capital elasticity is near zero and the estimated labor elasticity is near one." Second, running in sharp contrast to the Chang et al. (2011) result, the necessary condition for equilibrium indeterminacy is independent of the extent of monopoly power. Besides, in the case of proportional relative congestion, the necessary condition for equilibrium indeterminacy is independent of the elasticity of the productive government expenditure. To be more specific, it is unlikely for a one-sector growth model with productive government spending to exhibit local indeterminacy, provided that proportional relative congestion exists. That is, the result in Guo and Harrison (2008) no longer holds. Finally, when the production technology in the private sector possesses the feature of internal increasing returns, the higher the degree of internal increasing returns, the more difficult it will be for the indeterminacy result to arise.

Since we have studied the positive analysis in previous chapters, it is natural to go further to investigate fiscal policy in order to remedy market imperfections and externalities, such as productive government spending, the congestion effect and the imperfectly competitive market that we have discussed in the previous section. The majority of existing studies concerning market externalities can generally be classified based on two aspects, namely, consumption externalities and production externalities. With regard to consumption externalities, a number of studies, such as Ljungqvist and Uhlig (2000), Dupor and Liu (2003), Liu and Turnovsky (2005) and Liu and Chang (2011) have devoted considerable amounts of attention to implementing the optimal fiscal policy to correct consumption externalities. With regard to production externalities, Eicher and Turnovsky (2000), Gómez (2004), Chang et al. (2009) and

Lai and Liao (2012) have carefully examined the optimal fiscal policies in the model with production externalities.

Following Dixit and Stiglitz (1977) and Blanchard and Kiyotaki (1987), many recent studies instead focus on macroeconomic policies in the presence of imperfect competition. Up till now, three familiar but distinct types of mechanism have been discussed in the imperfect competition literature. One line of the literature allows positive profits in equilibrium to highlight the importance of monopoly profits available in the economy.[4] By contrast, under imperfect competition with the free entry and exit of firms, another line derives the result that monopolistically competitive firms will make zero profits in equilibrium.[5] Besides, the other line of the literature, in particular, utilizes the zero-profit condition to determine the overhead cost instead of the number of firms in equilibrium to emphasize the fact that the overhead cost is crucial to economic activities.[6]

Compared with the existing studies on normative analysis under imperfect competition, our analysis is characterized by three distinct traits. The first distinction is the introduction of internal increasing returns to scale stemming from diminishing marginal costs. Until now, the linkage between optimal fiscal policies and the extent of internal returns to scale has been virtually absent in the existing literature. This paper thus turns the focus to the extent of the internal returns to scale. As we will show later, the extent of the internal returns to scale is a crucial determinant of the optimal fiscal policies. The second distinction is the simultaneous presence of consumption and production externalities. As such, once the consumption tax and income taxes (on both labor income and capital income) are

[4] Of the various studies, Dixon (1987), Benhabib and Farmer (1994), Chang et al. (2009) and Lai et al. (2010) focus on this situation.

[5] Dixon and Lawler (1996), Devereux et al. (2000), Chang et al. (2011) and Bilbiie et al. (2012) deal with this situation.

[6] See, for example, Rotemberg and Woodford (1992), Hornstein (1993), and Kim (2000).

available to the government, we will thus use it to compare the relative efficiency of fiscal policies between consumption externalities and production externalities. According to our analysis, there exists an appropriate use of consumption tax and income tax for consumption and production externalities. The third distinction is the adjustment mechanism. The existing imperfect competition studies on the optimal fiscal policies are either characterized by a zero-profit condition due to free entry or, alternatively, adopt a constant number of firms in which there exist positive profits. It has been well known that the introduction of fiscal policies can be utilized to remedy inefficiency in the presence of externalities. Owing to the fact that three differential types of mechanisms are being discussed in the imperfect competition literature, this paper thus introduces the adjustment mechanism to address the interrelations between the optimal fiscal policies and market distortions under different types of mechanisms. According to our analysis, the adjustment mechanism is a crucial determinant of the optimal fiscal policies in the presence of market distortions.

By introducing these features into our model, several main findings emerge. First, in the presence of consumption and production externalities, a consumption tax should be utilized to correct consumption externalities, while an income tax should be utilized to remedy production externalities. Second, the inclusion of an adjustment mechanism plays an important role in governing the implementation of optimal labor and capital income taxes. Third, when the government spending provides productive services, the optimal ratio of government expenditure is solely determined by the extent of the production externalities if the number of firms is fixed, while the result should be modified if free entry and exit of firms is taken into account. Fourth, free entry in the competitive equilibrium may result in under entry, provided that the degree of increasing returns to specialization is strong enough.

The remainder of this dissertation is organized as follows. Chapter 2 examines the economic dynamics and the cyclical behavior of consumption and real wages in which a generalized specification of production specialization and the congestion effect of the start-up cost are taken into account. Chapter 3 focuses on the dynamic properties under the one-sector growth model in which we distinguish returns to specialization from monopoly power. Besides, we consider the role of the extent of internal increasing returns and the role of productive government spending that is subject to the congestion effect. Chapter 4 introduces three types of mechanism dealing with the optimal fiscal policies in the presence of consumption and production externalities. Finally, Chapter 5 concludes our analysis.

Chapter 2

The Effects of Government Spending with Free Entry

2.1 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 fall in both consumption and real wages.[7] The reason for this result is that an expansion in fiscal spending generates a negative wealth effect, which leads to a reduction in private consumption and a rise in the level of labor supply (and hence employment), thereby resulting in a decrease in the real wage. Accordingly, both real wages and consumption exhibit countercyclical behavior over the business cycle. However, in general the theoretical predictions concerning the behavior of both real wages and consumption from the standard RBC models are not consistent with the empirical evidence.

With regard to the cyclical behavior of real wages, existing empirical studies on the co-movement between real wages and aggregate output are mixed. On the one hand, using data from the U.S. economy, Solon and Barsky (1989), Solon et al. (1994), Hart et al. (2002) and Kandil (2005) find that real wages are strongly pro-cyclical.[8] On the other hand, Gärtner (2009) finds that Canadian real wages experience countercyclical behavior.[9] However, the existing *theoretical* studies including Baxter and King (1993), Cardia (1995), Edelberg et al. (1999), Burnside et al. (2004) and Cavallo (2005) assert that real wages are countercyclical; that is, real wages are negatively correlated with aggregate output. Up till now, to the best of our knowledge, it is surprising that the economic modeling of the positive

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7 See Rebelo (2005) for a survey on the properties of RBC models.

8 By taking job stayers into account, Shin and Shin (2008) obtain a similar result. Since job stayers constitute a major fraction of the labor force, their analysis constitutes important progress in understanding the procyclicality of real wages. See Shin and Shin (2008) for detailed discussions.

9 Throughout this chapter, that real wages are procyclical is defined to involve higher real wages in good times (output is rising), and that real wages are countercyclical is defined to involve lower real wages in good times. See, for example, Kaminsky et al. (2004) and Woo (2009).

relationship between real wages and aggregate output has been virtually absent in the literature. The first purpose of this chapter is thus to provide a plausible solution to reconcile the discrepancy between the theoretical prediction and empirical observations.

With reference to the cyclical behavior of consumption, empirical studies by Blanchard and Perotti (2002), Fatas and Mihov (2002), Gali et al. (2007) and Ravn et al. (2007) find that a fiscal expansion is associated with a rise in private consumption. The conflict between theoretical inference and empirical observation is now dubbed "the fiscal policy puzzle" in the literature. Recently, some studies have made an effort to provide their solution to the fiscal policy puzzle. Chen et al. (2005) first consider the productive role of government spending as a possible vehicle to explain the positive co-movement between consumption and fiscal spending. In addition, by specifying the non-separable utility function, Linnemann (2006) and Bilbiie (2009) solve the puzzle from the perspective of preference-based explanations. Devereux et al. (1996) show that in the presence of increasing returns to specialization stemming from monopoly power, a government spending shock can generate a positive response of private consumption if increasing returns are sufficiently large. However, in their analysis they specify a parameter to capture both the returns to production specialization and the degree of monopolistic competition. A question thus naturally arises in their analysis: Does the positive linkage between government spending and private consumption stem from the returns to production specialization or the degree of monopolistic competition? The second purpose of this chapter is to clarify whether the key factor for the pro-cyclical behavior of private consumption is the returns to production specialization, rather than the degree of monopolistic competition. In addition, in Devereux et al. (1996), the production of each intermediate good remains intact and aggregate production is increased in response to an expansion in fiscal expenditure. This result, however, stands in stark contrast to the empirical observation. For example, Basu (1995) finds that the quantities of each intermediate good used should be pro-cyclical rather than fixed. To bridge the discrepancy between the theoretical analysis and empirical evidence, this chapter endogenizes the start-up cost that is subject to the congestion effect, and shows that the intermediate good production is no longer fixed in the long run.

The returns to production specialization are now regarded as an important factor affecting the scale economies in the production of manufactures (Holtz-Eakin and Lovely, 1996). As documented by Francois (1990, p. 110), "[the] gains from [the returns to production specialization] are realized through the reorganization of the production process and through qualitative changes in the mix of inputs which, in turn, require increased use of management and highly specialized personnel." Based on the above viewpoint observed in the industrial economy, this chapter develops a dynamic general equilibrium model featuring the returns to production specialization, and uses it to explore the relationships among real wages, consumption, and aggregate output.

The remainder of this chapter is organized as follows. Section 2 sets up a dynamic optimizing macro model which is able to capture both increasing and decreasing returns to specialization. Section 3 deals with how real wages and private consumption will react in response to an expansion in government spending. Finally, concluding remarks are provided in Section 4.

2.2 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 sector. Suppose that the final good is produced through the use of a range of differentiated intermediate inputs. The households derive utility from the consumption of the final good and from enjoying leisure, and they accumulate physical capital as a saving asset. The government levies a lump-sum tax to finance its expenditures.

2.2.1 Firms

Following Bénassy (1998), final output is produced by perfectly competitive firms with the following technology:[10]

$$Y = N^{\alpha+1-\frac{1}{\lambda}}\left(\int_0^N y_i^{\lambda}\, di\right)^{\frac{1}{\lambda}}; 0 < \lambda < 1, \quad \alpha \gtrless 0, \tag{1}$$

[10] 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.

where y_i represents the quantity of input i used in the production of the final good and N is the number of intermediate goods. As we will explain later, the parameter λ measures the degree of monopoly of the intermediate good firms, and the parameter α measures the extent of the returns from specialization.

The production function reported in equation (1) displays a generalized form of increasing (or decreasing) returns to specialization in the sense that the larger the number N of intermediate firms, the higher (lower) the amount of final output obtained. If all intermediate goods are hired in the same quantity, namely, y, then final output is given by $Y = N^{\alpha+1}y$. Thus, there are constant returns to the quantity employed of a fixed variety of intermediate goods, but either increasing (if $\alpha > 0$) or decreasing (if $\alpha < 0$) returns to an expansion in variety, while holding fixed the quantity employed of each intermediate good.

In their paper, Devereux et al. (1996) and Chang et al. (2007) specify that the production function of final output has the following form: $Y = (\int_0^N y_i^\lambda di)^{\frac{1}{\lambda}}$, where monopoly power and increasing returns to specialization (an expansion in variety) are characterized by the same parameter λ. As stressed by Bénassy (1998), the specification of equation (1) allows us to clearly separate increasing returns to specialization from monopoly power, so that both effects can be fully disentangled.

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

$$\underset{y_i}{Max}\ \pi^f = N^{\alpha+1-\frac{1}{\lambda}}(\int_0^N y_i^\lambda di)^{\frac{1}{\lambda}} - \int_0^N p_i y_i\, di,$$

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

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

Equation (2) is the demand function for the i th intermediate good which is characterized by a constant price elasticity $1/(1-\lambda)$. Moreover, λ measures the degree of monopoly power of the intermediate good firms. A larger λ implies a higher price elasticity of demand for intermediate good i and indicates that the intermediate goods sector is more competitive.[11]

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

$$y_i = Ak_i^a h_i^{1-a} - \phi N^\sigma ; \quad A > 0, \infty > \sigma \geq 0, 1 > a > 0. \tag{3}$$

where k_i and h_i respectively represent capital and labor hired by the i th intermediate good producer, a $(1-a)$ measures the share of capital (labor) in output of the intermediate goods sector, A is a constant technology parameter, ϕ is a fixed parameter of the start-up cost, and σ captures the extent of the congestion effect of the start-up cost.

In line with Das and Das (1996), Kim (1997), Datta and Dixon (2002) and Chen et al. (2005), in equation (3) the start-up cost is specified as being positively related to the number of firms. Some studies provide the economic reasoning for such a setting. Das and Das (1996, p.218) claim that "[e]ntry sunk costs in our model contain a fixed cost of entry …, and, in addition, a variable component which is an increasing function of the number of entrants …. The latter may be called entry adjustment costs. Such costs would arise due to resources needed for initial set-up that are imperfectly elastic in supply-costs of resources which are wholly or partly specific to the industry. An example would be the cost of initial advertising to make consumers aware of a new brand. The greater the number of entrants the greater is the cost of product differentiation." In addition, Datta and Dixon (2002, p. 232) state that "when more firms are being set up, the cost of setting up is higher. This might be because of a direct externality in the setting up of new firms, or due to the fixed supply of some factor involved in the creation of new firms (some specialized human capital or other input)."

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 i th intermediate good producer can be expressed as:

[11] See also, for example, Fender and Yip (1993, p.444) on this feature.

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

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

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

$$w = \frac{\lambda(1-a)p_i(y_i + \phi N^\sigma)}{h_i} \,, \tag{5}$$

$$r = \frac{\lambda a\, p_i(y_i + \phi N^\sigma)}{k_i} \,. \tag{6}$$

Then, substituting equations (5) and (6) into (4) allows us to derive the profit of the i th intermediate good producer:

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

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 labor 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:

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

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:

$$y = \frac{\lambda\phi N^\sigma}{1-\lambda} \,. \tag{9}$$

Given that $y = Ak^a h^{1-a} - \phi N^\sigma$, $K = Nk$, $H = Nh$ and $y = \lambda\phi N^\sigma/(1-\lambda)$, we can obtain the variety of intermediate goods in equilibrium:

$$N = \left(\frac{(1-\lambda)AK^a H^{1-a}}{\phi} \right)^{\frac{1}{\sigma+1}} . \tag{10}$$

Then, we can derive the expression: $N = ((1-\lambda)Y/\lambda\phi)^{1/1+\alpha+\sigma}$ from equations (1) and (10). This result supports the empirical evidence proposed by Etro and Colciago (2010) in which the number of firms is positively related to aggregate output.

Inserting equations (9) and (10) into (1), we can further derive the aggregate production function of the final good:[12]

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

We restrict our analysis to the case of $a(1+\alpha+\sigma)/(1+\sigma) < 1$, which implies that the externality is not strong enough to generate sustained growth. Besides, we further impose the constraints $0 < a(1+\alpha+\sigma)$ and $0 < (1-a)(1+\alpha+\sigma)$ to guarantee that the marginal productivities of factors are positive.

It is clear from equation (11) that the aggregate production function exhibits increasing returns to scale when $\alpha > 0$,[13] while the aggregate production function exhibits decreasing returns to scale when $\alpha < 0$.[14]

2.2.2 Households

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

$$U = \int_0^\infty [\ln C_t - BH_t] e^{-\rho t} dt , \quad B > 0 , \tag{12}$$

where $\rho\,(>0)$ represents the constant rate of time preference and t is the time index. 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 labor would be able to explain the fact that the sum of employed workers is much more variable than individual working hours.[15] Accordingly, in this analysis we adopt the characterization of indivisible labor as employed by Zhang (1996), Harrison and Weder (2000), Ljungqvist and Uhlig (2000) and Linnemann (2009).

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[12] Eicher and Turnovsky (1999, 2000) specify an aggregate production function that can exhibit both increasing and decreasing returns to scale.

[13] Benhabib and Farmer (1994), Fingleton and McCombie (1998), and Bosi and Magris (2000) specify an aggregate production function that exhibits increasing returns to scale.

[14] Some empirical evidence proposed by Burnside (1996), Basu and Fernald (1997), Ramcharran (2001), and Lee (2007) supports the feature of decreasing returns to scale in the production function.

[15] See Heer and Mauβner (2008) for more discussions.

