One of the unsatisfactory aspects of spatial economics is the role ascribed to the agricultural sector. To study how economic activities are impacted by the falling trade costs of manufactured goods, it is convenient to assume that the agricultural sector has only one homogeneous product and that it is traded costlessly. This paper reports how these oversimplified assumptions can be improved and what new results are derived regarding the nonmanufacturing sectors. In particular, we survey how to apply this general-equilibrium approach to clarify the role of trade costs in disclosing some well-known puzzles, including the resource curse, Dutch disease, and transfer paradox.

**KEYWORDS:** spatial economics, agricultural sector, agglomeration, trade cost, trade pattern

**1. Introduction**

Agglomeration or the clustering of economic activity, occurs at many geographical levels, and has a variety of compositions. Spatial economics aims to clarify the economic mechanisms that lead to such phenomena using a general-equilibrium approach. Paul Robin Krugman, winner of the 2008 Nobel Prize in economics, has done a lot of work in analyzing location of economic activity and trade patterns. Focusing on the interaction of increasing returns to scale (IRS), monopolistic competition and trade costs, Krugman’s contributions established two related fields, New Economic Geography (NEG) and New Trade Theory (NTT), studying how regional economy and trade patterns evolve with regional integration and trade globalization.

The main concern of spatial economics is the economic activity in the manufacturing sector, whose production is under IRS and monopolistic competition. To allow for the reaction of production to demand in the IRS sector, many authors add one more (agricultural) sector, in accordance with Helpman and Krugman (1985, Sect. 10.4), characterized by constant returns to scale (CRS), perfect competition, a single homogeneous product, and costless trade. Since labor is the only input of agricultural production, the wages (factor prices) in two countries are equalized. The general equilibrium analysis is simplified by these convenient assumptions of the agricultural sector, which have been the standard for more than three decades. Nevertheless, the assumptions are criticized by some authors. As pointed out by Fujita and Thisse (2013, p. 307), it is hard to see why trading the agricultural good is costless in a model seeking to ascertain the overall impact of trade costs on the location of economic activity. Moreover, it is known that some results need to be revised if such assumptions are removed. Some authors have seriously examined the agricultural transport costs and agricultural labor markets in spatial economics. This paper aims to provide a comprehensive review on these results and shed some light on the latest knowledge and developments in spatial economics.

Fujita et al. (1999, Chapter 7) studied the impacts of agricultural transport costs and the heterogeneity of agricultural goods on agglomeration in NEG. In their qualitative analysis and numerical simulations, transport costs and product heterogeneity in the agricultural sector act as brakes on urban development. A rise in agricultural transport costs fosters dispersion in the manufacturing sector, and a slight differentiation of agricultural goods leads to a dispersing location of manufacturing firms when trade costs of the manufactured goods are small. In their model, consumer preferences are described by a constant elasticity of substitution (CES) function. Because of the analytical intractability in the CES framework, their research is limited to insightful simulation exercises. Using a quasilinear utility, Picard and Zeng (2005) revisit the agricultural sector. They provide an analytical characterization of the location equilibria. Their welfare analysis finds that overurbanization crucially depends on the values of agricultural transport costs and on the firms’ requirement for local unskilled labor.

Davis (1998) questions the costless trade of the agricultural good in a trade model. He finds that there is little suggestion that total trade costs are higher for the differential goods (p. 1269). One important result of Krugman (1980) is that a large country has an advantage in attracting firm location (the so-called home market effect, HME). However, Davis (1998) shows that such an advantage disappears when the trade costs of the agricultural good are as large as the

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trade costs of manufactured goods. His result is generalized by Takatsuka and Zeng (2012a), who find a threshold value of agricultural trade costs. The HME occurs if and only if the agricultural trade costs are below this threshold value so that agricultural trade is allowed, which offsets the trade imbalance in the manufacturing sector. Interestingly, they also show that trade integration in the agricultural sector, rather than in the manufacturing sector, leads to deindustrialization in the smaller country. Their analysis is further extended to the welfare issue. The trade costs in two sectors are shown to have different impacts on welfare in two countries.

Takatsuka and Zeng (2012b) then extend the footloose capital model, which has two production factors (immobile labor and mobile capital), subject to general agricultural trade costs. Surprisingly, no matter how large the agricultural trade costs are, the HME is shown to occur. In fact, the mobile capital generates a channel to offset the trade imbalance of a country. The assumption of costless agricultural trade seems to be innocuous in equilibrium analysis when mobile capital is included. Their result is confirmed by Takahashi et al. (2013), who refine the footloose capital model by removing the agricultural sector, confirming the ubiquity of the HME.

