Structural Change and Economic Dynamics 41 (2017) 1–12

Contents lists available at ScienceDirect

Structural Change and Economic Dynamics

journal homepage: www.elsevier.com/locate/sced

Population growth and trade patterns in semi-endogenous growth economies

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ARTICLE INFO

Article history:
Received 30 April 2014
Received in revised form 9 July 2016
Accepted 5 January 2017
Available online 12 January 2017

JEL classification:
F10
F43
O11
O41

Keywords:
Semi-endogenous growth model
Trade patterns
Population growth
Per capita consumption growth

ABSTRACT

This paper builds a two-country, two-sector (manufacturing and agriculture), semi-endogenous growth model and investigates the relationship between trade patterns and the growth rate of per capita real consumption. Under free trade, if the home country produces both goods and the foreign country specializes in agriculture, then the per capita growth rates of the home country and foreign country are equalized. By contrast, if the home country specializes in manufacturing and the foreign country specializes in agriculture, then the per capita growth rate of the home country is higher than that of the foreign country.

1. Introduction

This paper builds a two-country, two-sector, semi-endogenous growth model and investigates the relationship between trade patterns and economic growth. We investigate how the per capita growth rate of a country changes depending on the sector in which it specializes.[1]

Other studies have analyzed the relationship between trade patterns and growth.[2] Kaneko (2000) builds a growth model with human capital accumulation and shows that the relationship between the terms of trade and growth depends on whether the country specializes in the consumption goods or the investment goods sector. If the home country specializes in the investment goods sector, its growth rate does not depend on the terms of trade. On the contrary, if the home country specializes in the consumption goods sector, its growth rate does depend on the terms of trade and increases as the terms of trade improve. However, Kaneko (2000) utilizes a small-open-economy model and hence the terms of trade are given exogenously.

Kaneko (2003) builds a two-country, two-sector, AK growth model and endogenizes the terms of trade. The author finds that if a country with a growth rate lower than that of its trade partner under autarky has a comparative advantage in the consumption goods sector, then the country can narrow or even reverse the growth gap by trading with the other country.

Felbermayr (2007) describes the situation where a capital-abundant North and a capital-scarce South trade with each other. In the model, the trade pattern is determined endogenously, while the North produces investment goods and the South produces consumption goods. The production technology of investment goods is determined by an AK model and that of consumption goods is based on a decreasing returns to scale model. Along the balanced growth path (BGP), the South's terms of trade are continuously improving, such that even its decreasing returns to scale can grow at the same rate as the North. Therefore, the South can eliminate the growth gap by trading.

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[1] Our model is one of supply-constrained growth. By contrast, many studies consider demand-constrained growth in an open economy (e.g., Thirlwall, 2011; Pacheco-López and Thirlwall, 2007; Pasinetti, 1993). While these studies investigate the situation where trade between countries is already conducted, our model explicitly considers the structure of comparative advantage and therefore can compare the autarkic situation with the free trade situation.

[2] Wong and Yip (1999) present a small-open-economy, two-sector model of endogenous growth with capital accumulation and learning-by-doing and analyze the relationship between economic growth, industrialization, and international trade.

http://dx.doi.org/10.1016/j.strueco.2017.01.001
0954-349X/

The above studies use scale-growth models in which population size positively affects per capita growth. This assumption, however, seems counterfactual. Jones (1995) attempts to remove the scale effects by presenting a semi-endogenous growth model in which the growth rate of output per capita reacts positively to the population growth rate and not the size of the population. In other words, the higher the population growth rate, the faster the country grows.[3]

In this paper, we build a two-country, two-sector, semi-endogenous growth model in which manufacturing has increasing returns to scale and agriculture has constant returns to scale. We then investigate the relationship between trade patterns, growth, and income gaps between the two countries under free trade in the long run.

We use the semi-endogenous growth model for two reasons. First, we can obtain sustainable per capita income growth even though population growth is strictly positive. Second, we do not need to impose knife-edge conditions on the parameters of the model. To our knowledge, this model differs from most other models in that we explicitly consider population growth. In addition, existing models belong to the AK class of models, and as such, impose knife-edge conditions on the production functions.

In this respect, Sasaki (2011a) builds a semi-endogenous growth, North–South economic development model and shows that along the BGP, both countries grow at the same rate but their per capita incomes grow at different rates because of the differences in population growth. In Sasaki (2011a), the growth rate of per capita consumption in the North may either be increasing or decreasing in Northern population growth, but it is increasing in Southern population growth, and the growth rate of per capita consumption in the South is decreasing in Southern population growth but is increasing in Northern population growth.