The representative household faces the following budget constraint:

$$\dot{K}_t = w_t H_t + r_t K_t + \Pi_t - C_t - T_t ,^{16} \tag{13}$$

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

The household maximizes the discounted sum of future instantaneous utilities reported in equation (12) subject to the budget constraint reported in equation (13) and the initial capital stock K_0. Performing the optimization problem leads to the first-order conditions in terms of the aggregate variables as follows:

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

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

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

$$\dot{K} = wH + rK + \Pi - C - T , \tag{17}$$

and the transversality condition:

$$\lim_{t \to \infty} \mu K e^{-\rho t} = 0 , \tag{18}$$

where μ is the shadow price of physical capital. Combining equation (14) with (16) yields the standard Keynes-Ramsey Rule:

$$\dot{C} = (r - \rho) C . \tag{19}$$

In addition, inserting equations (3), (8) and (10) into (5) and (6) yields:

$$w = \frac{(1-a)Y}{H} , \tag{20}$$

$$r = \frac{aY}{K} . \tag{21}$$

2.2.3 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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[16] For simplicity and without loss of generality, the depreciation rate of physical capital is set to zero.

$$G = T\,. \tag{22}$$

2.2.4 The competitive equilibrium

By substituting equations (7), (20), (21) and (22) into (17), we obtain the economy-wide resource constraint:

$$\dot{K} = Y - C - G\,. \tag{23}$$

Based on equations (11), (14), (15) and (20), we can solve employment for the instantaneous relationship:

$$H = H(K, C)\,, \tag{24}$$

where

$$H_K = \frac{-a(\alpha + 1 + \sigma)H}{\Omega K}\,, H_C = \frac{(1+\sigma)H}{\Omega C}\,, \Omega = (1-a)(\alpha + 1 + \sigma) - (1+\sigma)\,.$$

The main equations of the symmetric equilibrium of the economy can then be summarized as follows:

$$H = H(K, C)\,, \tag{25}$$

$$Y = \lambda \left(\frac{1-\lambda}{\phi} \right)^{\frac{\alpha}{\sigma+1}} \left(AK^a H^{1-a} \right)^{\frac{1+\alpha+\sigma}{\sigma+1}}\,, \tag{26}$$

$$\dot{K} = Y - C - G\,, \tag{27}$$

$$\dot{C} = (\frac{aY}{K} - \rho)C\,, \tag{28}$$

$$G = T\,. \tag{29}$$

2.3 Long-run effects of fiscal policy

In this section we examine the long-run effect of government spending. Substituting equations (25) and (26) into (27) and (28), the dynamic system of the economy can be expressed as:

$$\dot{K} = \lambda \left(\frac{1-\lambda}{\phi} \right)^{\frac{\alpha}{\sigma+1}} \left(AK^a H^{1-a} \right)^{\frac{1+\alpha+\sigma}{\sigma+1}} - C - G\,, \tag{30}$$

$$\dot{C} = \left[a\lambda \left(\frac{1-\lambda}{\phi} \right)^{\frac{\alpha}{\sigma+1}} A^{\frac{1+\alpha+\sigma}{\sigma+1}} K^{\frac{a(1+\alpha+\sigma)}{\sigma+1} - 1} H^{\frac{(1-a)(1+\alpha+\sigma)}{\sigma+1}} - \rho \right] C\,. \tag{31}$$

Given an initial government expenditure G_0, linearizing equations (30) and (31) around the steady state $(\tilde{K},\tilde{C})$ yields:

$$\begin{pmatrix}\dot{K}\\ \dot{C}\end{pmatrix}=\begin{pmatrix}J_{11} & J_{12}\\ J_{21} & J_{22}\end{pmatrix}\begin{pmatrix}K-\tilde{K}\\ C-\tilde{C}\end{pmatrix}+\begin{pmatrix}-1\\ 0\end{pmatrix}(G-G_0), \tag{32}$$

where

$$J_{11}=\frac{-a(\alpha+1+\sigma)\tilde{Y}}{\Omega\tilde{K}},\ J_{12}=\frac{(1-a)(\alpha+1+\sigma)\tilde{Y}}{\Omega\tilde{C}}-1,\ J_{21}=\frac{-a\alpha\tilde{C}\tilde{Y}}{\Omega\tilde{K}^2},$$

$$J_{22}=\frac{a(1-a)(\alpha+1+\sigma)\tilde{Y}}{\Omega\tilde{K}}.$$

Based on equation (32), we can infer the trace and determinant of the Jacobian:[17]

$$Tr(J)=\frac{-a^2(\alpha+1+\sigma)\tilde{Y}}{\Omega\tilde{K}}, \tag{33}$$

$$Det(J)=\frac{a[(1-a)(\alpha+1+\sigma)\tilde{Y}-\alpha\tilde{C}]\tilde{Y}}{\Omega\tilde{K}^2}. \tag{34}$$

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. Since C is the only jump variable in this dynamic system, there exists a continuum of equilibrium paths converging to the steady state if the dynamic system has two real negative roots. With this understanding, the necessary and sufficient condition for generating local indeterminacy in the dynamic system requires that the trace value of the Jacobian be negative and the determinant value of the Jacobian be positive.

According to the above discussion, we are able to formulate the following proposition:[18]

Proposition 1. ***The necessary and sufficient condition for local indeterminacy in the dynamic system requires*** $\Omega=(1-a)(\alpha+1+\sigma)-(1+\sigma)>0$**.**

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[17] We can show that $(1-a)(\alpha+1+\sigma)\tilde{Y}-\alpha\tilde{C}=\alpha(\tilde{Y}-\tilde{C})+[(1-a)(1+\sigma)-a\alpha]\tilde{Y}>0$ by using the constraint $0<a(1+\alpha+\sigma)/(1+\sigma)<1$.

[18] Alternatively, as stated by Benhabib and Farmer (1994), the necessary condition for local indeterminacy requires that the equilibrium wage-hours locus be positively sloped (the slope here is $(1-a)(1+\alpha+\sigma)/(1+\sigma)-1$) and is steeper than the slope of the labor supply curve (the slope here is zero), which results in the same condition for local indeterminacy as reported in Proposition 1.

It is clear that the necessary and sufficient condition for local indeterminacy is totally unrelated to the extent of the monopoly power, but closely related to the following factors: the labor share $1-a$, the degree of returns to production specialization α, and the extent of the congestion effect σ. We in turn examine how the possibility of local indeterminacy is related to each of these factors.

We first discuss the linkage between the possibility of local indeterminacy and the extent of monopoly power. In an influential paper, Benhabib and Farmer (1994) develop a monopolistic competition model and indicate that the condition for local indeterminacy depends crucially upon the extent of monopoly power. Similarly, McKnight (2011) analyzes the necessary condition without free entry in the open economy, and finds that the condition for local indeterminacy is closely related to the degree of monopoly power. In addition, Chang et al. (2011) consider a monopolistic competition model with free entry and conclude that local indeterminacy can easily occur for mild externalities provided that the degree of monopoly power is large. Departing from their analysis, our study distinguishes increasing returns to specialization from monopoly power and further finds that the necessary and sufficient condition for local indeterminacy is independent of monopoly power.[19]

The independent result can be explained intuitively. As addressed in the literature on imperfect competition, such as Dixon (1987) and Startz (1989), a higher degree of monopoly power increases monopoly profits for firms and hence increases households' disposable income. By way of this so-called feedback effect, the degree of monopoly power can govern the transitional dynamics of the economy. Once free entry is allowed, it will result in a zero profit in equilibrium, which implies that the feedback effect from monopoly profits on the household's behavior is cut off. As a consequence, the condition for local indeterminacy is independent of the monopoly power.

However, the possibility of local indeterminacy is related to the increasing returns to specialization α and the extent of the congestion effect σ. By differentiating the necessary and sufficient conditions for local indeterminacy Ω with respect to α and σ, we have:

[19] By differentiating the necessary condition for local indeterminacy Ω with respect to λ, we have: $\partial\Omega/\partial\lambda = \partial[(1-a)(\alpha+1+\sigma)-(1+\sigma)]/\partial\lambda = 0$

$$\frac{\partial[(1-a)(\alpha+1+\sigma)-(1+\sigma)]}{\partial \alpha}=1-a>0, \tag{35a}$$

$$\frac{\partial[(1-a)(\alpha+1+\sigma)-(1+\sigma)]}{\partial \sigma}=-a<0. \tag{35b}$$

Our intuitive explanation for the indeterminacy results in equations (35a) and (35b) is borrowed from Guo and Harrison (2004). For ease of presentation, we state the Keynes-Ramsey rule reported in equations (35a) and (35b) in the following discrete-time form:

$$\frac{C_{t+1}}{C_t}=\beta\left[1+a\lambda\left(\frac{1-\lambda}{\phi}\right)^{\frac{\alpha}{\sigma+1}} A^{\frac{1+\alpha+\sigma}{\sigma+1}} K_{t+1}^{\frac{a(1+\alpha+\sigma)}{\sigma+1}-1} H_{t+1}^{\frac{(1-a)(1+\alpha+\sigma)}{\sigma+1}}\right], \tag{36}$$

where β denotes the discount factor. When the households generate optimistic expectations regarding having a higher future return on physical capital (i.e., the marginal product of capital, henceforth referred to as MPK), they will reduce current consumption C_t for more investment and enjoy higher future consumption C_{t+1}. A higher value of future consumption together with a lower value of current consumption causes the left-hand side of equation (36) to increase.

With a rise in C_{t+1} and a fall in C_t, it is clear from equation (36) that a self-fulfilling equilibrium driven by the agents' optimistic expectations can emerge when the right-hand side of equation (36) increases. As described above, the additional investment increases the amount of new capital stock K_{t+1}, and H_{t+1} will rise in response given that both aggregate labor and aggregate capital are complements by nature. Under such a situation, a higher value of α causes MPK to increase, while a higher value of σ causes MPK to decrease. As a consequence, in association with a higher value of , the households' initial optimistic expectations regarding a rise in MPK are more likely to lead to a rise in MPK. Accordingly, the households' initial optimistic expectations are more likely to be self-fulfilling, and the economy is more likely to display equilibrium indeterminacy. With similar intuition, we can infer that, in association with a higher value of σ, the economy is more unlikely to exhibit equilibrium indeterminacy.

Summing up the above discussion, we can establish the following proposition:[20]

Proposition 2. ***In a one-sector RBC model with monopolistic competition and free entry, the necessary and sufficient condition for equilibrium indeterminacy is independent of the monopoly power. Furthermore, the equilibrium indeterminacy becomes easier when*** α ***increases, while it becomes more difficult when*** σ ***increases.***

At the balanced growth equilibrium, the economy is characterized by $\dot{K} = \dot{C} = 0$. Let us recall that $\widetilde{K}$ and $\widetilde{C}$ are the stationary values of K and C, respectively. Then, from equation (32) we can infer the following result:[21]

$$\frac{\partial \widetilde{K}}{\partial G} = \frac{(1-a)(\alpha+1+\sigma)\widetilde{K}}{[(1-a)(\alpha+1+\sigma)\widetilde{Y} - \alpha \widetilde{C}]} > 0, \tag{37}$$

$$\frac{\partial \widetilde{C}}{\partial G} = \frac{\alpha \widetilde{C}}{[(1-a)(\alpha+1+\sigma)\widetilde{Y} - \alpha \widetilde{C}]} \gtreqless 0; \quad \text{if } \alpha \gtreqless 0. \tag{38}$$

Equations (37) and (38) indicate that a fiscal expansion has a positive effect on the level of capital stock and an ambiguous effect on private consumption. The economic intuition behind equation (38) can be well understood by analyzing the following three scenarios.

The first scenario we deal with can be treated as a benchmark case, and is intended for comparison with other scenarios. The benchmark case is concerned with the standard RBC situation where the returns to production specialization are absent ($\alpha = 0$). Under such a situation, as indicated in equations (37) and (38), an expansion in fiscal expenditure leads to an increase in the level of the capital stock and private consumption is likely to remain unchanged as a result of the fiscal shock. Following a fiscal expansion, the representative household reacts to this fiscal shock by providing more labor supply and accumulating a higher level of capital stock, thereby resulting in a rise in the aggregate output of the final good. Accordingly, an increase in government expenditure financed by a lump-sum tax leads to a reduction

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[20] In a two-final-good model, Pavlov and Weder (2012) show that the variety effect of the final investment good crucially affects the indeterminacy condition. By introducing the congestion effect of the start-up cost, our model further shows that the condition for equilibrium indeterminacy is independent of the monopoly power but is closely related to the degree of returns to specialization and the congestion effect of the start-up cost.

[21] In the Devereux et al. (1996) analysis, fiscal policy is defined as the ratio of government spending to output. In our analysis, however, fiscal policy is defined as the level of government spending. It is obvious that the ratio of government spending to output is not equivalent to the level of government spending when the expansion in output exceeds the fiscal increment.

in consumption from the beginning, but later on this reduction is exactly offset by a rise in aggregate output. Based on this cognition, a fiscal expansion is therefore ineffective in influencing consumption provided that the returns to production specialization are absent. However, this result runs counter to the existing empirical evidence exhibiting the positive co-movement of consumption and income.

We then deal with the second scenario where increasing returns to an expansion in variety ($\alpha > 0$) are present. Under such a situation, as indicated in equations (37) and (38), an expansion in fiscal expenditure has a positive effect on both the capital stock and private consumption. Moreover, an expansion in fiscal expenditure leads to a rise in the number of intermediate goods. Compared with the benchmark case, an additional positive impact on aggregate output stemming from increasing returns to specialization is created. By virtue of the increasing returns to specialization, a rise in aggregate output exceeds an expansion in fiscal expenditure, and hence fiscal expansion crowds in private consumption.

Some recent studies including Chen et al. (2005), Linnemann (2006) and Ganelli and Tervala (2009) are devoted to solving the fiscal policy puzzle. Chen et al. (2005) shed light on the role of productive public expenditure, and find that consumption may be pro-cyclical in relation to aggregate output if infrastructure and labor are technical complements and the degree of complementarity is sufficiently large. Linnemann (2006) considers the non-separability between consumption and leisure in the utility function and consumption and leisure are substitutes for the representative 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.[22] Moreover, by introducing public consumption into the household's utility function and considering non-separability between the public and private consumption, Ganelli and Tervala (2009) show that, in association with a high degree of public-private consumption complementarity, government expansion is more likely to generate a positive effect on private consumption.[23] In departing from these studies, this chapter instead lays emphasis on the importance of the role of the returns to production specialization. To be more specific, we show that, in the presence of varied expansion in production, increasing

[22] 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.
[23] See Ganelli and Tervala (2009) for a detailed discussion.

returns to production specialization can serve as a plausible vehicle to explain the positive response of consumption to the fiscal shocks found in empirical studies.

One point should be emphasized here. In their previous study, Devereux et al. (1996) 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 [labor supply elasticity]." (p. 244). Second, fiscal spending may raise private consumption provided that the degree of monopoly power is large. By contrast, this chapter specifies two distinct parameters to reflect the returns to production specialization and the degree of monopolistic competition, respectively. We unambiguously show that, when the production process is featured with increasing returns to specialization, an expansion in fiscal spending definitely has a positive effect on private consumption regardless of whether the market structure is characterized by monopolistic competition or perfect competition.[24] To be more specific, the impact of government spending on long-run consumption is independent of the markup.

The third scenario we deal with is that where decreasing returns to an expansion in variety ($\alpha < 0$) are present. By a similar inference to the second scenario, in the presence of decreasing returns to specialization, a rise in aggregate output falls short of an expansion in fiscal expenditure, and, as a consequence, fiscal expansion partially crowds out private consumption.[25]

In summing up the above discussion, we can establish the following proposition:

Proposition 3. ***In the presence of increasing returns to specialization (*** $\alpha > 0$ ***), private consumption will increase in response to fiscal expansions. By contrast, in the presence of decreasing returns to specialization (*** $\alpha < 0$ ***), private consumption will decrease in response to fiscal expansions.***

Moreover, from equations (23), (24) and (36) we can infer the following result:[26]

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[24] Proposition 3 is robust even if the intermediate goods market is perfectly competitive.

[25] By considering an economy where labor is divisible and production specialization is absent, Lewis (2009) derives a similar result.