There are other nonmanufacturing sectors besides agriculture. The general-equilibrium approach developed in spatial economics is useful to solve some mysteries in the real world. For example, a “resource curse” is known as a paradoxical situation in which countries with an abundance of natural resources are unable to use that wealth to develop their economies. A similar term, “Dutch disease,” refers to the economic contraction resulting from a rapid development of resources. Of course, such facts are related to government corruption, which happens when proper resource rights and an income-distribution framework are not established in society. Scholars find that some economic mechanisms may lead to such paradoxical situations. For example, based on small open economy models, Corden and Neary (1982) show that a resource boom shifts labor from the manufacturing sector directly and indirectly. On one hand, the resource boom increases demand for labor in the resource sector which directly reduces labor in the manufacturing sector. On the other hand, in the presence of a nontradable sector, the resource boom brings extra revenue to increase the expenditure on nontradable goods. This raises the demand for labor in the nontradable sector and indirectly reduces labor in the manufacturing sector. Their models assume that the resource country is small enough that its policies do not alter world prices, interest rates, or incomes. Equipped with knowledge on agricultural studies in spatial economics, the mechanisms can be explored more deeply and generally. Takatsuka et al. (2015) replace the agricultural sector with the resource sector. They successfully show how these economic mechanisms are related to trade costs in both the resource sector and the manufacturing sector and how governments of resource-based cities can make efficient policies to avoid Dutch disease.

The idea of a nontradable sector can be applied to examine two recent policies in Japan. One is the “Hometown Tax Donations policy” (Furusato Nouzei in Japanese). Under this program, Japanese residents can donate a certain proportion of their income taxes to their favorite towns. The motivation of the Japanese government is to promote regional development by income transfer. However, a transfer paradox — a situation in which a transfer of endowments between two agents results in a welfare loss for the recipient and a welfare gain for the donor — is well-known among economists. Based on a small open economy model, Yano and Nugent (1999) demonstrate that increased production of nontraded goods can change the domestic price so as to offset the benefits of aid and create such a transfer paradox. Morales (2021) uses an NEG model to show that even a slight income transfer between two symmetric regions may deindustrialize the recipient region and reduce the nominal wages of workers in the recipient region when trade costs of the manufactured goods are low.

The second policy is the “Go to Travel” campaign in 2020. The direct motivation of this policy is to promote the tourism sector which has been massively affected by the COVID-19 crisis. This is considered an efficient way to revitalize regional economies. The general-equilibrium approach of spatial economics can also be applied to clarify how the booming of the tourism sector is related to the development of other sectors. This is demonstrated by Zeng and Zhu (2011), who find that a push in the tourism sector needs to be large enough to promote the manufacturing sector.

While a simple agricultural sector makes it easy to focus on the economic activities in the manufacturing sector, a closer look at nonmanufacturing sectors in spatial economics using a general equilibrium approach helps us to know how different sectors interact with each other. One significant result from such works is understanding that the impact of trade costs may not be monotonic. Earlier researchers studied trade policies by comparing autarky and free trade, assuming a monotonic process for intermediate trade costs between them. When the heterogeneity and/or trade costs in the nonmanufacturing sector are incorporated, results in spatial economics show that the intermediate process may not be monotonic.

This paper surveys various models in this respect. Putting them together, we show how they can be applied to analyze interesting phenomena and economic policies. Model analysis becomes more challenging in such frameworks. To introduce some new techniques, this paper provides detailed information about how to exploit implicit functions to gain analytical results, because we agree with Samuelson that mathematics is the natural language with which to understand the economic world. However, due to space limits, we are unable to include some basic results regarding the traditional model of a homogeneous agricultural good which is traded costlessly. Interested readers can find them in Fujita et al. (1999, Chapters 4 and 5) and Fujita and Thisse (2013, Chapters 8 and 9).

The rest of the paper is organized as follows. For convenience of exposition, Sect. 2 first provides a useful result for the popular CES framework. Like the folk theorem in game theory, this result is widely known among spatial
economists but has not yet been sufficiently addressed in the literature. Section 3 introduces the results for the agricultural sector. The first part, Sects. 3.1 and 3.2, focuses on the geography models. Because of the intractability of the CES utility function, Sect. 3.1 reveals the dispersion force of the agricultural sector through some qualitative analysis and numerical simulations. Then we introduce a quasilinear utility framework in Sect. 3.2, which provides full analytical results on the agricultural sector. The second part, Sect. 3.3 addresses trade models. The one-factor models are presented in Sect. 3.3.1, and the two-factor models are summarized in Sect. 3.3.2. Section 4 introduces the application results for resource goods. We demonstrate how spatial economics provides new insights on the resource curse, the transfer paradox, and the effect of booming tourism. Finally, Sect. 5 concludes.

2. A General Result for CES

In a monopolistic competition setup of the manufacturing sector, a continuum of differentiated varieties are produced. Since Dixit and Stiglitz (1977), most papers assume a CES utility representing a composite index of the consumption of all varieties. This leads to the result of constant elasticity of substitution between two varieties and constant price elasticity of demand for each variety. We use \(\frac{1}{\sigma}C_27\) to denote the common elasticity. Then \(\frac{1}{\sigma C_27} = \frac{1}{\sigma}C_0\) represents the intensity of the preferences for variety in the manufacturing sector.

Let \(Q(p)\) be the demand function (of a region or a country) for a variety with price \(p\), and let \(p(Q)\) be the inverse demand function. The property of constant price elasticity of demand is written as

\[
\frac{1}{\sigma}C_27 = \frac{1}{\sigma}C_0 p Q p_0(Q).
\]

On the production side, a variety is produced by a unique firm with a fixed input of \(C_f\) and a marginal input of \(C_m\). Under the market-clearing condition, the net profit of this firm is

\[
\pi = Q p(Q) - C_f - C_m Q.
\]

The firm chooses the optimal quantity to maximize the profit, whose first-order condition (FOC) is written as

\[
0 = Q p'(Q) + p - C_m = -\frac{p}{\sigma} + p - C_m,
\]

where (2.1) is applied in the last equality. Thus, the equilibrium price is

\[
p = \frac{\sigma}{\sigma - 1}C_m.
\]

Accordingly, the markup is a constant \(\sigma/(\sigma - 1) = 1/\rho\) in the market equilibrium.