However, in Sasaki (2011a), the production pattern is fixed and given exogenously. By contrast, in the present paper, the trade pattern is determined endogenously. This modification has two advantages. First, we can examine whether the assumed trade pattern in Sasaki (2011a)—the low-population-growth North produces only manufactured goods, whereas the high-population-growth South produces only agricultural goods—is sustainable over time. Second, we can compare an autarkic situation with a free trade situation. In particular, we can investigate whether the growth rate of the per capita income of a country increases or decreases when it switches from autarky to free trade.

Our model is based on the small-open-economy model of Christiaans (2008). He extends Wong and Yip's (1999) model to develop a small-open-economy, semi-endogenous growth model in which agriculture has constant returns to scale and manufacturing has increasing returns to scale and examines the dynamics as the economy moves toward a long-run equilibrium. We extend Christiaans' small-open-economy model to a large two-country model. In this respect, Sasaki (2011b) is closely related to the present paper. Based on Christiaans (2008), Sasaki (2011b) builds a two-country, semi-endogenous growth model and investigates the relationship between long-run trade patterns and long-run per capita growth rates. However, the author only considers the case where the population growth rates are equal.

According to our analysis, we find that the difference between the population growth rates of the two countries affects the trade patterns and relationships between the per capita growth of the home country (Home hereafter) and that of the foreign country (Foreign hereafter).

Under autarky, the growth rate of per capita real consumption is higher in the country where population growth is higher than that of the other country, along the BGP. Under free trade, if Home diversifies, that is, produces both goods, and Foreign asymptotically specializes completely in agriculture,[4] then the BGP growth rates of Home and Foreign are equalized, and this trade pattern is sustainable as long as the population growth of Home is higher than that of Foreign. On the contrary, under free trade, if Home specializes completely in manufacturing and Foreign asymptotically specializes completely in agriculture, then the BGP growth rate of Home is higher than that of Foreign, and this trade pattern is sustainable as long as the population growth of Home is lower than that of Foreign.

Therefore, the relationship between population growth and per capita consumption growth differs under autarky and free trade. Moreover, the magnitude of the relationship between the per capita consumption growth of Home and that of Foreign can be reversed under free trade.

We mention the effect on economic growth of population aging, which leads to a decline in population growth. Naito and Zhao (2009) examine how population aging affects trade patterns by formulating a two-country, two-good, two-factor, two-period-lived overlapping generations model in which the two countries are identical except for their exogenous rates of population growth.[5] In their model, good 1 is a capital good that is either invested or consumed, while good 2 is a pure consumption good. Both goods are produced with constant returns to scale production functions. They identify the aging (younger) country as the one with the lower (higher) exogenous rate of population growth and find that the low population growth aging country exports capital-intensive goods.

In our model, as shown later, the younger country with high population growth diversifies and produces manufactured goods, while the aging country with low population growth specializes in agriculture. That is, the younger country exports capital-intensive goods and hence our result is contrary to that of Naito and Zhao (2009). This difference lies in the specification of the production function of the manufacturing (capital goods-producing) sector. While they use a constant returns to scale production function, we adopt an increasing returns to scale production function.

The rest of the paper is organized as follows. Section 2 presents the framework of the model and analyzes the equilibrium under autarky. Section 3 describes the free trade equilibrium corresponding to each trade pattern and investigates whether each trade pattern is sustainable over time. Section 4 compares the growth rates of per capita real consumption under autarky and free trade in both countries. Section 5 concludes the paper.

2. The model

We consider a world that consists of two countries: Home and Foreign. Both countries produce homogeneous manufactured and agricultural goods. The manufactured good is used for both consumption and investment, whereas the agricultural good is used only for consumption.

[3] For a systematic exposition of scale effects and semi-endogenous growth, see Jones (1999, 2005), Aghion and Howitt (2005), and Dinopoulos and Sener (2007). For more sophisticated semi-endogenous growth models, see also Kortum (1997), Dinopoulos and Thompson (1998), Peretto (1998), Segerstrom (1998), Young (1998), Howitt (1999), and Dinopoulos and Syropoulos (2007).

[4] The word "asymptotically" means that the agricultural output converges to zero, but it never vanishes because we assume that Foreign's capital stock is strictly positive. See also Christiaans (2008).

[5] There are very few studies that examine the effect of population aging on economic growth through channels of trade patterns. Naito and Zhao (2009), Sayan (2005), and Yakita (2012) are a few examples.