[26] By setting up a two-sector model with variable returns-to-scale technology, Chao and Yu (1993) examine the effect of fiscal spending in a neoclassical economy. They show that government spending leads to a higher national welfare if the spending results in an increase in the relative price in a higher returns-to-scale sector.

$$\frac{\partial \widetilde{Y}}{\partial G}=\frac{(1-a)(\alpha+1+\sigma)\widetilde{Y}}{[(1-a)(\alpha+1+\sigma)\widetilde{Y}-\alpha\widetilde{C}]}>0\,. \tag{39}$$

We can further derive the following expression from equations (3), (5) and (7):

$$\frac{\partial(\widetilde{w}/\widetilde{p})}{\partial G}=\frac{\alpha a(1-a)\lambda A\widetilde{K}^{a}\widetilde{H}^{-a}}{[(1-a)(\alpha+1+\sigma)\widetilde{Y}-\alpha\widetilde{C}]}\gtreqless 0\,;\ \ if\ \ \alpha\gtreqless 0\,. \tag{40}$$

Equation (40) reveals that a fiscal expansion leads to an ambiguous effect on real wages, depending crucially upon whether the returns to production specialization are increasing or decreasing. Similar to the effect of a fiscal expansion on private consumption, the economic intuition behind equation (40) can also be understood by analyzing the following scenarios.

We first discuss the benchmark scenario where the returns to production specialization are absent ($\alpha=0$). On the one hand, a fiscal expansion leads to an increase in labor supply as a result of a negative wealth effect. On the other hand, a fiscal expansion leads to a reduction in consumption at the same time, and hence the level of the capital stock will rise over time. Capital accumulation will lead the firms to increase their demand for labor in view of the complementary relationship between labor and physical capital in production. It happens that the rise in labor supply is exactly offset by the rise in labor demand and, as a result, real wages remain intact at the initial level. Accordingly, the impact of real wages is independent of the fiscal shock under such a situation.

We then deal with the second scenario where increasing returns to specialization ($\alpha>0$) are present. Under such a situation, an expansion in fiscal spending leads to a rise in the number of intermediate goods. Compared with the benchmark case, an additional positive impact on aggregate output stemming from increasing returns to specialization is created and therefore labor demand is increased further than the benchmark case. With an additional positive effect on labor demand, at the initial level of real wages, the rise in labor demand exceeds the rise in labor supply, and hence to restore labor market equilibrium, the new real wage rate should rise in response. Accordingly, in the presence of increasing returns to specialization, real wages are pro-cyclical in response to the fiscal expansion shock. Our 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.

The third scenario we deal with is that where decreasing returns to specialization are present ($\alpha < 0$). Being just the opposite of the second scenario, when compared with the benchmark case, an additional negative impact on aggregate output stemming from decreasing returns to specialization is created. This in turn leads to an additional adverse effect on labor demand. With the additional adverse effect on labor demand, at the initial level of real wages the rise in labor demand falls short of the rise in labor supply, and hence to restore labor market equilibrium, the new real wage rate should fall in response. Accordingly, real wages are countercyclical in response to the fiscal expansion shock when the production process is featured with decreasing returns to specialization. This situation also provides an alternative channel to explain the empirical finding of a negative relationship between real wages and aggregate output. See for instance, Gärtner (2009).

The results in equations (37) and (40) lead us to establish following proposition:

Proposition 4. ***If the aggregate production function is featured with increasing returns to specialization, real wages are pro-cyclical. However, in the presence of decreasing returns to specialization in production, real wages are countercyclical.***[27]

Finally, from equations (9) and (10) we can derive the following expression:

$$\frac{\partial \tilde{y}}{\partial G} = \frac{\sigma\lambda\phi(1-a)A\tilde{N}^{\sigma}}{(1-\lambda)[(1-a)(\alpha+1+\sigma)\tilde{Y} - \alpha\tilde{C}]} \geq 0\,; \;\; if \;\; \sigma \geq 0\,. \tag{41}$$

Equation (41) represents another novelty for empirical implications of this chapter. As stated by Devereux et al. (1996, p. 239), "with our specification, all variation in aggregate output is due to entry and exit, as output per firm is unaffected by changes in the aggregate state [and] this implication is, of course, at odds with the fact that output per firm does vary over time."[28] However, the Devereux et al. (1996) finding stands in stark contrast to the empirical observation proposed by, for example, Basu (1995). By endogenizing the start-up cost, this chapter shows that the output level of each intermediate good producer is positively related to the fiscal expansion shock provided that the congestion effect of the start-up cost exists. With this

[27] It is worth mentioning that the robustrness of this proposition is independent of the labor supply elasticity. To be more specific, we would derive the same result even if the utility function were specified as $U = \ln C - BH^{1+x}/1+x$.

[28] This anomalous result also appears in a series of articles, such as Devereux et al. (2000), Chang et al. (2007) and Chang et al. (2011).

understanding, we establish the following proposition:

Proposition 5. ***The output level of an individual firm in monopolistic competition is positively related to fiscal expansions, provided that the start-up cost is subject to the congestion effect.***

2.4 Conclusion

Most recent empirical studies have pointed out that both consumption and real wages exhibit a positive co-movement with fiscal spending. However, the standard RBC models are incapable of explaining these empirical findings. This chapter thus develops a dynamic general equilibrium macroeconomic model featuring monopolistic competition and a generalized form of the returns to production specialization. Several main findings emerge from the analysis. First, by making a distinction between returns to specialization and monopoly power, this chapter shows that the necessary and sufficient condition for local indeterminacy is independent of the monopoly power but closely related to the degree of returns to specialization and the congestion effect of the start-up cost. Second, in the presence of increasing returns to specialization, private consumption will increase in response to an expansion in government spending. By contrast, in the presence of decreasing returns to specialization, private consumption will decrease in response to an expansion in government spending. Third, when the aggregate production function is featured with increasing returns to production specialization, real wages are pro-cyclical in relation to aggregate output. By contrast, when the aggregate production function is featured with decreasing returns to production specialization, real wages are countercyclical in relation to aggregate output. Fourth, the output level of each intermediate good will increase in response to an expansion in government spending, provided that the start-up cost is subject to the congestion effect.

Chapter 3

Monopoly Power, Endogenous Entry, and Macroeconomic (In)Stability in a Growing Economy

3.1 Introduction

The issue of local indeterminacy or belief-driven fluctuations has been studied extensively in the field of macroeconomics. In their pioneering work, Benhabib and Farmer (1994) propose that local indeterminacy requires a sufficiently high degree of increasing returns to scale in production or sufficiently strong monopoly power.

As pointed out by both Burnside (1996) and Basu and Fernald (1997), the empirical evidence suggests that private production externalities at the aggregate level are much smaller. Subsequent studies support their efforts to establish different models to match the local indeterminacy conditions for empirically plausible values. Wen (1998) incorporates endogenous capital utilization into the Benhabib and Farmer (1994) model and shows that the required increasing returns for local indeterminacy can be substantially reduced. Guo and Lansing (2007) introduce endogenous maintenance activity into the Wen (1998) model and find that local indeterminacy can occur with a very mild degree of increasing returns. Meng and Yip (2008) show that, with separable preferences, local indeterminacy can arise even if negative capital externalities are present. In addition, Chang et al. (2011) introduce an endogenous entry under monopolistic competition and find that local indeterminacy can occur with an empirically plausible degree of increasing returns provided that the degree of monopoly power is large (less competition). In addition to the one-sector model mentioned above, Benhabib and Farmer (1996), Harrison and Weder (2000), Harrison (2001), and Guo and Harrison (2010) respectively develop their real business cycle model featuring two sectors. A common finding in these studies is that indeterminacy is consistent with plausible values of sector-specific externalities.

However, all of the above studies seem to downplay the role of government expenditure in governing the dynamic behavior of the economy. By considering a one-sector general equilibrium model with perfectly competitive markets and constant returns to scale social technology, Schmitt-Grohé and Uribe (1997) point out that indeterminacy may occur when the government implements a balanced-budget rule with a constant level of government expenditures. By contrast, Guo and Harrison (2004) find that the economy always displays saddle-path stability and equilibrium uniqueness under a balanced-budget rule when government expenditures are endogenously determined. Following the spirit of Aschauer (1989),[29] Guo and Harrison (2008) reexamine the interrelations between the stability of equilibria and a balanced-budget rule when the government spending provides productive services or positive utility. They show that the economy may exhibit indeterminacy and sunspots under a balanced-budget rule that consists of fixed income tax rates. The main reason is that public spending provides a positive externality in production or enters the household's non-separable utility function while serving as a positive consumption externality.

As claimed by Thompson (1974) and Barro and Sala-i-Martin (1992), all service provided by the public sector, like transport, public utilities and possibly national defense, are characterized by some degree of congestion. When confronted with such an observation, it is a natural extension to consider the congestion effect of public goods when assessing the effect of government spending on the private sector. In recent years, by setting up an endogenous growth model, a number of studies, including Barro and Sala-i-Martin (1992), Turnovsky (1996), Ott and Turnovsky (2006), and Agénor (2008), have discussed the congestion effect. However, a common fact in these papers is that they all emphasize how the aggregate capital stock affects the congestion of public goods, and hence are silent on the linkage between the firm's endogenous entry and the congestion of public goods. As shown by Dos Santos Ferreira and Dufourt (2006), the competitive behavior of firms regarding an entry and exit decision may serve as a driving force behind the business cycle. To capture this idea, in this chapter the number of firms in equilibrium is endogenously determined by the zero profit condition. With such a specification, we show that the endogenous entry of firms plays an important role in determining

[29] By using US data from 1949 to 1985, Aschauer (1989) estimates the output elasticity of public capital to be in the range from 0.39 to 0.56.

the possibility of local indeterminacy.

Moreover, in their well-cited paper, Benhabib and Farmer (1994) introduce internal increasing returns at the level of the intermediate firm in a monopolistic competition market structure without free entry. Their analysis indicates that the condition for local indeterminacy crucially depends upon the extent of monopoly power. More recently, Chang et al. (2011) consider an endogenous entry under monopolistic competition and find that local indeterminacy can occur with an empirically plausible degree of increasing returns provided that the degree of monopoly power is large. However, their conclusions are based on the assumption that there is no difference between returns to production specialization and monopoly power. By making a distinction between these two factors and allowing for the firm’s endogenous entry, this chapter takes the analysis a step further to examine how the possibility of the emergence of local determinacy is related to each of these two factors.

Some existing RBC studies, including Perry (1973), Shapiro (1986), Bernanke and Parkinson (1991) and Burnside et al. (1995), find a puzzling fact: capital services seem to play no role in explaining cyclical fluctuations in output while the estimated labor-output elasticity often exceeds one. Green et al. (1988) and Wen (1998) incorporate capacity utilization into the standard real business cycle model with a positive production externality and provide a possible explanation for this empirical puzzle. With the channel of the firm’s endogenous entry and exit, this chapter tries to provide an alternative way of solving the puzzle.

This remainder of this chapter is organized as follows. Section 2 describes the model economy. Section 3 deals with local dynamic properties. Section 4 concludes our discussion.

3.2 The Model

The economy in our model consists of three types of agents: firms, households, and a government. The production environment consists of two sectors: a perfectly competitive final goods sector, and a monopolistically competitive intermediate goods sector. Suppose that the final good is produced through the use of a range of differentiated intermediate goods. The households derive utility from both the consumption of the final good and leisure, and they accumulate physical capital as an instrument for saving. Moreover, government spending provides a public service to private production but is subject to congestion.

3.2.1 Firms

There are N kinds of intermediate goods y_i, $i = 1, 2, ..., N$, which are used by a single representative firm to produce a final good Y. In line with Bénassy (1998) and Abadir and Talmain (2002), final output is produced with the following technology:

$$Y = N^{1-\frac{1}{\lambda}} \left(\int_0^N y_i^\lambda \, di\right)^{\frac{1}{\lambda}}; \quad 0 < \lambda < 1. \tag{1}$$

As we will explain later, the parameter λ measures the degree of monopoly power of the intermediate good firms.

Some points related to the specification of equation (1) should be mentioned here. First, if all intermediate goods are used in the same quantities, namely, y, the production of final output is given by $Y = Ny$. Thus, there are constant returns to the quantity employed of a fixed variety of intermediate goods. Second, the production of final output exhibits constant returns to an expansion of variety, while holding the quantity employed of each intermediate good fixed. This implies that production specialization is absent, and hence the degree of the returns to production specialization is zero. [30] Third, given that in equation (1) the parameter λ reflects the degree of monopoly power and the degree of the returns to production specialization is restricted to zero, it is quite obvious that the specification of equation (1) allows us to make a distinction between returns to production specialization and monopoly power.[31]

Assuming that the final good is the numéraire and that p_i is the price of the

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[30] Most of the existing studies on belief-driven fluctuations do not take increasing returns to production specialization into account in their analysis. To compare our results with the findings in the existing literature and to simplify our discussion, we assume that production specialization is totally absent. It should be noted that our analytical results are qualitatively valid once production specialization is present. The detailed mathematical derivations are available upon request.

[31] In their paper, Devereux et al. (1996) and Chang et al. (2007) specify that the production function of final output has the following form: $Y = (\int_0^N y_i^\lambda \, di)^{\frac{1}{\lambda}}$, where monopoly power and increasing returns to specialization (an expansion in variety) are characterized by the same parameter λ.

intermediate good i (in terms of the final good), the profit-maximization problem for the final good firm is expressed as:

$$\underset{y_i}{Max} \quad \pi^f = N^{1-\frac{1}{\lambda}}\left(\int_0^N y_i^{\lambda}\, di\right)^{\frac{1}{\lambda}} - \int_0^N p_i y_i\, di .$$

The first-order condition leads to the following expression:

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

Equation (2) is the demand function for the i th intermediate good which is characterized by a constant price elasticity $1/(1-\lambda)$. A higher value of λ implies a higher price elasticity of demand and indicates that the intermediate good sector is more competitive. Accordingly, the parameter λ measures the degree of monopoly power of the intermediate good firms.

Intermediate good producers operating in a monopolistic competitive market use capital and labor to produce their product and sell it to the final good sector. In addition, in line with the viewpoint proposed by Aschauer (1989) and Barro (1990), government infrastructure provides a positive externality in relation to private production. The production technology for intermediate good i can be described as:[32]

$$y_i = (k_i^a h_i^{1-a})^{\gamma} g_i^x - \phi ; \;\; 0 < a < 1, \;\; \gamma \geq 1, \;\; x \geq 0 , \tag{3}$$

where k_i and h_i respectively denote capital and labor hired by the i th intermediate producer, g_i refers to the public good services available to each firm, a $(1-a)$ measures the capital (labor) share in the sector of the intermediate good output,[33] x captures the extent of the production externality arising from public good services,[34] and ϕ is an overhead cost. The intermediate good production exhibits internal increasing (constant) returns to scale technology if $\gamma > 1$ ($\gamma = 1$).

In our analysis, when assessing available public good services g_i, we would

[32] To simplify our analysis, in this chapter the congestion effect of the start-up cost is omitted. It should be noted that, however, the congestion effect of the start-up cost could govern the dynamic properties that we have shown in the previous chapter.

[33] Regardless of the extent of the returns to scale in individual firms, the capital (labor) share of income is given by a $(1-a)$. See Dhawan and Guo (2001) for a detailed discussion.

[34] By using data for OECD countries, Ford and Poret (1991) find that the public capital-output elasticity ranges from 0.29 to 0.77. In addition, Wylie (1996) estimates the output elasticity of public capital to be around 0.5 for the Canadian economy.

like to consider the possibility that public good services are subject to either absolute or relative congestion. As a consequence, public services available to each firm are given by the following general form:

$$g_i = G(\frac{1}{N})^R(\frac{1}{K})^A, \ 0 \le R \le 1, \ 0 \le A \le 1, \tag{4}$$

where G is aggregate government spending and public services to individual firms are decreasing in either the aggregate capital stock K or the number of firms N.[35]

In line with Eicher and Turnovsky (2000), Pintea and Turnovsky (2006) and Gómez (2008), the specification of equation (4) indicates that public infrastructure is subject to both relative and absolute congestion. The congestion function in equation (4) captures the effects of public services that are congested by both the endogenously determined number of firms and aggregate capital stock.[36] The economic reasoning behind the specification in equation (4) can be well understood by analyzing the following three scenarios.

The first scenario concerns the situation where the provision of public services is treated as a pure public good, i.e., $R = A = 0$ and hence $g_i = G$. As noted by Thompson (1974) and Barro and Sala-i-Martin (1992), all services provided by the public sector are characterized by some degree of congestion. As a consequence, the scenario featuring the pure public goods could be viewed as the benchmark situation.