The net profit is, therefore,

\[
\pi = (p - C_m)Q - C_f = \frac{C_m Q}{\sigma - 1} - C_f.
\]

The free-entry condition implies a zero net profit. Thus, we have

\[
\frac{C_f}{C_m Q} = \frac{1}{\sigma - 1}.
\]

Namely, the ratio of fixed cost to variable cost is a constant \(1/(\sigma - 1)\). Accordingly, the equilibrium output of each firm is

\[
Q = \frac{(\sigma - 1)C_f}{C_m}.
\]

The above results are summarized as follows.

**Lemma 2.1 (Constant ratios of a CES setup).** In a CES monopolistic competition framework, the markup is \(1/\rho\). The ratio of the fixed cost to the sales revenue is a constant \(1/\sigma\), and the ratio of the variable cost to the sales revenue is a constant \((\sigma - 1)/\sigma\). Furthermore, the output of each variety is (2.2).

Figure 1 illustrates the results of Lemma 2.1. This result is further extended to general additive preferences by Toulemonde (2017). The results of Lemma 2.1 are not limited to the domestic market. Since Krugman (1980), transportation costs have been assumed to take Samuelson’s “iceberg” form in a CES framework. Specifically, in order to deliver one unit of goods produced in one country/region to the other, one needs to ship \(\tau\) units of goods, where \(\tau \geq 1\). A constant fraction of goods, \((\tau - 1)/\tau\), melts away in transit. Thus, to supply foreign customers, the marginal cost become \(\tau C_m\). Since the markup is constant, the consumer price is \((\sigma/(\sigma - 1))\tau C_m\) in the foreign market. In equilibrium, the supply of (2.2) is equal to the summation of the domestic demand and the foreign demand multiplied by \(\tau\).
3. Agricultural Goods

3.1 Studies on economic geography

The earliest study on the role of agricultural transportation costs was conducted by Fujita et al. (1999, Chapter 7). They extended the pioneering work of Krugman (1991) to explicitly include the agricultural transportation costs. Since the setup of Krugman (1991) does not lead to a closed-form solution even for a short-run equilibrium, it was improved as the so-called footloose entrepreneur (FE) model by Forslid and Ottaviano (2003). We here rewrite the analysis of Fujita et al. (1999, Chapter 7) by using the FE model.

In this model, there are two regions (1 and 2) and two kinds of workers. Two regions are symmetric in the sense that they have the same mass \( L \) of unskilled workers who are immobile. The total mass of skilled workers is \( H \), and they are mobile across regions. There are two sectors: manufacturing M and agriculture A. All residents share the same CES preferences

\[
U = M^\mu A^{1-\mu},
\]

where

\[
M = \left[ \int_0^{nw} q(i)^\rho di \right]^{\frac{1}{\rho}}
\]

is the composite manufactured good and \( \mu \in (0, 1) \) is the expenditure share in the M sector, consisting of a continuum of product varieties \( i \in [0, nw] \). As in Sect. 2, parameter \( \rho \in (0, 1) \) represents the love for varieties and \( \sigma = 1/(1 - \rho) \) is the substitute elasticity between any two varieties.

The M sector and the A sector are differentiated by superscripts \( m \) and \( a \). For example, the transportation cost for manufacturing goods is denoted by \( \tau^m \), and the transportation cost for agricultural goods is denoted by \( \tau^a \) when we need to differentiate them. We also use \( \phi^m = (\tau^m)^{1-\sigma} \), which is called the trade freeness of manufactured goods.

The A sector employs unskilled workers only. Forslid and Ottaviano (2003) assume that a homogeneous agricultural good is produced under CRS and perfect competition and transported costlessly so that the wages of unskilled workers in two regions are equal. Since the assumption of free transportation in the A sector is removed here, the wage rates of unskilled workers in two regions are endogenously given and not necessarily equal. They are denoted by \( w_1^a \) and \( w_2^a \).

In the M sector, each variety is produced under IRS, and the market is monopolistic competition. By Lemma 2.1, the equilibrium price and output of each variety in Region \( r = 1, 2 \) are

\[
p_r = w_r^\sigma, \quad q_r = \frac{F\sigma w_r}{w_r^a},
\]

respectively, where \( w_r \) is the wage of skilled workers in Region \( r \). The total mass of firms is \( nw = H/F \). In a short-run equilibrium, firms do not move across regions. Let the firm share in Region 1 be \( \lambda \). Then the price indices of manufactured goods are

\[
P_1 = \left(\frac{H}{F}\right)^{\frac{1}{\sigma}} \left[ \lambda (u_1^a)^{1-\sigma} + (1 - \lambda)(u_2^a)^{1-\sigma}\phi^a \right]^{\frac{1}{1-\sigma}}
\]

\[
P_2 = \left(\frac{H}{F}\right)^{\frac{1}{\sigma}} \left[ \lambda (u_1^a)^{1-\sigma}\phi^m + (1 - \lambda)(u_2^a)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}.
\]