The second scenario in association with $R > 0$ and $A = 0$ is referred to as purely relative congestion.[37] With relative congestion the agent can derive a constant level of public services (g_i) from the aggregate government spending (G) if and only if the number of firms remains constant. A typical example of relative congestion, as pointed out by Eicher and Turnovsky (2000) and Pintea and Turnovsky

[35] As mentioned above, the equilibrium number of firms is endogenously determined by the zero profit condition due to free entry. The congestion function specified here should confine the number of firms in order to assess the efficacy of productive government spending available to each firm. The essential idea of the relative congestion specified here is in line with Eicher and Turnovsky (2000), where we put forward their design so as to confine the number of firms to the congestion specification.

[36] Recently, Chang et al. (2007) specified a generalized congestion function in which the public goods are congested by both the endogenously determined number of firms and the aggregate capital stock. However, their focus is on the normative analysis.

[37] Turnovsky (1996), Ott and Turnovsky (2006) and Dioikitopoulos and Kalyvitis (2008) adopt the specification of the relative congestion in their models.

(2006), might be highway traffic.[38] It should be mentioned that in our model the number of firms is endogenously determined by a zero profit condition due to free entry and, as a result, congestion increases if the number of firms increases.

The third scenario in association with $R=0$ and $A>0$ is referred to as purely aggregate (absolute) congestion.[39] In this case, congestion increases with the aggregate capital stock in the economy provided that public services remain unchanged. A plausible example of absolute congestion might be police protection or fire protection as pointed out by Eicher and Turnovsky (2000) and Gómez (2008).[40]

Let π_i^m denote the profit of the i th intermediate good firm, and 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 decision problem of the i th intermediate good producer, taking g_i as given, can be expressed as:

$$\underset{h_i\, k_i}{Max} \quad \pi_i^m = p_i y_i - w\, h_i - r\, k_i\,, \tag{5}$$

$$s.t. \quad y_i = (k_i^a h_i^{1-a})^\gamma g_i^x - \phi \ \text{ and } \ y_i = N^{\frac{\lambda}{1-\lambda}(1-\frac{1}{\lambda})} p_i^{\frac{-1}{1-\lambda}} Y\,.$$

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

$$w = \frac{\lambda(1-a)\gamma\, p_i(y_i+\phi)}{h_i}\,, \tag{6}$$

$$r = \frac{\lambda\, a\gamma\, p_i(y_i+\phi)}{k_i}\,. \tag{7}$$

Then, substituting equations (6) and (7) into (5) allows us to derive the profit of the i th intermediate good producer:

$$\pi_i^m = p_i[(1-\lambda\gamma)y_i - \lambda\gamma\phi]\,. \tag{8}$$

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[38] In the special case where $R=1$ and $A=0$, public services available to the individual are subject to proportional (relative) congestion, and the public good is like a private good in that the agent receives his proportional share of public services, $g_i = G/N$.

[39] This specification is introduced in Barro and Sala-i-Martin (1992) and Agénor (2008).

[40] In the special case where $R=0$ and $A=1$, public services available to the agent, $g_i = G/K$, are subject to proportional absolute congestion. Under such a situation, the agent can maintain a constant level of public services g_i if and only if the aggregate government spending grows in proportion to the level of aggregate private capital.

We confine the analysis to a symmetric equilibrium under which $p_i = p$, $y_i = y$, $k_i = k = K/N$, and $h_i = h = H/N$ for all i, where H denotes the aggregate labor hired by the intermediate firms. From the zero-profit condition for the final good sector, we obtain:

$$p = 1. \tag{9}$$

Moreover, free entry guarantees zero profits for each intermediate good producer, and as a result, the quantity of each intermediate good produced in equilibrium is given by:[41]

$$y = \frac{\lambda\gamma\phi}{1-\lambda\gamma}. \tag{10}$$

By substituting equations (3) and (4) into (10), we can derive the variety of intermediate goods in equilibrium:

$$N = \left(\frac{1-\lambda\gamma}{\phi}\right)^{\frac{1}{\gamma+xR}}\left[K^{a\gamma-xA}H^{(1-a)\gamma}G^{x}\right]^{\frac{1}{\gamma+xR}}. \tag{11}$$

By inserting equations (10) and (11) into (1), we can obtain the aggregate production function of the final good:

$$Y = \lambda\gamma\left(\frac{1-\lambda\gamma}{\phi}\right)^{\frac{1-\gamma-xR}{\gamma+xR}}\left[K^{a\gamma-xA}H^{(1-a)\gamma}G^{x}\right]^{\frac{1}{\gamma+xR}}. \tag{12}$$

3.2.2 Households

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

$$U = \int_0^{\infty}[\ln C_t - \xi H_t]e^{-\rho t}dt, \tag{13}$$

where $\rho\,(>0)$ represents the constant rate of time preference, and t is the time index. As stressed by Hansen (1985) and Rogerson (1988), the households can work either a fixed number of hours or not at all. Accordingly, in our analysis we

[41] We impose the constraint $1-\lambda\gamma > 0$ so that in equilibrium the output level of intermediate goods is positive.

adopt the characterization of indivisible labor to specify that the utility function is linear in terms of hours worked.[42].

The representative household faces the following budget constraint: [43]

$$\dot{K}_t = (1-\tau)(w_t H_t + r_t K_t + \Pi_t) - C_t\,, \tag{14}$$

where the $\Pi_t (= \int_0^{N_t} \pi_{it}^m \, di)$ is the distributed aggregate profits from firms, and τ is the proportional income tax rate imposed by the government. For notational simplicity, in what follows the time subscript "t" is omitted unless the analysis requires it.

The household maximizes the discounted sum of future utility (13) subject to the budget constraint (14) and the initial capital stock K_0. Performing the optimization problem leads to the first-order conditions in terms of the aggregate variables as follows:

$$\frac{1}{C} = \mu\,, \tag{15}$$

$$\xi = \mu(1-\tau)w\,, \tag{16}$$

$$\mu(1-\tau)r = -\dot{\mu} + \mu\rho\,, \tag{17}$$

$$\dot{K} = (1-\tau)(wH + rK + \Pi) - C\ . \tag{18}$$

Moreover, we have to impose the following transversality condition:

$$\lim_{t\to\infty} \mu K e^{-\rho t} = 0\,, \tag{19}$$

where μ is the shadow price of physical capital.

Combining equation (15) with equation (17) yields the standard Keynes-Ramsey rule:

$$\dot{C} = [(1-\tau)r - \rho]C\ . \tag{20}$$

In addition, the aggregate consistency condition refers to:

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[42] The existing studies on RBC including Harrison and Weder (2000), Ljungqvist and Uhlig (2000), and Guo and Harrison (2008) adopt the same specification.

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

$$w = \frac{(1-a)Y}{H}, \tag{21}$$

$$r = \frac{aY}{K}. \tag{22}$$

3.2.3 The government

At any point in time, the government levies an income tax with a proportional rate to finance its public expenditure. Accordingly, the government's budget constraint can be expressed as:

$$G = \tau(wH + rK + \Pi) \ . \tag{23}$$

3.2.4 The competitive equilibrium

Substituting equations (8), (21), (22) and (23) into (12) yields the aggregate supply function:

$$Y = \psi\left[K^{a\gamma - xA} H^{(1-a)\gamma}\right]^{\frac{1}{\gamma-(1-R)x}}, \tag{24}$$

where $\psi = \tau^{\frac{x}{\gamma-(1-R)x}} (\lambda\gamma)^{\frac{\gamma+xR}{\gamma-(1-R)x}} (1-\lambda\gamma/\phi)^{\frac{1-\gamma-xR}{\gamma-(1-R)x}}$.

In this study, we focus on the analysis of an exogenously growing economy. Accordingly, the restriction that an exogenously growing economy converges to a stationary value of aggregate output can be expressed as:

Condition CC (the convergence condition): $0 < \dfrac{(a\gamma - xA)}{\gamma-(1-R)x} < 1$. (25)

Based on the aggregate supply function reported in equation (24), it is quite easy to infer the output elasticity with respect to capital ε_K and the output elasticity with respect to labor ε_H as being respectively given by:

$$\varepsilon_K = \frac{(a\gamma - xA)}{\gamma-(1-R)x}, \tag{26}$$

$$\varepsilon_H = \frac{(1-a)\gamma}{\gamma-(1-R)x}. \tag{27}$$

As reported in equations (26) and (27), the crucial factors in determining both ε_K and ε_H are the capital share a, the degree of internal returns to scale γ, the extent of the production externality arising from public services x, the extent of relative congestion R, and the extent of absolute congestion A.

Some empirical studies, such as Perry (1973), Shapiro (1986), Bernanke and Parkinson (1991), and Burnside et al. (1995), find that the estimated output elasticity of capital is close to zero and the estimated output elasticity of labor is close to or greater than one. This result is regarded as a puzzle in the RBC literature; see e.g., Wen (1998).

The expression reported in equations (26) and (27) provides a plausible vehicle to solve this puzzle. It may, however, be easier to explain our point via numerical simulations. The parameters we utilize are adopted from Baxter and King (1993), Eicher and Turnovsky (2000), and Dos Santos Ferreira and Lloyd-Braga (2008), and are: $a = 0.3$, $x = 0.3$, and $\gamma = 1$. Tables 1 and 2 report the computed values of ε_K and ε_H for the cases of internal constant returns to scale ($\gamma = 1$) and increasing returns to scale ($\gamma = 1.1$), respectively.

Table 1

		A					
		0		0.5		1	
		ε_K	ε_H	ε_K	ε_H	ε_K	ε_H
	0	0.43	1	0.21	1	0	1
R	0.5	0.35	0.82	0.18	0.82	0	0.82
	1	0.30	0.70	0.15	0.70	0	0.70

Parameter values: $a = 0.3$, $x = 0.3$, $\gamma = 1$.

Table 2

		A					
		0		0.5		1	
		ε_K	ε_H	ε_K	ε_H	ε_K	ε_H
	0	0.41	0.96	0.23	0.96	0.04	0.96
R	0.5	0.35	0.81	0.19	0.81	0.03	0.81
	1	0.3	0.70	0.16	0.70	0.03	0.70

Parameter values: $a = 0.3$, $x = 0.3$, $\gamma = 1.1$.

Some interesting observations follow from the results reported in Tables 1 and 2. First, in association with a higher degree of absolute congestion, the output elasticity of capital will decrease in response, while the output elasticity of labor remains intact. As indicated in equation (26), in association with $a = 0.3$, $\gamma = 1$ or 1.1, and $x = 0.3$, $a\gamma - xA$ will decrease in response as A increases. This leads to a decrease in ε_K. Second, when the public service available to the agent is subject to purely proportional absolute congestion (i.e., $A = 1$ and $R = 0$), the output elasticity of capital is close to zero and the output elasticity of labor is close of one. This result can be treated as a plausible vehicle to explain the puzzle mentioned above. Third, in association with a higher degree of internal increasing returns to scale, the output elasticity of labor will decrease in response.

Summing up the above discussion, we can establish the following proposition:

Proposition 1. ***Under the situation where public services are subject to purely proportional absolute congestion, the output elasticity of capital is close to zero and the output elasticity of labor is close to one.***

By substituting equations (8), (21), (22) and (23) into (18), we can obtain the economy-wide resource constraint:

$$\dot{K} = Y - C - G \ . \tag{28}$$

In addition, from equations (15), (16), (21) and (24), we can solve employment for the instantaneous relationship:

$$H = H(K, C), \tag{29}$$

where

$$H_K = \frac{-(a\gamma - xA)H}{[(1-R)x - a\gamma]K},$$

$$H_C = \frac{[\gamma - (1-R)x]H}{[(1-R)x - a\gamma]C}.$$

The main equations of the symmetric equilibrium of the economy can thus be summarized as follows:

$$H = H(K, C), \tag{30}$$

$$Y = \psi\left[K^{a\gamma - xA} H^{(1-a)\gamma}\right]^{\frac{1}{\gamma-(1-R)x}}, \tag{31}$$

$$\dot{K} = (1-\tau)Y - C, \tag{32}$$

$$\dot{C} = [(1-\tau)\frac{aY}{K} - \rho]C\,, \tag{33}$$

$$G = \tau Y\,. \tag{34}$$

The macroeconomic model expressed in equations (30)-(34) determines five endogenous variables H, Y, K, C, and G.

3.3 Macroeconomic Indeterminacy

Substituting equations (30) and (31) into (32) and (33), the dynamic system of the economy can be expressed as:

$$\dot{K} = (1-\tau)\psi K^{\frac{a\gamma - xA}{\gamma-(1-R)x}} H^{\frac{(1-a)\gamma}{\gamma-(1-R)x}} - C\,, \tag{35}$$

$$\dot{C} = \left\{(1-\tau)a\psi K^{\frac{a\gamma - xA}{\gamma-(1-R)x}-1} H^{\frac{(1-a)\gamma}{\gamma-(1-R)x}} - \rho\right\} C\,. \tag{36}$$

Let $\widetilde{K}$ and $\widetilde{C}$ be the stationary values of K and C. Then, linearizing equations (35) and (36) around the steady-state equilibrium yields:

$$\begin{bmatrix}\dot{K}\\ \dot{C}\end{bmatrix} = \begin{bmatrix}J_{11} & J_{12}\\ J_{21} & J_{22}\end{bmatrix}\begin{bmatrix}K-\widetilde{K}\\ C-\widetilde{C}\end{bmatrix}, \tag{37}$$

where

$$J_{11} = \frac{(1-\tau)(a\gamma - xA)\widetilde{Y}}{[\gamma-(1-R)x]\widetilde{K}} + \frac{(1-\tau)(1-a)\gamma\widetilde{Y}H_K}{[\gamma-(1-R)x]\widetilde{H}}\,,$$

$$J_{12} = \frac{(1-\tau)(1-a)\gamma\widetilde{Y}H_C}{[\gamma-(1-R)x]\widetilde{H}} - 1\,,$$

$$J_{21} = \frac{(1-\tau)a\widetilde{C}\widetilde{Y}}{\widetilde{K}^2}\left[\frac{(a\gamma - xA)}{[\gamma-(1-R)x]} - 1\right] + \frac{(1-\tau)a(1-a)\gamma\widetilde{C}\widetilde{Y}H_K}{[\gamma-(1-R)x]\widetilde{K}\widetilde{H}}\,,$$

$$J_{22} = \frac{(1-\tau)a(1-a)\gamma\widetilde{C}\widetilde{Y}H_C}{[\gamma-(1-R)x]\widetilde{K}\widetilde{H}}\,.$$

From equation (37), we can infer the trace and determinant of the Jacobian:

$$Tr(J) = \frac{(1-\tau)(xA - a^2\gamma)\widetilde{Y}}{\Omega\widetilde{K}}\,, \tag{38}$$

$$Det(J) = \frac{(1-\tau)a\widetilde{C}\widetilde{Y}\left[\gamma - (a\gamma - xA) - (1-R)x\right]}{\Omega\widetilde{K}^2}\,, \tag{39}$$

where

$$\Omega = (1-R)x - \gamma[1-(1-a)]\,.$$

3.3.1 The condition for indeterminacy

As addressed in the literature on dynamic rational expectations models (for example, Burmeister 1980; Buiter 1984; Turnovsky 2000), for the dynamic system there exists a unique perfect foresight equilibrium solution if the number of unstable (positive) roots equals the number of jump variables. Since C is the only jump variable in this dynamic system, there exists a continuum of equilibrium paths converging to the steady state if the dynamic system has two real negative roots, as argued by Benhabib and Farmer (1994). Therefore, a necessary and sufficient condition for local indeterminacy is that both real roots are negative. As a consequence, the economy is subject to belief-driven fluctuations if and only if the following conditions are satisfied:

$$Tr(J) < 0 \quad \text{and} \quad Det(J) > 0. \tag{40}$$

According to the above discussion, we are able to formulate the following proposition:[44]

Proposition 2. ***The necessary condition for local indeterminacy in the dynamic system requires*** $\Omega = (1-R)x - \gamma[1-(1-a)] > 0$**.**

Proof: It should be noted that **Condition CC** reported in equation (25) imposes the following restriction:

$$0 < \frac{(a\gamma - xA)}{[\gamma - (1-R)x]} < 1$$

This implies $\gamma - (a\gamma - xA) - (1-R)x > 0$. Inserting this restriction into equation (39), we can infer that local indeterminacy emerges when the determinant value of the Jacobian is positive, that is, $\Omega = (1-R)x - \gamma[1-(1-a)] > 0$.□

It is clear that the necessary condition for local indeterminacy is totally unrelated to the extent of the monopoly power. However, it is closely related to the following factors: the capital share a, the degree of internal returns to scale γ, the extent of the production externality arising from public services x, and the extent of relative congestion R. We then in turn examine how the possibility of local indeterminacy

[44] As documented by Guo and Lansing (2007, p. 156), "a necessary (but not sufficient) condition for local indeterminacy requires that the equilibrium wage-hours locus is positively sloped and steeper than the labor supply curve". Based on such cognition, in the following analysis we only focus on the necessary condition.

is related to each of these factors.[45]

3.3.2 Economic intuition for indeterminacy

We first discuss the linkage between the possibility of local indeterminacy and the extent of monopoly power. In an earlier paper, Benhabib and Farmer (1994) incorporate internal increasing returns at the level of the intermediate firm in a monopolistic competition market structure without free entry. Their analysis indicates that the condition for local indeterminacy crucially depends upon the extent of the monopoly power. In addition, Chang et al. (2011) consider an endogenous entry under monopolistic competition and conclude that local indeterminacy can occur with an empirically plausible degree of increasing returns provided that the degree of monopoly power is large. Departing from their analysis, our study allows for endogenous entry and distinguishes returns to specialization from monopoly power. With this specification, we find that the necessary condition for local indeterminacy is independent of monopoly power.[46]

The independent result between monopoly power and local indeterminacy can be explained intuitively. It is well known in the literature on imperfect competition, see e.g., Coto-Martínez (2006), that a higher degree of monopoly power tends to generate more monopoly profits for firms and hence increases the lifetime income of households.[47] By way of this so-called feedback effect from monopoly profits to the household's behavior, the degree of monopoly power can govern the transitional dynamics of the economy. Once a firm's free entry is allowed, it will result in a zero-profit condition in equilibrium. Zero monopoly profits imply that the feedback effect from monopoly profits on the household's behavior is cut off. As a consequence, the condition for local indeterminacy is independent of the monopoly power.[48]

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[45] In what follows, to satisfy both the necessary and sufficient condition for local indeterminacy we impose the constraint for a relatively smaller absolute congestion, i.e., $A < a^2\gamma / x$. Obviously, when we exclude absolute congestion from our model (i.e., $A = 0$), the constraint is automatically satisfied.