The total incomes in the two regions are

\[
Y_1 = w_1^a L + w_1 \lambda H, \quad Y_2 = w_2^a L + w_2(1 - \lambda)H.
\]

By using (3.3), the market-clearing condition for the manufactured goods in two regions is written as
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In the symmetric equilibrium agricultural transportation is difficult. We can not solve \( V_r \) analytically. Therefore, we use simulations to examine how the roots depend on \( \tau^a \). Figure 2 plots \( \Delta V \) with parameters \( \sigma = 2.5, \mu = 0.6, L = 3, H = 2, \) and \( F = 1 \), and the three curves are for \( \tau^a = 1.0, 1.1, \) and 1.2, respectively.

Figure 2 shows that \( \Delta V \geq 0 \) holds for a sufficiently large \( \phi^m \) when \( \tau^a = 1 \), which reproduces the result of Forslid and Ottaviano (2003). When \( \tau^a \) increases, the full agglomeration is stable only for an intermediate \( \phi^m \). In particular, the full agglomeration is unstable for a large \( \phi^m \). When \( \tau^a \) further increases, the full agglomeration becomes unstable for all \( \phi^m \). In fact, skilled workers in Region 1 are highly encouraged to move to Region 2 to save marginal labor costs when agricultural transportation is difficult.

Second, we examine the break point (the level of trade cost at which symmetry equilibrium becomes unsustainable). In the symmetric equilibrium \( \lambda = 1/2 \), the agricultural good is not traded, so \( u_1^a = u_2^a \) holds. For some accidental

\[
\frac{Fw_1}{u_1^a} = \frac{\mu}{(w_1^a)\gamma} (Y_1P_1^{\gamma-1} + Y_2P_2^{\gamma-1} \phi^m), \quad \frac{\sigma Fw_2}{u_2^a} = \frac{\mu}{(w_2^a)\gamma} (Y_1P_1^{\gamma-1} \phi^m + Y_2P_2^{\gamma-1}).
\]

Solving these, we obtain a closed-form solution for the wage rates of skilled workers in two regions:

\[
w_1 = \frac{L(u_2^a)^{\gamma-1} - \mu}{H(\sigma - \mu)} \times \frac{(u_2^a)^{\gamma-1}(w_1^a + u_2^a)(1-\lambda)\sigma \phi^m + (w_2^a)^{\gamma-1}[u_2^a\sigma(\phi^m)^2 + w_2^a(\sigma - \mu + \mu(\phi^m)^2)](1-\lambda)}{[(u_2^a)^{2\gamma-1}(1-\lambda)^2 + (u_2^a)^{2\gamma-1}L^2][\sigma \phi^m + (w_2^a)^{\gamma-1}\lambda(1-\lambda)(\sigma - \mu + (\sigma + \mu)(\phi^m)^2)]},
\]

\[
w_2 = \frac{L(u_1^a)^{\gamma-1} - \mu}{H(\sigma - \mu)} \times \frac{(u_1^a)^{\gamma-1}(w_1^a + u_2^a)(1-\lambda)\sigma \phi^m + (w_2^a)^{\gamma-1}[w_1^a\sigma(\phi^m)^2 + w_2^a\sigma - \mu + \mu(\phi^m)^2)]\lambda}{[(u_1^a)^{2\gamma-1}(1-\lambda)^2 + (u_2^a)^{2\gamma-1}L^2][\sigma \phi^m + (w_2^a)^{\gamma-1}\lambda(1-\lambda)(\sigma - \mu + (\sigma + \mu)(\phi^m)^2)]}. \tag{3.6}
\]

We analyze a long-run equilibrium in the subsequent part, which is divided according to the heterogeneity in the agricultural sector. In both cases, we choose the unskilled labor in Region 2 as the numéraire so that \( u_2^a = 1 \).

### 3.1.1 Homogeneous agricultural good

Assume that one unskilled worker produces one unit of a regional agricultural good in either region. Therefore, the domestic price of the agricultural good is equal to the wage rate of the local unskilled workers. If two regions produce the same agricultural good, the wages of unskilled workers are determined by the trade pattern in the A sector. Specifically, when Region \( r \) imports the agricultural good from Region \( s \), then \( u_1^a/u_2^a = \tau^a \) holds. If two regions produce agricultural goods by themselves, then the wage ratio of unskilled workers is determined by the trade balance in the M sector. The value of \( u_2^a = u_1^a/w_2^a \) falls in \( [1/\tau^a, \tau^a] \).

Given the nominal wages of (3.6), the real wages (indirect utility) of skilled workers in Region \( r \) are written as

\[
V_r = \mu^a(1-\mu)^{1-\mu}w_rP_r^{-\mu}(u_r^a)\mu-1. \tag{3.7}
\]

Now we are able to pin down some critical variables. First, we calculate the sustain point (the level of trade cost at which full agglomeration becomes sustainable). If all firms agglomerate in Region 1, then Region 1 imports the agricultural good from Region 2 so that \( u_1^a = \tau^a u_2^a \). Then the full agglomeration equilibrium is stable if \( \Delta V(\phi^m) = (V_1 - V_2)_i \geq 0 \). We write the utility differential \( \Delta V \) as a function of \( \phi^m \) to emphasize that it depends on \( \phi^m \).

Unfortunately, we can not solve \( \Delta V(\phi^m) = 0 \) analytically. Therefore, we use simulations to examine how the roots depend on \( \tau^a \). Figure 2 plots \( \Delta V \) with parameters \( \sigma = 2.5, \mu = 0.6, L = 3, H = 2, \) and \( F = 1 \), and the three curves are for \( \tau^a = 1.0, 1.1, \) and 1.2, respectively.

Figure 2 shows that \( \Delta V \geq 0 \) holds for a sufficiently large \( \phi^m \) when \( \tau^a = 1 \), which reproduces the result of Forslid and Ottaviano (2003). When \( \tau^a \) increases, the full agglomeration is stable only for an intermediate \( \phi^m \). In particular, the full agglomeration is unstable for a large \( \phi^m \). When \( \tau^a \) further increases, the full agglomeration becomes unstable for all \( \phi^m \). In fact, skilled workers in Region 1 are highly encouraged to move to Region 2 to save marginal labor costs when agricultural transportation is difficult.

Second, we examine the break point (the level of trade cost at which symmetry equilibrium becomes unsustainable). In the symmetric equilibrium \( \lambda = 1/2 \), the agricultural good is not traded, so \( u_1^a = u_2^a \) holds. For some accidental

![Fig. 2. Sustain point for different \( \tau^a \) values, the case of homogeneous A.](image-url)
moves of skilled workers, the wage of unskilled workers in the destination region rises, which increases the production costs of firms there. As a result, the migrated skilled workers are likely to return to the region of origin, so the symmetric equilibrium is indeed stable for any $\tau^d > 1$. In other words, the break point does not exist for any $\tau^d > 1$.

Remember that the stability of the symmetric equilibrium depends on the trade freeness when $A$ is costlessly traded. However, no matter how small $\tau^d$ is, the costly agricultural trade makes the symmetric equilibrium constantly stable. This peculiar property results from two kinks in the relative wage schedule of unskilled workers: $w_1$ changes nonsmoothly when Region 1 imports $A$ from Region 2 to a constant $1/\tau^d$ when Region 1 exports $A$ to Region 2.

The following facts are observed from the simulations.

**Remark 3.1.** The bifurcation diagram of this core–periphery model is illustrated in Fig. 3. We have at most five equilibria and two of them are unstable, indicated by the broken curves. The symmetric equilibrium is always stable.

Regarding the stability of the symmetric equilibrium, Appendix 7.1 of Fujita et al. (1999) provides a rigorous proof for the Krugman (1991) model, which can be easily rewritten for this FE setup.

### 3.1.2 Heterogeneous agricultural goods

A simple way to remove the kinks in the relative wage schedule of unskilled workers is to differentiate the agricultural goods produced in the two regions. This also makes the results of theoretical studies closer to those of empirical research.

In the utility function of (3.1), the term of $A$ becomes

$$A = \left( A_1^{n-1} + A_2^{n-1} \right)^{\frac{n}{n-1}},$$

where $A_i$ is the consumption of the agricultural good produced in Region $i$.

As in the homogeneous case, we assume that one unskilled worker produces one unit of a regional agricultural good. The agricultural price indices are

$$P_1^a = [(u_1^a)^{1-\eta} + (u_2^a)^{1-\eta}]^{\frac{1}{1-\eta}}, \quad P_2^a = [(u_1^a\tau^d)^{1-\eta} + (u_2^a)^{1-\eta}]^{\frac{1}{1-\eta}}.$$

As in the original FE model, producing a variety in the manufacturing sector requires $F$ skilled workers as the fixed input and $\rho$ unskilled workers as the marginal input. In Region $r$, the total fixed cost is $Hw_r$. Lemma 2.1 implies that the equilibrium price of a local variety is $p_r = w_1^\rho$ and that the total variable cost is

$$L_r^m w_r^\rho = (\sigma - 1)\lambda_r H w_r,$$

where $\lambda_r$ is the firm share in Region $r$ and $L_r^m$ is the total input of unskilled workers in the manufacturing sector in Region $r$. As in (3.4), we also use $\lambda$ for $\lambda_1$ so that $\lambda_2 = 1 - \lambda$.

Meanwhile, the market clearing condition in the two regions is written as

$$L - L_r^m = \frac{1 - \mu}{(w_2^\rho)^\rho} \left[ \frac{Y_1}{(P_1^a)^{1-\eta}} + \frac{Y_2(\tau^d)^{1-\eta}}{(P_2^a)^{1-\eta}} \right].$$
The above result can also be directly derived from (3.11). Thus, we are able to obtain the wage rates of skilled workers in another way:

\[ w_1 = \frac{L}{\lambda H} \frac{C_1}{C_3}, \quad w_2 = \frac{L}{(1 - \lambda) H} \frac{C_2}{C_3}, \]  