[46] By differentiating the necessary condition for local indeterminacy Ω with respect to λ, we have:

$$\frac{\partial \Omega}{\partial \lambda} = \frac{\partial \{(1-R)x - \gamma[1-(1-a)]\}}{\partial \lambda} = 0 .$$

[47] In their static model with imperfect competition, Dixon (1987) and Startz (1989) also show that a higher degree of monopoly power is associated with more monopoly profits for firms, thereby leading to a rise in the disposable income for households.

[48] This is also the reason why Startz (1989) concluded that the long-run output effect is independent of

The above discussion leads to the following proposition:

Proposition 3. ***In a one-sector RBC model with monopolistic competition and free entry, the necessary condition for equilibrium indeterminacy is independent of the monopoly power.***

We then deal with the interrelation between the possibility of local indeterminacy and the extent of production externalities from the public sector. In their recent paper, to highlight the role of production externalities from the public sector, Guo and Harrison (2008) assume that all internal returns to scale and relative congestion are absent (i.e., $\gamma = 1$ and $R = 0$). Substituting $\gamma = 1$ and $R = 0$ into the necessary condition for local indeterminacy yields:

$$\Omega\,(\gamma = 1, R = 0) = x - a\,. \tag{41}$$

Equation (41) reveals the main finding in Guo and Harrison (2008): when government spending is financed with a fixed tax rate, the economy displays equilibrium indeterminacy if production externalities from the public sector are large enough.

However, if public services available to the individual are subject to proportional relative congestion (i.e., $R = 1$), the necessary condition for local indeterminacy will change to:

$$\Omega\,(\gamma = 1, R = 1) = -\,a < 0\,. \tag{42}$$

Equation (42) indicates that the economy displays equilibrium determinacy even if production externalities from the public sector are brought into the picture. This reveals the fact that the introduction of productive government spending no longer provides a vehicle for the occurrence of local indeterminacy if public services available to the individual are subject to proportional relative congestion.[49] The intuition for this result is easy to understand. By incorporating useful government spending into the private production function, the possibility for the emergence of local indeterminacy will increase when public expenditures generate sufficiently strong production externalities. With proportional relative congestion, public services provided by the government are equally shared by all firms. The feature of

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the monopoly power. Similarly, Bénassy (1996) derived the conclusion that output persistence is independent of the monopoly power.

[49] Domenech and Garcia (2002) consider the case of proportional congestion for public goods, while they adopt the specification in the utility function when public expenditures provide a positive preference externality.

a firm's free entry would make the production externalities available to each firm become of trifling importance, and hence the economy always displays equilibrium determinacy even if production externalities from the public sector are present.

The above discussion leads to the following proposition:

Proposition 4. ***In the presence of proportional relative congestion, the equilibrium indeterminacy disappears even if productive government expenditures are incorporated.***

Finally, we would like to deal with how the possibility of local indeterminacy is related to the internal increasing returns to scale γ. In their pioneering paper, by excluding the possibility of firm entry and exit, Benhabib and Farmer (1994) propose that indeterminacy can easily occur provided that internal increasing returns are large enough. Running in sharp contrast to the Benhabib and Farmer (1994) result, this chapter allows for endogenous entry, and finds that a higher degree of internal increasing returns (γ) is more unlikely to result in local indeterminacy when production externalities from the public sector are present.

In the presence of productive government spending (i.e., $x > 0$), from the necessary condition for local indeterminacy we have:

$$\frac{\partial \Omega}{\partial \gamma} = \frac{\partial \left\{(1-R)x - \gamma[1-(1-a)]\right\}}{\partial \gamma} < 0 . \tag{43}$$

Our intuitive explanation for the indeterminacy results in equation (43) is borrowed from Guo and Harrison (2004). For ease of presentation, the Keynes-Ramsey rule reported in equation (36) can be expressed in the following discrete-time form:

$$\frac{C_{t+1}}{C_t} = \frac{(1-\tau)a\psi\left[K_{t+1}^{(a\gamma - xA)} H_{t+1}^{(1-a)\gamma}\right]^{1/[\gamma-(1-R)x]}}{K_{t+1}} - \rho . \tag{44}$$

When the households generate optimistic expectations regarding having a higher future return on physical capital, i.e., the marginal productivity of capital (denoted by MPK) is expected to increase in the future, they will tend to reduce consumption and raise investment today. This in turn will induce a rise of the capital stock in the next period (K_{t+1}). Given that labor and physical capital are complements in production, labor supply in the next period (H_{t+1}) will increase, too. As a result, future consumption C_{t+1} will rise in response. A higher value of future consumption

(C_{t+1}) together with a lower value of current consumption (C_t) will cause the left-hand side of equation (44) to increase.

With a rise in C_{t+1} and a fall in C_t, it is clear from equation (44) that a self-fulfilling equilibrium driven by the agents' optimistic expectations can emerge when the right-hand side of equation (44) increases. As described above, when agents become optimistic, H_{t+1} will rise in response. As such, when faced with a higher degree of internal increasing returns (γ), two conflicting effects will be at work. First, a higher value of γ increases the labor productivity, which is reflected by the term $(1-a)\gamma$ on the right-hand side of equation (44). Second, due to the fact that agents' optimistic expectations create more future consumption demand (C_{t+1}), the number of firms in the next period (N_{t+1}) will increase in response. An increase in the number of firms will cut down factor inputs in production and intensify the relative congestion, thereby leading to a lower degree of a positive effect stemming from productive government spending. This negative induced effect arising from free entry is reflected by the term $1/[\gamma-(1-R)x]$ on the right-hand side of equation (44). In equilibrium, the second effect due to free entry dominates the first effect and, as a result, a higher value of γ is more likely to lead to a fall in the right-hand side of equation (44). As a consequence, a higher value of γ is less likely to result in local indeterminacy.

It should be noted that in Benhabib and Farmer (1994) the number of firms is exogenous, and hence the second effect is excluded. Accordingly, their analysis proposes that a higher value of γ more easily results in local indeterminacy. This is the reason why our result runs in sharp contrast to the Benhabib and Farmer (1994) assertion.

Summing up the above discussion, we can establish the following proposition:

Proposition 5. ***When the production technology of a private firm possesses the feature of internal increasing returns, the possibility for the emergence of local indeterminacy is negatively related to the extent of the internal increasing returns to scale.***

3.4 Conclusion

By allowing for the endogenous entry of producers, this chapter sets up a monopolistically competitive model with productive government expenditure that is subject to the congestion effect. Then, this chapter focuses on the linkage between endogenous entry and the possibility of indeterminacy. Several main results are obtained from the analysis.

First, some existing RBC studies, e.g., Bernanke and Parkinson (1991) and Burnside et al. (1995), find a puzzling fact: the estimated output elasticity of capital is close to zero and the estimated output elasticity of labor is close to or greater than one. By resorting to endogenous entry, this chapter endogenizes the output elasticity of both inputs and provides a plausible way to solve the puzzle. Second, by making a distinction between returns to production specialization and monopoly power, this chapter finds that the necessary condition for equilibrium indeterminacy is independent of the monopoly power. Third, the introduction of productive government spending no longer provides a vehicle for the occurrence of local indeterminacy if public services available to the individual are subject to proportional (relative) congestion. Finally, by allowing for endogenous entry, this chapter asserts that a higher degree of internal increasing returns is associated with a lower possibility for the emergence of indeterminacy when production externalities from the public sector are present. If a firm's endogenous entry and exit is excluded, the reverse result is true.

Chapter 4

What Determines Optimal Fiscal Policies under Imperfect Competition? A Comprehensive Analysis

4.1 Introduction

Recently, externalities have been an important subject of extensive discussion in the field of economic growth. The majority of extant studies concerning market externalities can be classified generally into two aspects, consumption externalities and production externalities. With regard to consumption externalities, Abel (1990) first explores the effect of consumption externalities on asset prices and shows further that consumption habit formation plays an important role in explaining equity premium puzzle. Gali (1994) shows that asset prices and returns in an economy with a keeping-up-with-the-Joneses preference are equivalent to those of an economy with a properly adjusted degree of risk aversion. Garcia-Penalosa and Turnovsky (2008) find that, in a growing economy with heterogeneous agents, the "keeping up with the Joneses" preference results in less inequality than that in an economy without consumption externalities. With regard to production externalities, Romer (1986) proposes production externalities arising from learning by doing and analyzes the effect of production externalities on long-run economic growth. By considering government infrastructure in private production activities, Barro (1990) shows that the economy is able to sustain a balanced growth rate in the presence of productive government spending.

Subsequent studies on externalities pay their attention to the normative analysis, and turn to examine the optimal fiscal policies from the viewpoint of welfare maximization. With respect to consumption externalities, Ljungqvist and Uhlig (2000) show that, if households' preference specification embodies a "keeping up with the Joneses" effect, equilibrium consumption is more likely to result in over-consumption, and as a result, the optimal income tax rate is positive. Similarly, Dupor and Liu (2003) show that an optimal tax rate is positive or negative depending upon a preference exhibiting jealousy or admiration. In contrast to Ljungqvist and Uhlig (2000), Liu and Turnovsky (2005) and Liu and Chang (2011) find that the government uses a consumption tax to correct for the consumption externalities once the consumption tax is an alternative.

With respect to production externalities, by incorporating the congestion effect of productive government spending into the Barro (1990) model, Eicher and Turnovsky (2000) show that the optimal tax rate on capital increases with the degree of the congestion effect. Later on, Gómez (2004) shows that an optimal income tax rate in the first-best optimal equilibrium depends on not only upon the extent of production externalities arising from productive government expenditures, but also the congestion effect. Liu and Turnovsky (2005) introduce learning-by-doing externalities based on the cumulative aggregate capital stock, and show that the optimal tax rate on capital is negative. More recently, by separating government spending into federal and local government spending, Gong and Zou (2011) derive an optimal tax rate (on both federal and local government taxes) is just the sum of the production externalities arising from the federal and local government expenditures. By extending the Barro (1990) model from linear income taxation to nonlinear income taxation, Lai and Liao (2012) show that the Pareto optimality can be achieved in the Barro model if policy instruments for the tax scalar and the extent of the tax progressness/repressiveness are set optimally.

The results of all of above studies are derived in a perfect competition environment. However, by examining U.S. industry data, some empirical studies including Hall (1988, 1991) find that the estimated markup ratio is greater than one. Accordingly, the hypothesis of perfect competition can be treated as a first approximation, but does not reflect reality.

Many recent studies in macroeconomics have focused on macroeconomic policies in the presence of imperfect competition. Till now, to the best of our knowledge, three familiar but distinct types of adjustment mechanisms are now discussed in the literature concerning imperfect competition. The first type allows imperfectly competitive firms to earn positive profits in equilibrium, and hence allows mechanism to highlight the importance of monopoly profits in affecting the relevant macro variables in the economy (e.g., Dixon, 1987; Benhabib and Farmer, 1994; Guo and Lansing, 1999; Chang et al., 2009). The second type emphasizes the role of endogenous monopoly firms, and focuses on the situation where monopolistically competitive firms make zero profits in equilibrium via the channel of free entry and exit of firms (Dixon and Lawler, 1996; Devereux et al., 2000; Chang et al., 2011; Bilbiie et al., 2012). The third type instead highlights the importance of endogenous overhead costs, and pays attention to the situation where monopolistically competitive firms make zero profits in equilibrium via the channel of adjusting overhead costs (Rotemberg and Woodford, 1992; Hornstein, 1993; Kim, 2000).[50]

Compared with existing literature on the normative analysis under imperfect competition, our analysis has the following three distinctive traits. The first trait is the introduction of internal increasing returns to scale stemming from diminishing marginal costs. To the best of our knowledge, until now the linkage between optimal fiscal policies and the extent of internal returns to scale is all but absent in the existing literature. This chapter thus turns the focus and examines what the role played by the extent of internal returns to scale is in determining optimal fiscal policies. The second trait is the simultaneous presence of consumption and production externalities. As such, once the consumption tax and income taxes (on both labor income and capital income) are available to the government, we are able to compare the relative efficiency of these two taxations in correcting both consumption externalities and production externalities. As we will show in this chapter, there exists an appropriate use of consumption tax and income tax for remedying consumption and production distortions. The third trait is the distinct types of adjustment mechanism. The existing imperfect competition studies on optimal fiscal policies either are characterized by a zero-profit condition due to free entry, or alternatively, adopt a constant number of firms in which there exists a positive profit (Guo and Lansing, 1999; Judd, 2002; Coto-Martinez, 2006; Chang et al., 2007). As mentioned above, three different types of adjustment mechanisms (fixed monopoly firms, endogenous monopoly firms, and endogenous overhead costs) are the topics of discussion in the imperfect competition literature debate. This chapter thus tries to create a comprehensive analysis on the interrelation between the optimal fiscal policies and market distortions under three different types of adjustment mechanisms.

[50] See Hornstein (1993) for a detailed discussion.

This chapter is organized as follows. Section 2 describes the model economy. Section 3 examines optimal fiscal policies with an endogenous number of firms. Section 4 examines optimal fiscal policies with endogenous overhead costs. Section 5 examines optimal fiscal policies within the existence of monopoly profits. Section 6 concludes our discussion.

4.2 The Model

The economy under consideration consists of three types of agents: households, firms, and a government. The production environment consists of two sectors: the perfectly competitive final good sector and the monopolistically competitive intermediate goods sector. Suppose that this final good is produced through the use of a range of differentiated intermediate inputs.[51] The households derive utility from consuming the final good and enjoying leisure. Savings are held in the form of physical capital. The balanced-budget government provides infrastructure service that enhances private productivity but is subject to congestion effect.

4.2.1 Firms

Following Bénassy (1998), final output is produced by a perfectly competitive firm with the following technology:

$$Y = N^{\alpha+1-1/\lambda}\left(\int_0^N y_i^{\lambda}\, di\right)^{1/\lambda}, \quad 0 < \lambda < 1, \quad \alpha \geq 0, \tag{1}$$

where y_i represents the quantity of input i used in the production of the final good and N is the total number of intermediate goods. As we will explain later, the parameter λ measures the degree of monopoly of the intermediate good firms, and the parameter α measures the extent of the increasing returns due to production specialization.