(3.10)

where

\[
C_1 = [\mu x^{-1} + (w^2_i)^{-1}] (\sigma - \mu) (w^2_i)^{(r^a)^{-1}} + [(1 - \mu)^2 + \sigma - 1] (w^2_i)^{r^a} + \mu (\mu - 1) w^2_i (r^a)^{-1} - (1 - \mu) \sigma (r^a)^{-1} + (w^2_i)^{-1},
\]

\[
C_2 = [\mu (w^2_i x^{-1})^{-1} + 1] (\sigma - \mu) (r^a)^{-1} + [(1 - \mu)^2 + \sigma - 1] (w^2_i)^{r^a} + \mu (\mu - 1) x^{-1} - \sigma (1 - \mu) (w^2_i)^{-1} [(w^2_i)^{-1} + 1],
\]

\[
C_3 = (\sigma - \mu) [(\sigma - 1) (w^2_i)^{-1} (r^a)^{-1} + (\sigma - \mu) (w^2_i)^{-1} (x^{-1}) (r^a)^{-1} + (w^2_i)^{-1} (\sigma - 2) + (\sigma - 1) (r^a)^{-1}].
\]

Equations (3.6) and (3.10) can be used to pin down \( w_1, w_2, \) and \( w_3 \) (one of the equations is redundant).

In the original FE model, the assumptions of a homogeneous agricultural good and its free trade make the analysis convenient. The agricultural good is chosen as the numéraire so that its price is constant and does not vary with \( \lambda \). In contrast, when agricultural goods are heterogeneous, the wage rates of unskilled workers in two regions vary to balance the labor and goods markets. We have the following result, showing that the regional incomes depend on \( \lambda \) only indirectly through the wage rates of unskilled workers.

**Lemma 3.1.** When the agricultural goods are heterogeneous, the regional incomes and the input of unskilled workers in the manufacturing sector depend on firm share \( \lambda \) only through the wage rates of unskilled workers.

**Proof.** The total income in Region \( r \) is

\[ Y_r = L w^a_r + \lambda H w_r = L \left( w^a_r + \frac{C_r}{C_3} \right), \quad r = 1, 2. \]  

(3.11)

Since \( C_1, C_2, \) and \( C_3 \) do not depend on \( \lambda \) explicitly, we know that the regional incomes change with \( \lambda \) only through \( w^a_r \). The result regarding the input of unskilled workers in the manufacturing sector holds from (3.9) and (3.10).

The whole income \( Y^w = Y_1 + Y_2 \) in this model can be derived as follows. First, let \( \mu^a_r \) be the expenditure share on agricultural good \( A_r, r = 1, 2. \) Then \( \mu^a_1 + \mu^a_2 = 1 - \mu \) holds. The market clearance of agricultural good \( A_r (r = 1, 2) \) gives

\[ \mu^a_r Y^w = (L - L^m) w^a_r, \]

which implies

\[ L^m w^a_r = L w^a_r - \mu^a_r Y^w. \]

Meanwhile, Eq. (3.9) yields

\[ \lambda H w_r = \frac{1}{\sigma - 1} L^m w^a_r = \frac{1}{\sigma - 1} (L w^a_r - \mu^a_r Y^w). \]

Accordingly, we have

\[ Y^w = \frac{1}{\sigma - 1} (L w^a_1 - \mu^a_1 Y^w) + L w^a_1 + \frac{1}{\sigma - 1} (L w^a_2 - \mu^a_2 Y^w) + L w^a_2 \]

\[ = \frac{\sigma}{\sigma - 1} (L w^a_1 + L w^a_2) - (1 - \mu) Y^w, \]

where the last equality is obtained from the fact that \( \mu^a_1 + \mu^a_2 = 1 - \mu \). Consequently, the total income is

\[ Y^w = \frac{\sigma L}{\sigma - 1} (w^a_1 + 1). \]  

(3.12)

The above result can also be directly derived from (3.11).

Because there are two agricultural goods, (3.7) is replaced by

\[ V_r = \mu^a (1 - \mu)^{\eta + \mu} w_r (P^a)^{\mu - 1}. \]

Since we do not have an explicit form for \( w^a_r \), we use simulations to show how firm location evolves regarding \( \phi^a \). To investigate the sustain point, we plot in Fig. 4 three curves of \( \Delta V(\phi^a) = (V_1 - V_2) \eta + 1 \) for parameters \( \mu = 0.6, \sigma = 2, \eta = 3, L = 3, \) and \( H = 2, \) while \( r^a \) is given as 1.0, 1.5, and 2.0.

The curves in Fig. 4 are similar to the case of a homogeneous agricultural good (Fig. 2). When \( r^a \) increases, the
The scope of $\phi^m$ in which the full agglomeration is stable shrinks and finally disappears. However, the case of $\tau^a = 1$ is different. When agricultural goods are differentiated, the full agglomeration is unstable for a large $\phi^m$. This is because the agricultural good of Region 1 cannot be perfectly substituted by the other one, and the agglomerating region suffers high labor costs of both skilled and unskilled workers.

To see the break point, we plot $V(\phi) = \frac{V_1(\phi)}{V_2(\phi)}$ in Fig. 5 with parameters $\mu = 0.6$, $\sigma = 2$, $\eta = 3$, $L = 3$, $H = 2$, $F = 1$, $\tau^a = 1.0$, $\tau^a = 1.5$, and $\tau^a = 2.0$. The symmetric equilibrium $\lambda = 1/2$ is stable if the slope of curve $V(\lambda)$ at $\lambda = 1/2$ is negative. Figure 5 shows that the symmetric equilibrium is unstable for a small $\tau^a$, which is in contrast to the case of a homogeneous agricultural good. When $\tau^a$ increases, the symmetric equilibrium gradually becomes stable.

The sustain-point result is also different. With the same parameters of (3.13), full agglomeration is the only stable equilibrium when $\tau^a = 1$. In contrast, both the full agglomeration and the symmetric equilibria are stable when $\tau^a = 1.5$, while the symmetric equilibrium is the only stable one when $\tau^a = 2$.

The following facts are observed from the simulations.

**Remark 3.2.** A bifurcation diagram of this core–periphery model is illustrated in Fig. 6, where unstable equilibria are drawn as broken curves. Firm location takes the form of dispersion $\rightarrow$ agglomeration $\rightarrow$ redispersion.

Note that two sides of the bifurcation diagram of Fig. 6 are of subcritical pitchfork. A supercritical pitchfork bifurcation is also possible. In fact, the relationship between the break and sustain points depends on parameters. Two panels of Fig. 7 display how the break and sustain points depend on transport costs in two sectors. The left panel uses the parameters of (3.13), while the right panel uses $\sigma = 3$ and $\eta = 60$ to replace the values of $\sigma$ and $\eta$ in (3.13). The sustain point curve is outside the break point curve in the left panel but the opposite relationship is observed in the right panel. Two curves may even cross, in which case, one side is subcritical and the other is supercritical in the bifurcation diagram.
By comparing Remarks 3.1 and 3.2, we know that the heterogeneous agricultural goods play the role of a dispersion force, which is crucial when the trade costs in the manufacturing sector are small.

3.2 Quasilinear preferences

The CES utility function of Sect. 3.1 is helpful in capturing the income effect. The FE model is good enough to provide an analytical solution to the short-run equilibrium; however, it is still not tractable enough in the long-run equilibrium analysis. Remarks 3.1 and 3.2 are based on simulations. Ottaviano et al. (2002) improve the tractability of Krugman (1991) by using a quasilinear utility function to replace the CES preferences, maintaining the love-of-variety structure of preferences. Picard and Zeng (2005) further extend their framework to include the agricultural trade costs. They separate the numéraire from the agricultural goods. The utility function (3.1) is replaced by the following quasilinear utility with a quadratic subutility function:

\[
U(q_0, q^m, q^a) = \mu m \int_0^{q_0} q^m(j) \, dj - \frac{\beta^m - \gamma^m}{2} \int_0^{q_0} (q^m(j))^2 \, dj - \frac{\gamma^m}{2} \left[ \int_0^{q_0} q^m(j) \, dj \right]^2 + \alpha \left( q^a(1) + q^a(2) \right) - \frac{\beta^a - \gamma^a}{2} \left[ (q^a(1))^2 + (q^a(2))^2 \right] - \frac{\gamma^a}{2} [q^a(1) + q^a(2)]^2 + q_0.
\]

There are three kinds of goods in the economy: manufactured, agricultural, and the numéraire. The parameter \( \alpha \) measures the intensity of preferences for the products, \( \gamma \) measures the substitutability between varieties, and the difference \( \beta - \gamma > 0 \) is a proxy for the consumer’s preferences toward product variety. The numéraire good (interpreted as a diamond or gold, which is used for decoration) is homogeneous and produced by nature. The numéraire is initially allocated evenly among workers. Let the quantity given to each individual be \( q_0 \), which is sufficiently large for the equilibrium consumption of the numéraire to be positive for each individual. We assume that the numéraire can be transported between countries costlessly.

Each consumer maximizes his/her utility given his/her budget constraint.
\[
\int_0^{q^0(y)} p^m(j)q^a(j)\text{d}j + p^s(1)q^s(1) + p^s(2)q^s(2) + q_0 = y + \tilde{q}_0, \\
\]

where \(p^\rho(\cdot)\) and \(p^m(\cdot)\) are the consumer prices and \(y\) is the consumer’s income. This implies that each individual consumes all varieties (provided that prices are small enough, which is assumed below).

Denote \(p^m_s(\cdot)\) and \(q^m_s(\cdot)\) as the price of and the demand for varieties produced in Region \(r \in \{1, 2\}\), respectively, and consumed in Region \(s \in \{1, 2\}\). In the agricultural sector, we imagine that rice is produced in Region 1 while potatoes are produced in Region 2. Since each region only produces one agricultural good, we have \(q^m_1(2) = q^m_2(2) = q^m_2(1) = q^m_2(1) = 0\). It is easy to obtain the Marshallian demands in Region 1:

\[
\begin{align*}
q^m_1 = a^m - (b^m + c^m)p^m_1 + c^m p^m_1, \\
q^m_2 = a^m - (b^m + c^m)p^m_2 + c^m p^m_2,
\end{align*}
\]

(3.15)

where \(a^m = \frac{\alpha^m}{\beta^m + (n^u - 1)\gamma^m}, \quad b^m = \frac{1}{\beta^m + (n^u - 1)\gamma^m}, \quad c^m = \frac{\gamma^m}{(\beta^m - \gamma^m)(\beta^m + (n^u - 1)\gamma^m)}\). Note that \(c^m = 0\) corresponds to the case in which rice and potatoes are independent of each other while \(c^m \to \infty\) represents the case in which rice and potatoes are perfectly substitutable. The demands in Region 2 have mirror expressions.