If all intermediate goods are hired in the same quantity, namely y, then output is given by $Y = N^{\alpha+1}y$. As a consequence, an expansion in the number of intermediate inputs raises the final goods production if $\alpha > 0$. Thus, the parameter

[51] As stated by Kim (2004), heterogeneous outputs need to be aggregated from a macroeconomic point of view. A conventional specification is introducing an aggregator, such as a firm producing a final good, in the economy.

α reflects the extent of the increasing returns due to production specialization. In their previous studies, Devereux et al. (1996) and Chang et al. (2007) specify that the production function of final output has the following form: $Y = (\int_0^N y_i^{\lambda} di)^{1/\lambda}$, where monopoly power and increasing returns to production specialization (an expansion in variety) are characterized by the same parameter λ. As stressed by Bénassy (1998), the specification of Eq. (1) allows us to incontrovertibly separate returns to production specialization from monopoly power, so that both effects can be fully disentangled.

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

$$\underset{y_i}{Max}\ \pi^f = Y - \int_0^N p_i y_i \, di \,,$$

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

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

Eq. (2) is the demand function for the i th intermediate good which is characterized by a constant price elasticity $1/(1-\lambda)$.

Intermediate good firms operating in a monopolistic market use the capital stock, labor input, and public services provided by the government to produce their product and sell it to the final good firm at the profit-maximizing price. To be more specific, the production technology for the i th intermediate good i can be expressed as:

$$y_i = (k_i^{\beta} h_i^{1-\beta})^{\gamma} (G^S)^{\chi} - \phi ,\ \ 0 < \beta < 1 , \gamma \geq 1 , \chi \geq 0 , \tag{3}$$

where k_i and h_i respectively represent the capital stock and labor input hired by the i th intermediate good producer, G^S refers to the public services available to each firm, β ($1-\beta$) measures the capital (labor) share in the sector of the intermediate good output, γ captures the degree of the production efficiency stemming from diminishing marginal costs, χ captures the extent of the production externalities resulting from the public services, ϕ is an overhead cost.

It should be noted that there are two kinds of internal economies of scale in our model. The first kind of economies of scale stems from the presence of the overhead cost ϕ. Production technology is said to feature increasing returns to scale if $\phi > 0$ and constant returns to scale if $\phi = 0$.[52] More specifically, this kind of internal economics of scale stems from the fact that *diminishing average costs* are exhibited. The higher value of ϕ, the faster average costs would diminish. In fact, this kind of internal economies of scale is a common specification in the existing studies, such as Startz (1989), Devereux et al. (1996, 2000), to mention just a few.

The second one originates from the presence of the degree of *diminishing marginal costs* γ. More precisely, the firm's production technology exhibits internal increasing returns to scale if $\gamma > 1$ and constant returns if $\gamma = 1$. It should be noted that the feature of diminishing marginal costs is an identical concept for economies of scale, and some of existing studies, such as Hornstein (1993), Ambler and Cardia (1998), Weder (2000), Dhawan and Guo (2001) and Dos Santos Ferreira and Lloyd-Braga (2008) have devoted their attention to discussing its role on various topics. As stressed by Kim (2004), the imperfectly competitive environment allows us to discuss the feature of internal increasing returns to scale that is inhibited under a perfectly competitive framework. However, to the best of our knowledge, until now the linkage between optimal fiscal policies and the extent of internal returns to scale is effectively absent in the existing literature on the macroeconomic model with imperfect competition, this chapter thus turns the focus to examine what is the role played by the extent of internal returns to scale in determining optimal fiscal policies.

The public services that are available to the individual firm are given by $G^S = G/K^{\sigma}$, where G is aggregate government expenditure on infrastructure, K is the aggregate capital stock, and σ measures the degree of congestion. The congestion function specified here follows the spirit of a number of studies on a growing economy, including Barro and Sala-i-Martin (1992), Turnovsky (1996) and Agénor (2008). The case of a pure public good is represented by $\sigma = 0$ where government expenditure is non-rival and non-excludable in nature. The other polar

[52] See Costa and Dixon (2011) for a detailed discussion with this feature.

case in association with $\sigma = 1$ corresponds to the scenario where government expenditure is subject to proportional congestion. In addition, government expenditure is subject to partial congestion if $0 < \sigma < 1$. In what follows, we will show that the congestion effect plays an important role in our analysis.

The intermediate good firm i, taking G^S as given, chooses k_i and h_i to maximize its profits, π_i^m. Let w and r respectively denote the market wage and capital rental rate. Based on the demand function reported in Eq. (2) and the production function reported in Eq. (3), the optimization problem of the ith intermediate good producer can be expressed as:

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

$$s.t. \quad y_i = (k_i^{\beta} h_i^{1-\beta})^{\gamma} (G^S)^{\chi} - \phi \;\text{ and }\; p_i = N^{\lambda(\alpha+1-1/\lambda)} y_i^{\lambda-1} Y^{1-\lambda}.$$

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

$$r = \frac{\lambda\beta\gamma p_i (y_i + \phi)}{k_i}, \tag{5}$$

$$w = \frac{\lambda(1-\beta)\gamma p_i (y_i + \phi)}{h_i}. \tag{6}$$

Then, substituting Eqs. (5) and (6) into (4) allows us to derive the profits of the ith intermediate good firm:

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

4.2.2 Households

Consider an economy populated by a unit measure of identical and infinitely-lived households. The representative household derives utility from leisure $1-h$ (h is working time) and the comparison between its own consumption c and the reference level. The reference level is the average value of consumption C in the whole economy. Given that the number of the households is normalized to unity, the average value of consumption is equal to aggregate consumption. As a result, the lifetime utility of the representative household U can then be expressed as:

$$U = \int_0^\infty [\ln(c_t - \theta C_t) + \eta \ln(1-h_t)] e^{-\rho t} dt\,; \;\; \theta \geq 0,\;\; \eta > 0,\;\; \rho > 0, \tag{8a}$$

where ρ represents the constant rate of time preference, θ captures the degree of the consumption externalities resulting from aggregate consumption. When $\theta = 0$, the household derives utility from its own consumption, while $\theta > 0$ captures the consumption externality effect reflecting the psychological feature of jealousy. Under the situation in association with $\theta > 0$, the household preference exhibits the feature of "keeping up with the Joneses" as stressed by Ljungqvist and Uhlig (2000), Dupor and Liu (2003) and Liu and Turnovsky (2005).

The representative household faces the following budget constraint:

$$\dot{k}_t = (1-\tau_l) w_t h_t + (1-\tau_k)(r_t k_t + \Pi_t) - (1+\tau_c) c_t + T_t, \text{[53]} \tag{8b}$$

where $\Pi_t (= \int_0^N \pi_{it}^m\, di)$ is the distributed aggregate profits from firms, τ_l (τ_k) is the labor (capital) income tax rate, τ_c is the consumption tax rate, $T_t > 0\ (< 0)$ is a lump-sum transfer (tax) from the government. The time subscript "t" is omitted for notational simplicity unless the analysis requires it.

Given an initial capital stock K_0, the household seeks to maximize the discounted sum of lifetime utilities reported in Eq. (8a) subject to the budget constraint reported in Eq. (8b), while treating aggregate consumption as given. Accordingly, the optimum conditions for the representative household's problems are:

$$\frac{1}{c - \theta C} = \mu(1+\tau_c), \tag{9a}$$

$$\frac{\eta}{1-h} = \mu(1-\tau_l) w, \tag{9b}$$

$$\frac{\dot{\mu}}{\mu} = \rho - (1-\tau_k) r, \tag{9c}$$

together with Eq. (8b) and the transversality condition $\lim_{t\to\infty} \mu k e^{-\rho t} = 0$, where μ is the shadow price of physical capital.

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

4.2.3 The government

At any point in time, the government adjusts the lump-sum transfer to balance its budget constraint. Accordingly, the government's budget constraint can be expressed as:

$$G + T = \tau_l wH + \tau_k (rK + \Pi) + \tau_c C\,. \tag{10}$$

In order to have a more comprehensive view of an imperfectly competitive market regarding the optimal fiscal policies set by a benevolent government, in the following three sections we will respectively deal with the three distinct situations. First, with free entry and exit in the imperfectly competitive market, the number of the intermediate good firms would adjust once the firm has a positive profit. As such, the number of the intermediate good firms is endogenously determined by the zero-profit condition.[54] Second, to compete with other existing firms and to highlight product differentiation, the intermediate good firm raises the overhead cost (e.g., the advertising cost) once it has a positive profit. As a consequence, the overhead cost is endogenously determined by the zero-profit condition of the intermediate good firm.[55] Third, in departing from the above two situations, we consider the "short-run" situation where the zero-profit condition does not hold and both the number of the intermediate good firms and the overhead cost keep intact. This situation is intended for comparison with other two situations where the zero-profit condition is present.

4.3 Optimal Fiscal Policies with Endogenous Number of Firms

This section deals with the situation wherein, with free entry and exit in an imperfectly competitive market, the number of the intermediate good firms is

[54] Among the the literature, Startz (1989), Devereux et al. (1996, 2000), Blanchard and Giavazzi (2003) and Coto-Martinez and Dixon (2003) focus on this situation.
[55] Rotemberg and Woodford (1992), Hornstein (1993), and Kim (2000, 2004) address this situation.

endogenously determined by the zero-profit condition. We confine the analysis to a symmetric equilibrium under which $p_i = p$, $y_i = y$, $k_i = k = K/N$, and $h_i = h = H/N$ for all i, where H denotes aggregate labor hired by the intermediate good firms. As a result of the zero-profit condition for the final good sector, we obtain:

$$p = N^{\alpha}. \tag{11}$$

Moreover, free entry guarantees zero profits for each intermediate good producer, and the volume of each intermediate good in equilibrium is given by:

$$y = \frac{\lambda\gamma\phi}{1-\lambda\gamma}. \tag{12}$$

It should be noted that the profit maximization problem for the intermediate good firm is not well-defined in a steady state if y is negative (i.e., $1-\lambda\gamma < 0$).[56] Based upon this supposition, in the following analysis we impose the constraint $1-\lambda\gamma > 0$ throughout this chapter. By substituting Eq. (3) into (12), we can derive the equilibrium number of firms:

$$N = \left(\frac{(1-\lambda\gamma)K^{\beta\gamma-\sigma\chi}H^{(1-\beta)\gamma}G^{\chi}}{\phi}\right)^{1/\gamma}. \tag{13}$$

Since the production of the final good is $Y = N^{\alpha+1}y$, the equilibrium number of firms can be written in an alternative form:

$$N = \left(\frac{(1-\lambda\gamma)Y}{\lambda\gamma\phi}\right)^{1/(\alpha+1)}. \tag{14}$$

By inserting Eqs. (13) into (14), we can further obtain the aggregate production function as follows:[57]

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[56] More specifically, the second-order condition for maximum profit does not hold if $1-\lambda\gamma < 0$. See Kim (2004) for a detailed discussion on this point.

[57] To satisfy the common feature of positive marginal productivity of capital, the restriction $(\beta\gamma - \sigma\chi) > 0$ is imposed throughout this paper.

$$Y = \lambda\gamma \left(\frac{1-\lambda\gamma}{\phi} \right)^{(\alpha+1-\gamma)/\gamma} \left(K^{\beta\gamma-\sigma\chi} H^{(1-\beta)\gamma} G^{\chi} \right)^{(\alpha+1)/\gamma} . \tag{15}$$

In addition, the aggregate consistency condition refers to:

$$r = \frac{\beta Y}{K} , \tag{16}$$

$$w = \frac{(1-\beta)Y}{H} . \tag{17}$$

By substituting Eqs. (1), (5), (6), (7), (10) and (11) into (9), we can derive the economy-wide resource constraint:

$$\dot{K} = Y - C - G . \tag{18}$$

4.3.1 The Decentralized Equilibrium

We define the decentralized equilibrium. The decentralized equilibrium is a sequence of allocations $\{c_t, h_{i,t}, k_{i,t}, h_t, k_t, y_{i,t}, C_t, H_t, K_t, Y_t\}_{t=0}^{\infty}$, a sequence of prices $\{w_t, r_t, p_{i,t}\}_{t=0}^{\infty}$, a sequence of available varieties $\{N_t\}_{t=0}^{\infty}$ and a sequence of policies $\{\tau_{c,t}, \tau_{l,t}, \tau_{k,t}, T_t, G_t\}_{t=0}^{\infty}$ such that:

(D1). Households choose $\{c_t, h_t, k_t\}$ to maximize utility subject to Eq. (9) given $\{r_t, w_t, \tau_{c,t}, \tau_{l,t}, \tau_{k,t}, T_t, \Pi_t, C_t\}_{t=0}^{\infty}$.

(D2). Competitive final good firm chooses $\{y_{i,t}\}$ to maximize profits given $\{p_{i,t}\}$.

(D3). Each monopolistic firm $i \in [0, N_t]$ in the intermediate goods sector chooses $\{k_{i,t}, h_{i,t}\}$ to maximize profits given $\{r_t, w_t, G_t^S\}$ such that market demand function $p_{i,t} = N_t^{\lambda(\alpha+1-1/\lambda)} y_{i,t}^{\lambda-1} Y_t^{1-\lambda}$ holds.

(D4). The evolution of $\{N_t\}_{t=0}^{\infty}$ is determined by zero-profit condition.

(D5). The output of the final good production equals the aggregation of the volume of the intermediate good output such that $Y_t = N_t^{\alpha+1-1/\lambda} (\int_0^{N_t} y_{i,t}^{\lambda} di)^{1/\lambda}$.

(D6). The household size is normalized to unity and they consume an average amount in a symmetric equilibrium, thus $C_t = c_t$.

(D7). The capital market clears $K_t = k_t = \int_0^{N_t} k_{i,t} di$.

(D8). The labor market clears $H_t = h_t = \int_0^{N_t} h_{i,t} di$.

(D9). The market for final goods clears such that $Y_t = C_t + \dot{K}_t + G_t$.

(D10). The lump sum transfer is adjusted to balance the government budget such that $G_t + T_t = \tau_{l,t} w_t H_t + \tau_{k,t}(r_t K_t + \Pi_t) + \tau_{c,t} C_t$.

Accordingly, based on Eqs. (9a), (9b), and (9c), we can show that the equilibrium allocations satisfy:

$$\frac{1}{C - \theta C} = \mu(1 + \tau_c), \tag{19a}$$

$$\frac{\eta}{1 - H} = \mu(1 - \tau_l) w = \frac{\mu(1 - \tau_l)(1 - \beta) Y}{H}, \tag{19b}$$

$$\frac{\dot{\mu}}{\mu} = \rho - (1 - \tau_k) r = \rho - \frac{(1 - \tau_k)\beta Y}{K}. \tag{19c}$$

4.3.2 The Centralized Equilibrium

Subject to the aggregate resource constraint reported in Eq. (18) and social technology: $Y = N^{\alpha+1-\gamma} K^{\beta\gamma - \sigma\chi} H^{(1-\beta)\gamma} G^{\chi} - \phi N^{\alpha+1}$, the social planner internalizes the consumption externalities by setting $c = C$ in the utility function reported in Eq. (8), and seeks to maximize the households' discounted sum of lifetime utilities by choosing C, H, K, G and N.

Solving the planner's optimization problem leads to the following first-order conditions in terms of aggregate variables:

$$\frac{1}{C} = \Psi, \tag{20a}$$

$$\frac{\eta}{1 - H} = \frac{\Psi(1 - \beta)(\alpha + 1) Y}{H}, \tag{20b}$$

$$\frac{\dot{\Psi}}{\Psi} = \rho - \frac{(\beta\gamma - \sigma\chi)(\alpha + 1) Y}{\gamma K}, \tag{20c}$$

$$\frac{\chi(\alpha + 1) Y}{\gamma G} = 1, \tag{20d}$$

$$N = \left(\frac{(\alpha + 1 - \gamma)Y}{\gamma\phi} \right)^{1/(\alpha+1)}, \tag{20e}$$

where Ψ is the corresponding shadow price. One point should be mentioned is that output and the number of firms in the centralized economy is denoted respectively by Y^s and N^s, while output and the number of firms in the decentralized economy is respectively denoted by Y^c and N^c.

4.3.3 Optimal Fiscal Policies

By comparing the systems of the decentralized and centralized economy, we can establish the following proposition regarding the first-best fiscal policies:

Proposition 1. ***Under the situation where the number of the intermediate good firms is endogenously determined by the zero-profit condition, the presence of consumption externalities, production externalities, the congestion effect, and the imperfectly competitive intermediate good market leads to the following optimal tax rates and government expenditure:***

$$\tau_c^* = \frac{\theta}{1-\theta}, \tag{21a}$$

$$\tau_l^* = -\alpha, \tag{21b}$$

$$\tau_k^* = \frac{\sigma\chi(\alpha+1) - \beta\gamma\alpha}{\beta\gamma}, \tag{21c}$$

$$g^* = \frac{(\alpha+1)\chi}{\gamma}. \tag{21d}$$

Proof. Given $G = gY$, we could easily derive the optimal government expenditure to output ratio $g^* = (\alpha+1)\chi/\gamma$ from Eq. (20d). By comparing Eq. (19a) with Eq. (20a), Eq. (19b) with Eq. (20b) and Eq. (19c) with Eq. (20c), respectively, the optimal tax rates on consumption, labor and capital are set in accordance with $\tau_c^* = \theta/(1-\theta)$, $\tau_l^* = -\alpha$ and $\tau_k^* = (\sigma\chi(\alpha+1) - \beta\gamma\alpha)/\beta\gamma$. It should be noted that when the benevolent government implements the optimal fiscal policies τ_c^*, τ_l^*, τ_k^* and g^* to the decentralized economy, we could find that the resulting equilibrium allocations, characterized by Eqs. (18), (19a), (19b) and (19c), satisfy the socially optimal conditions as in Eqs. (18), (20a), (20b) and (20c). That is, the equilibrium consumption, labor hour, capital stock and output level in a decentralized economy is equal to that in a centrally planned economy. This further implies that the condition $\dot{\mu}/\mu = \dot{\Psi}/\Psi$ and $\mu = \Psi$ must be true in the steady state. Moreover, given that the utility function is specified in terms of consumption and leisure, we can infer that the welfare level under the decentralized economy (i.e., the indirect lifetime utility function) is definitely equal to that under the centralized economy.

One point should be mentioned here. The number of firms under the decentralized economy may be different from the centralized economy by inspecting Eqs. (14) and (20e). Based on this result, we may refer to τ_c^*, τ_l^*, τ_k^* and g^* as the Pareto (sub)optimal policies.[58]

We are now in a position to analyze the optimal fiscal policies. Three points related to the optimal ratio of government expenditure $g^*\left(=(\alpha+1)\chi/\gamma\right)$ should be mentioned here. First, in their previous studies, Turnovsky (1996, 2000) and Eicher and Turnovsky (2000) focus on the situation where returns to production specialization are absent ($\alpha = 0$) and firm's production technology exhibits internal constant returns to scale ($\gamma = 1$). As a result, their analysis finds that the optimal ratio of government expenditure is equal to the extent of the production externalities, i.e., $g^* = \chi$.[59] Second, Chang et al. (2007) develop an imperfect competition model

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[58] See Chang et al. (2007) for detailed discussions.

[59] Turnovsky (2009, p. 50) notes that "the optimal fraction of output claimed by the government … should equal the elasticity of output with respect to the government input. This optimality condition is standard across all models. It obtains both in the fixed-employment and elastic labor supply closed economy models, as well as in the fixed-employment small open economy model."

with free entry and use it to explore the optimal fiscal policies. They find that the optimal size of public goods should be set as a relation to the extent of monopoly power. By distinguishing the returns of production specialization from monopoly power, our analysis reveals that the optimal ratio of government expenditure is related to the extent of production specialization rather than the degree of monopoly power. Third, our analytical analysis further finds that the optimal ratio of government expenditure is effective in correcting the inefficiency caused by, in addition to production externalities and the returns of production specialization proposed by the existing literature, internal increasing returns to scale.

The intuition behind the result regarding the optimal ratio of government expenditure can be explained as follows. Under the situation in association with $\gamma = 1$ and $\alpha = 0$, as stated in (20d), the optimal fraction of government expenditure is determined so as to equal the marginal benefits to private production (i.e., marginal social benefits) and the unit resource costs (i.e., marginal social costs) of an additional government expenditure. As a result, the optimal government expenditure is equal to the extent of the externalities on private production (i.e., $g^* = \chi$).

We now turn to discuss the situation in association with $\gamma > 1$ and $\alpha > 0$. Because each unit of government spending decreases one unit of resources, the efficiency condition for determining the optimal size of public goods requires that marginal benefits to private production an additional government expenditure be equal to its unit resource costs (i.e., $\partial Y / \partial G = 1$). Via the channel of free entry and exit, both production specialization and internal increasing returns to scale are closely related to the number of firms, and hence affect the marginal benefits of government expenditure. To be more specific, an expansion in government spending leads to a rise in the number of firms, and the number of firms increases more with a higher extent of production specialization.[60] The more number of firms will intensify the marginal benefits of government spending, and hence the higher optimal ratio of government expenditure is associated with a higher extent of production specialization. In contrast, an expansion in government spending leads to a rise in the number of firms, and the number of firms increases less with a higher degree of internal increasing returns to scale. This will dilute the marginal benefits of government spending, and hence the optimal ratio of government expenditure is inversely related to the degree of internal increasing returns to scale.

Eq. (21a) shows that the first-best tax rate on consumption is positive in the presence of consumption externalities (i.e., $\theta > 0$). The intuition for this result is reminiscent of Liu and Turnovsky (2005). Since the households' utility function captures an externality that is characterized by jealousy, the household in the decentralized economy tends to result in over-consumption compared to the social optimum. In order to correct the undue level of consumption, a tax on consumption should be utilized to remove the distortion. As in Liu and Turnovsky (2005), the consumption tax in our analysis is utilized to correct consumption externalities, which is in sharp contrast to Ljungqvist and Uhlig (2000) who utilize the labor income tax to correct consumption externalities. As a consequence, once a consumption tax is available to the government, in terms of policy efficiency, the consumption tax itself can be used to correct consumption distortion.

Owing to the fact that the production process features increasing returns stemming from production specialization, the firm tends to produce too little final output in the decentralized economy compared to the social optimum. This further

[60] There are increasing returns to an expansion of variety by inspecting Eq. (14). As a result, increases in the number of firms will enhance the effect of government spending on productivity. That is, the effects of government spending are magnified by a coefficient $\alpha + 1$ owing to increasing returns to specialization. See Chang et al. (2007) for more discussion.

leads the firm to employ too little labor input and physical capital compared to the social optimum. In order to correct the undue level of both labor input and physical capital, a subsidy on both labor income and capital income should be utilized to remove the distortion. By making no difference between returns to production specialization and monopoly power, Chang et al. (2007) find that both optimal capital and labor income taxes decrease with monopoly power in the monopolistically competitive market with free entry of firms. This chapter instead makes a distinction between these two factors, and finds that both optimal taxes are related to production specialization rather than monopoly power.[61]

Furthermore, the negative externalities caused by congestion lower the effective productivity of the aggregate capital stock, and none of the firms take into account these externalities when making their optimal decision. Thus, the firm tends to employ too much physical capital compared to the social optimum in the presence of the congestion effect. Based on this, the capital income tax is set in order to remedy the negative externalities of congestion on production. Of particular importance, as we mentioned above, the production process is efficient as well as cost-effective in the individual firm production. This means that the firm hires too little physical capital compared to the social optimum. As a result, in the presence of internal increasing returns to scale (i.e., $\gamma > 1$), a capital subsidy should be taken to encourage the firm to employ more physical capital in the production process.[62]

We are now in a position to deal with the optimal number of firms. We can,

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[61] From Eqs. (21b) and (21c), we can derive the results: $\partial\tau_l^* / \partial\lambda = \partial\tau_k^* / \partial\lambda = 0$.

[62] Let PMP_K denote the "private" marginal products of capital in the decentralized economy, SMP_K denote the "social" marginal products of capital in the centralized economy. Based on Eqs. (19c) and (20c), we can infer that $PMP_K = (1-\tau_k)\beta Y/K$ and $SMP_K = (\alpha+1)(\beta\gamma - \sigma\chi)Y/\gamma K$. As is evident, the presence of internal increasing returns to scale leads to a higher value of SMP_K and drives a wedge between the private and social marginal products of capital. Therefore, a capital subsidy is set to encourage production, given that internal increasing returns to scale exists.

from Eqs. (19a)-(19c) and Eqs. (20a)-(20c), derive the result that the level of output in a decentralized economy Y^c is equal to that in a centralized economy Y^s when the benevolent government implements the optimal fiscal policies τ_c^*, τ_l^*, τ_k^* and g^* to the decentralized economy. Furthermore, we find that the number of firms under the decentralized economy may be different from the centralized economy when the condition $Y^s = Y^c$ is imposed. The result can be described by the following proposition:

Proposition 2. ***When the benevolent social planner implements the optimal fiscal policies τ_c^*, τ_l^*, τ_k^* and g^* in the decentralized economy, free entry in the competitive equilibrium may result in under entry provided that the degree of increasing returns to specialization is relatively strong or the degree of monopoly power is relatively small.***

Let N^c and N^s denote the equilibrium number of firms in the decentralized economy and in the centralized economy, respectively. When the benevolent social planner implements the optimal fiscal policies τ_c^*, τ_l^*, τ_k^* and g^* in the decentralized economy, we derive the result that $Y^s = Y^c$ from Eqs. (19a)-(19c) to Eqs. (20a)-(20c). From Eqs. (14) and (20e), the number of firms in two systems can be alternatively expressed as follows:

$$N^c = \left((1-\lambda\gamma)Y^c / \lambda\gamma\phi\right)^{1/(\alpha+1)}; \quad N^s = \left((\alpha+1-\gamma)Y^s / \gamma\phi\right)^{1/(\alpha+1)}. \tag{22}$$

By comparing N^c with N^s in Eq. (22), we obtain:

$$N^s \gtreqless N^c; \quad \text{if } \alpha+1 \gtreqless 1/\lambda. \tag{23}$$

We now provide the economic reasoning behind Eq. (23). First, under the situation where returns to production specialization are absent $(\alpha = 0)$, free entry results in over-entry related to the social optimum. This finding supports the result proposed by Mankiw and Whinston (1986) who stressed that "the existence of imperfect competition and a business stealing effect always creates a bias toward excessive entry." The reason is that a higher degree of monopoly power results in more profits, and this will in turn attract more number of firms entering the market once the firm's free entry is allowed. As a result, when $\alpha = 0$, free entry results in over-entry from the social optimal standpoint. Second, since the feature of increasing returns to production specialization is essentially a positive externality and none of the agents take into account when making their optimal decision, entry will be more desirable for social efficiency. Based on these two conflicting strength on firm's entry, we can infer that entry is insufficient, rather than excessive, compared to the social optimum if the degree of increasing returns to specialization is relatively strong or the extent of monopoly power is relatively small.[63]

In his earlier study, Kim (2004) indicates that the degree of increasing returns to specialization governs the optimal number of firms. Although our result in Eq. (23) is analogous to Kim (2004), there still exists the difference between Kim (2004) and our model. In Kim (2004), the issue on the number of firms between the competitive equilibrium and the social optimum is conducted in a partial equilibrium framework, and hence ignores the mutual interaction between the goods market and other markets. However, this chapter develops a general-equilibrium macroeconomic framework embodying a solid micro-foundation for the behavioral functions. Equipped with the feature, our analysis provides a new insight to the excessive entry debate.

Before ending this section, one point should be mentioned. In their previous analyses, Devereux et al. (1996, 2000) and Chang et al. (2011) do not make a distinction between production specialization and monopoly power, and their

[63] By developing a partial equilibrium framework, Bénassy (1996) shows that, in the presence of a consumer's taste for variety, under entry may result in a decentralized economy compared to the social optimum.

specification on parameters implicitly assumes $\alpha = 1/\lambda - 1$. With such a specific assumption, from Eq. (23) we can easily infer that in their framework the number of firms in the decentralized economy is equal to the socially efficient number of firms.

4.4 Optimal Fiscal Policies with Endogenous Overhead Costs

In this section, we deal with the situation where the overhead cost is endogenously determined by the zero-profit condition. To compete with other existing firms and to highlight product differentiation, the intermediate good firm raises the overhead cost (e.g., advertising, marketing and R&D expenditures) once it has a positive profit. As a consequence, the overhead cost is adjusted and endogenously determined by the zero-profit condition. It should be noted that under such a situation the number of firms N is constant.

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. From the zero-profit condition for the final good sector, we obtain:

$$p = N^{\alpha}. \tag{24}$$

Moreover, the zero-profit condition for the intermediate good producer leads to the following result:

$$\phi = \frac{(1-\lambda\gamma)y}{\lambda\gamma}. \tag{25}$$

One point regarding Eq. (25) should be stressed. If we adopt the common assumption in the existing studies on imperfect competition that the overhead cost is constant over time, equilibrium output per firm then remains constant in response. However, as pointed out by Kim (2004), in an actual economy individual firm's output responds to business fluctuations. As indicated in Eq. (25), a plausible way to escape from this deficiency is that the overhead cost is allowed to adjust.[64]

By substituting Eq. (3) into (25), we can derive the equilibrium output level of

[64] See Kim (2004) for a more detailed discussion.

the intermediate good producer:

$$y = \lambda\gamma(k^{\beta}h^{1-\beta})^{\gamma}(G^{S})^{\chi}. \tag{26}$$

Given that aggregate physical capital and aggregate labor input are $K = Nk$ and $H = Nh$, respectively, by inserting Eq. (26) and $G^{S} = G/K^{\sigma}$ into (1), the final good production function can be alternatively expressed as:

$$Y = \lambda\gamma N^{\alpha+1-\gamma}K^{\beta\gamma-\sigma\chi}H^{(1-\beta)\gamma}G^{\chi}. \tag{27}$$

In addition, the aggregate consistency condition refers to:

$$r = \frac{\beta Y}{K}, \tag{28}$$

$$w = \frac{(1-\beta)Y}{H}. \tag{29}$$

By substituting Eqs. (1), (5), (6), (7), (10) and (24) into (8b), the economy-wide resource constraint can be written as:

$$\dot{K} = Y - C - G. \tag{30}$$

4.4.1 The Decentralized Equilibrium

The decentralized equilibrium is defined as a sequence of allocations $\{c_t, h_{i,t}, k_{i,t}, h_t, k_t, y_{i,t}, C_t, H_t, K_t, Y_t\}_{t=0}^{\infty}$, a sequence of prices $\{w_t, r_t, p_{i,t}\}_{t=0}^{\infty}$, a sequence of the overhead cost $\{\phi_t\}_{t=0}^{\infty}$ and a sequence of policies $\{\tau_{c,t}, \tau_{l,t}, \tau_{k,t}, T_t, G_t\}_{t=0}^{\infty}$ such that:

(D1)-(D3). The same as in section 4.3.1.

(D4). The evolution of $\{\phi_t\}_{t=0}^{\infty}$ is determined by zero-profit condition.

(D5)-(D10). The same as in section 4.3.1.

Accordingly, the equilibrium allocations satisfy:

$$\frac{1}{C-\theta C} = \mu(1+\tau_c), \tag{31a}$$

$$\frac{\eta}{1-H} = \mu(1-\tau_l)w = \frac{\mu(1-\tau_l)(1-\beta)Y}{H}, \tag{31b}$$

$$\frac{\dot{\mu}}{\mu} = \rho - (1-\tau_k)r = \rho - \frac{(1-\tau_k)\beta Y}{K}. \tag{31c}$$

4.4.2 The Centralized Equilibrium

Subject to the aggregate resource constraint reported in Eq. (30) and social technology: $Y = N^{\alpha+1-\gamma} K^{\beta\gamma-\sigma\chi} H^{(1-\beta)\gamma} G^{\chi} - \phi N^{\alpha+1}$, the social planner internalizes the consumption externalities by setting $c = C$ in the utility function reported in Eq. (8a), and seeks to maximize the households' discounted sum of lifetime utilities by choosing C, H, K, G and ϕ.

Solving the planner's optimization problem leads to the following first-order conditions in terms of aggregate variables:

$$\frac{1}{C} = \Psi, \tag{32a}$$

$$\frac{\eta}{1-H} = \frac{\Psi(1-\beta)\gamma Y}{H}, \tag{32b}$$

$$\frac{\dot{\Psi}}{\Psi} = \rho - \frac{(\beta\gamma - \sigma\chi)Y}{K}, \tag{32c}$$

$$\frac{\chi Y}{G} = 1, \tag{32d}$$

$$\phi = 0, \tag{32e}$$

where Ψ is the corresponding shadow price.

4.4.3 Optimal Fiscal Policies

By comparing the systems of the decentralized and centralized economy, we can establish the following proposition regarding the first-best fiscal policies:

Proposition 3. ***Under the situation where the overhead cost is endogenously determined by the zero-profit condition, the presence of consumption externalities, production externalities, the congestion effect, and the imperfectly competitive intermediate good market leads to the following optimal tax rates and government expenditure:***

$$\tau_c^* = \frac{\theta}{1-\theta}, \tag{33a}$$

$$\tau_l^* = 1-\gamma, \tag{33b}$$

$$\tau_k^* = \frac{\sigma\chi - \beta(\gamma - 1)}{\beta}, \tag{33c}$$

$$g^* = \chi. \tag{33d}$$

Proof. Given $G = gY$, we could easily derive the optimal government expenditure to output ratio $g^* = \chi$ from Eq. (32d). By comparing Eq. (31a) with Eq. (32a), Eq. (31b) with Eq. (32b) and Eq. (31c) with Eq. (32c), respectively, the optimal tax rates on consumption, labor and capital are set in accordance with $\tau_c^* = \theta/(1-\theta)$, $\tau_l^* = 1-\gamma$ and $\tau_k^* = (\sigma\chi - \beta(\gamma-1))/\beta$. It should be noted that when the benevolent government implements the optimal fiscal policies τ_c^*, τ_l^*, τ_k^* and g^* to the decentralized economy, we could find that the resulting equilibrium allocations, characterized by Eqs. (30), (31a), (31b) and (31c), satisfy the socially optimal conditions as in Eqs. (30), (32a), (32b) and (32c). That is, the equilibrium consumption, labor hour, capital stock and output level in a decentralized economy is equal to that in a centrally planned economy. This further implies that the condition $\dot{\mu}/\mu = \dot{\Psi}/\Psi$ and $\mu = \Psi$ must be true in the steady state. Moreover, given that the utility function is specified in terms of consumption and leisure, we can infer that the welfare level under the decentralized economy (i.e., the indirect lifetime utility function) is definitely equal to that under the centralized economy.[65]

The economic intuition concerning the optimal ratio of government expenditure is straightforward. Owing to the fact that each unit of government spending decreases one unit of resources, the efficiency condition for determining the optimal size of public goods requires that marginal benefits to private production of an additional government expenditure is equal to its unit costs (i.e., $\partial Y/\partial G = 1$). In the absence of free entry and exit, we can infer from Eq. (27) that the optimal condition

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[65] Owing to the fact that the overhead costs under the decentralized economy may be different from the centralized economy by inspecting Eqs. (24) and (32e), we may refer to τ_c^*, τ_l^*, τ_k^* and g^* as the Pareto (sub)optimal policies as before.

can be alternatively expressed by $g^* = \chi$. This optimal rule is previously proposed by Turnovsky (1999) and Eicher and Turnovsky (2000).

Eq. (33a) shows that the first-best tax rate on consumption is positive in the presence of consumption externalities. Accordingly, once the consumption tax is available to the government, the consumption tax can be used to correct consumption distortion. Because the economic intuition behind the result is similar to that in Proposition 1, we omit the discussion here.

Owing to the distortion arising from internal increasing returns to scale (i.e., $\gamma > 1$), the firm produces too little final output in the decentralized economy compared to the social optimum. As a result, the firm tends to employ too little labor input compared to the social optimum. Accordingly, the undue level of labor input calls for a subsidy on labor income.

Furthermore, owing to the fact that the number of firms is constant, the distortion arising from production specialization does not exhibit. Accordingly, in comparison with Eq. (21c), Eq. (33c) reveals that the optimal capital income tax is independent with the extent of production specialization (α). Moreover, similar to Eq. (21c), Eq. (33c) indicates that the optimal capital income tax (subsidy) is crucially related to the degree of internal returns to scale (γ) and the congestion effect of public goods (σ). The economic reasoning behind the result is similar to that in Proposition 1, so there is no need to repeat this here.

4.5 Optimal Fiscal Policies with the Existence of Monopoly Profits

In a departure from the discussion in the previous two sections, this section deals with the situation that the zero-profit condition is not imposed. By so doing, our analysis is able to provide a profound understanding on the relationship between the existence of monopoly profits and the optimal fiscal policies. Under this situation the number of firms is constant and normalized to unity since the firm’s free entry and exit is not allowed. We confine the analysis to a symmetric equilibrium under which $p_i = p$, $y_i = y$, $k_i = k = K$, and $h_i = h = H$ for all i. From the zero-profit condition of the final good sector, we obtain:

$$p = 1. \tag{34}$$

Furthermore, the profits in the intermediate sector are given by:[66]

$$\Pi = (1-\lambda\gamma)Y \,. \tag{35}$$

We can further obtain aggregate production function as follows:

$$Y = K^{\beta\gamma-\sigma\chi} H^{(1-\beta)\gamma} G^{\chi} \,. \tag{36}$$

Based on above results, we can derive the equilibrium rental rate and real wage from Eqs. (5) and (6):

$$r = \frac{\lambda\beta\gamma Y}{K} \,, \tag{37}$$

$$w = \frac{\lambda(1-\beta)\gamma Y}{H} \,. \tag{38}$$

By substituting Eqs. (1), (10), (35), (37) and (38) into (8b), the economy-wide resource constraint can be written as:

$$\dot{K} = Y - C - G \,. \tag{39}$$

4.5.1 The Decentralized Equilibrium

We define the decentralized equilibrium. The decentralized equilibrium is a sequence of allocations $\{c_t, h_{i,t}, k_{i,t}, h_t, k_t, y_{i,t}, C_t, H_t, K_t, Y_t\}_{t=0}^{\infty}$, a sequence of prices $\{w_t, r_t, p_{i,t}\}_{t=0}^{\infty}$, a sequence of profits $\{\Pi_t\}_{t=0}^{\infty}$ and a sequence of policies $\{\tau_{c,t}, \tau_{l,t}, \tau_{k,t}, T_t, G_t\}_{t=0}^{\infty}$ such that:[67]

(D1)-(D3). The same as in section 4.3.1.

(D4). The evolution of $\{\Pi_t\}_{t=0}^{\infty}$ is determined by total revenue minus total cost.

(D5)-(D10). The same as in section 4.3.1.

Accordingly, the equilibrium allocations satisfy:

$$\frac{1}{C-\theta C} = \mu(1+\tau_c) \,, \tag{40a}$$

$$\frac{\eta}{1-H} = \mu(1-\tau_l)w = \frac{\mu(1-\tau_l)\lambda(1-\beta)\gamma Y}{H} \,, \tag{40b}$$

[66] We omit the overhead cost to simplify the model here since we do not need to impose the zero-profit condition to endogenously derive the number of firms or overhead cost. However, we would derive the same result even if the overhead cost is introduced.

[67] The conditions (D1)-(D3) and (D5)-(D10) from the definition of decentralized equilibrium are identical to that of the section 4.1.

$$\frac{\dot{\mu}}{\mu} = \rho - (1-\tau_k)r = \rho - \frac{(1-\tau_k)\lambda\beta\gamma Y}{K}. \tag{40c}$$

4.5.2 The Centralized Equilibrium

Subject to the aggregate resource constraint reported in Eq. (39) and social technology reported in Eq. (36), the social planner internalizes the consumption externalities by setting $c = C$ in the utility function reported in Eq. (8a), and seeks to maximize the households' discounted sum of lifetime utilities by choosing C, H, K and G.

Solving the planner's optimization problem leads to the following first-order conditions in terms of aggregate variables:

$$\frac{1}{C} = \Psi, \tag{41a}$$

$$\frac{\eta}{1-H} = \frac{\Psi(1-\beta)\gamma Y}{H}, \tag{41b}$$

$$\frac{\dot{\Psi}}{\Psi} = \rho - \frac{(\beta\gamma - \sigma\chi)Y}{K}, \tag{41c}$$

$$\frac{\chi Y}{G} = 1, \tag{41d}$$

where Ψ is the corresponding shadow price.

4.5.3 Optimal Fiscal Policies

By comparing the systems of the decentralized and centralized economy, the following proposition summarizes these first-best fiscal policies:

Proposition 4. ***Under the situation where the zero-profit condition is not binding, the presence of consumption externalities, production externalities, the congestion effect, and the imperfectly competitive intermediate good market leads to the following optimal tax rates and government expenditure:***

$$\tau_c^* = \frac{\theta}{1-\theta}, \tag{42a}$$

$$\tau_l^* = \frac{\lambda - 1}{\lambda}, \tag{42b}$$

$$\tau_k^* = \frac{\sigma\chi - \beta\gamma(1-\lambda)}{\lambda\beta\gamma}, \tag{42c}$$

$$g^* = \chi. \tag{42d}$$

Proof. Given $G = gY$, we could easily derive the optimal government expenditure to output ratio $g^* = \chi$ from Eq. (41d). By comparing Eq. (40a) with Eq. (41a), Eq. (40b) with Eq. (41b) and Eq. (40c) with Eq. (41c), respectively, the optimal tax rates on consumption, labor and capital are set in accordance with $\tau_c^* = \theta/(1-\theta)$, $\tau_l^* = (\lambda-1)/\lambda$ and $\tau_k^* = \left(\sigma\chi - \beta\gamma(1-\lambda)\right)/\lambda\beta\gamma$. It should be noted that when the benevolent government implements the optimal fiscal policies τ_c^*, τ_l^*, τ_k^* and g^* to the decentralized economy, we could find that the resulting equilibrium allocations, characterized by Eqs. (39), (40a), (40b) and (40c), satisfy the socially optimal conditions as in Eqs. (39), (41a), (41b) and (41c). That is, the equilibrium consumption, labor hour, capital stock and output level in a decentralized economy is equal to that in a centrally planned economy. This further implies that the condition $\dot{\mu}/\mu = \dot{\Psi}/\Psi$ and $\mu = \Psi$ must be true in the steady state. Moreover, given that the utility function is specified in terms of consumption and leisure, we can infer that the welfare level under the decentralized economy (i.e., the indirect lifetime utility function) is definitely equal to that under the centralized economy.

The same as Proposition 3, Eq. (42d) indicates that, with the constant number of firms, the optimal ratio of government spending is $g^* = \chi$. Since the economic intuition for this result is the same as that in Proposition 3, we do not repeat it here. Moreover, Eq. (42a) shows that the first-best tax rate on consumption is positive in the presence of consumption externalities. The economic intuition behind the result is similar to that in Propositions 1 and 3, so we omit the discussion here.

As reported in Eqs. (42b) and (42c), running in sharp contrast to the above two sections, the optimal taxes on both capital income and labor income is crucially related to monopoly power. The economic reasoning for this result can be explained as follows. The distortion created by the presence of monopoly power (i.e., $\lambda < 1$) drives a wedge between the private and social marginal product of factors. To be more precise, the existence of monopoly profits leads to a lower wage rate and rental rate and results in a lower level of both labor input and physical capital in the decentralized economy compared to the social optimum. In order to correct the undue level of both production inputs capital, a subsidy on both labor and capital income should be utilized to remove the monopoly inefficiency.

Furthermore, similar to the previous two situations, Eq. (42c) reveals that the optimal capital income tax (subsidy) is related to the degree of internal returns to scale (γ) and the congestion effect of public goods (σ). Since the economic reasoning behind the result is similar to that in Propositions 1 and 3, we omit the discussion here.

4.6 Conclusion

This chapter sets up a unified imperfectly competitive macroeconomic framework featured with three distinct types of adjustment mechanism (constant monopoly firms, endogenous monopoly firms, and endogenous overhead costs), and uses it to examine how the government implements optimal fiscal policies from the viewpoint of the social optimum. Several main findings emerge from the analysis. First, to correct for the externalities, the consumption tax should be utilized to correct consumption externalities and income tax should be utilized to remedy production externalities. Second, the optimal labor income tax (subsidy) is solely related to the degree of increasing returns to specialization when the number of firms is endogenously determined, while it is solely related to the degree of internal increasing returns to scale when the overhead cost is endogenously determined. Under the situation where the number of firms remains constant and the zero-profit condition does not hold in the short run, the optimal labor income tax (subsidy) is solely related to the degree of monopoly power. However, the optimal capital income tax (subsidy) is related to not only the degree of monopoly power but also the internal returns of scale as well as the congestion effect. Third, when government expenditure is productive, the optimal ratio of government expenditure is determined solely by the extent of production externalities if the number of firms is constant, while the result should be modified if free entry and exit of firms is taken into the picture. Fourth, free entry in the competitive equilibrium may result in under entry, provided that the degree of increasing returns to specialization is relatively strong or the extent of monopoly power is relatively small. In sum, the extent of consumption and production externalities would vary under three different adjustment mechanisms, and in turn leads the government to implement different fiscal policies for correcting the different extent of distortions. This result reveals that the types of adjustment mechanisms play a crucial role in determining optimal fiscal policies.

Chapter 5

Conclusion

This thesis includes three essays on real business cycle models under imperfect competition. The first essay studies the long-run effects of fiscal policy and the dynamic behavior of the economy in a market characterized by monopolistic competition with free entry. By introducing the viewpoint of industry organization, this essay is equipped with two distinctive features: first, we specify a generalized form of returns to production specialization; and, second, we suppose that the start-up cost is positively related to the number of firms. With these outstanding devices, we establish several interesting results. First, our analysis shows that the degree of returns to specialization and the congestion effect of the start-up cost are both key factors governing the condition of local indeterminacy. Second, the private consumption and real wage increase or decrease in response to an expansion in government spending, depending on whether the aggregate production function is featured with increasing returns or decreasing returns to production specialization. Finally, when the start-up cost is subject to the congestion effect, output per firm in the intermediate goods sector is pro-cyclical in relation to aggregate output. This result is confirmed by Basu (1995) who finds that the quantities of intermediate goods used should be pro-cyclical.

Empirical evidence proposed by Chirinko and Fazzari (1994) supports the feature of internal increasing returns in the firm's production due to economies of scale. Based on this, in the second essay, we introduce internal increasing returns to scale in the production of intermediate goods. In order to compare the results with those of Guo and Harrison (2008) and Chang et al. (2011), we consider productive government spending that is subject to the congestion effect and make a distinction between returns to production specialization and monopoly power. By allowing for endogenous entry in a market characterized by monopolistic competition, we derive several important results. First, in the case where public services are subject to purely proportional absolute congestion, the output elasticity of capital is close to zero and the output elasticity of labor is close to one. This result is confirmed by Wen (1998) who stresses that "the estimated elasticity of capital is near zero and that of labor is near or greater than one." Second, in sharp contrast to the Chang et al. (2011) result, the necessary condition for equilibrium indeterminacy is independent of the monopoly power. Third, in the case of proportional (relative) congestion, the necessary condition for equilibrium indeterminacy is independent of the elasticity of the productive government expenditure. This result runs in sharp contrast to the Guo and Harrison (2008) assertion. Finally, when the production technology of the private sector exhibits internal increasing returns, the existence of internal increasing returns exerts downward pressure on the possibility of local indeterminacy.

In the third essay, we will focus our attention on the normative aspects. It is well-known that market distortions, such as externalities and market imperfection, create market failures. Thus, the inefficiency can be modified by the optimal fiscal policies so that agents in the decentralized equilibrium will behave in a first-best way. However, this may not be totally true. By introducing three differential types of adjustment mechanism being discussed in the imperfect competition literature, we show that different fiscal policies, including a consumption tax, capital income tax, labor income tax, and government expenditure, play a distinct role in terms of remedying market distortions. In particular, it is more important to stress that adjustment mechanisms crucially govern the design of optimal fiscal policies. As our results show, in the presence of consumption and production externalities, an optimal consumption tax is utilized to correct the consumption distortion and is identical in three distinct scenarios, while the optimal income taxes (on both labor income and capital income) are utilized to correct the production distortion. In particular, three different types of adjustment mechanisms crucially govern the implementation of the optimal labor and capital income taxes. Moreover, when the government spending provides productive services, the optimal ratio of government expenditure is solely determined by the extent of production externalities if the number of firms is constant, while the result should be modified if the free entry and exit of firms is taken into account. Finally, compared with the excess entry theorem, free entry in the competitive equilibrium may result in under entry instead of over entry, provided that the degree of increasing returns to specialization is sufficiently strong.

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