In the M sector, the Marshallian demands are

\[
\begin{align*}
q^m_1 = a^m - (b^m + n^u c^m)p^m_1 + c^m p^m_1, \\
q^m_2 = a^m - (b^m + n^u c^m)p^m_2 + c^m p^m_2,
\end{align*}
\]

(3.16)

where \(a^m = \frac{\alpha^m}{\beta^m + (n^u - 1)\gamma^m}, \quad b^m = \frac{1}{\beta^m + (n^u - 1)\gamma^m}, \quad c^m = \frac{\gamma^m}{(\beta^m - \gamma^m)(\beta^m + (n^u - 1)\gamma^m)}\).

In the short run, firms are immobile across regions. Let \(\lambda\) be the firm share in Region 1. The manufacturing price index in Region 1 is simply \(P^m_1 = \lambda n^u p^m_1 + (1 - \lambda) n^u p^m_2\). The consumer surpluses in Region 1 are

\[
\begin{align*}
S^1 = \frac{(\alpha^m)^2 n^u}{2\beta^m} & - a^m n^u [\lambda p^m_1 + (1 - \lambda) p^m_2] \\
& + \frac{b^m + c^m n^u}{2} [\lambda (p^m_1)^2 + (1 - \lambda) (p^m_2)^2] - \frac{c^m}{2} (n^u)^2 [\lambda p^m_1 + (1 - \lambda) p^m_2]^2, \\
S^1 = \frac{(\alpha^m)^2}{b^m} & - a^m (p^m_1 + p^m_2) + \frac{b^m + c^m n^u}{2} [(p^m_1)^2 + (p^m_2)^2] - \frac{c^m}{2} (p^m_1 + p^m_2)^2,
\end{align*}
\]

and the indirect utility level in Region 1 is \(V_1 = S^1 + S^0 + y + \tilde{q}_0\).

We now turn to the production side. Again, the agricultural production is under CRS and each unit of rice/potatoes is produced by one unit of unskilled labor. The manufacturing production is under IRS. Each firm employs \(\psi^m\) skilled workers and \(\psi^m\) unskilled workers as a fixed cost. For simplicity, we assume the marginal input is zero. Given firm share \(\lambda\), there are \(\lambda H\) skilled workers in Region 1 and \((1 - \lambda) H\) skilled workers in Region 2. The labor-clearing condition of skilled workers gives \(H = n^u \psi^m\). The firm profit in Region 1 is calculated as

\[
\Pi^m_1 = p^m_1 q^m_1(L + \lambda H) + (p^m_1 - \tau^m) q^m_1 [L + (1 - \lambda) H] - \psi^m w_1 - \psi^m w_2, \\
\]

where \(w_1\) and \(w_2\) are the wages of the skilled and unskilled workers in Region \(r\) (as in Sect. 3.1), respectively, and \(\tau^m\) is the unit transport cost (rather than the iceberg transport cost of Sect. 3.1) of manufactured goods. It is assumed that \(\tau^m\) units of the numéraire are required to ship each unit of manufactured goods. Each firm chooses profit-maximizing prices, which are

\[
\begin{align*}
p^m_1 = \frac{2a^m + \tau^m c^m (1 - \lambda)n^u}{2(2b^m + c^m n^u)}, & \quad p^m_2 = p^m_1 + \frac{\tau^m}{2}, \\
p^m_2 = \frac{2a^m + \tau^m c^m n^u}{2(2b^m + c^m n^u)}, & \quad p^m_2 = p^m_2 + \frac{\tau^m}{2}.
\end{align*}
\]

(3.17)

Wages \(w_1\) and \(w_2\) of skilled workers are given by the free entry conditions for firms: \(\Pi^m_1 = \Pi^m_2 = 0\). Their differential is

\[
w_1 - w_2 = (2\lambda - 1) \frac{N_m(b^m + c^m N)}{2(2b^m + c^m N)} \left\{ 2a^m - \left[ b^m + \frac{c^m}{2\psi^m} (2L + H) \right] \right\} \psi^m \left( \frac{w^1 - w^2}{w^1 - w^2} \right).
\]

(3.18)

To pin down the wage differential of unskilled workers, we note that the mass of unskilled workers in the M sector in the two regions are \(\lambda n^u \psi^m\) and \((1 - \lambda) n^u \psi^m\). The agricultural market clearing condition in the two regions is written as
\[ L - \lambda n^w \psi^a = q_1^w (L + \lambda H) + q_1^{w^2} (L + (1 - \lambda) H), \quad \text{for rice} \]
\[ L - (1 - \lambda) n^w \psi^a = q_2^w (L + \lambda H) + q_2^{w^2} (L + (1 - \lambda) H), \quad \text{for potato,} \]

where \( \tau^a \) is the unit transport cost of agricultural goods (paid by numéraire): \( p_{12}^a = p_{11}^a + \tau^a \), \( p_{21}^a = p_{22}^a + \tau^a \). Together with (3.15), these equations imply
\[
\begin{align*}
p_{11}^a &= \frac{\alpha^w (2L + H) - L - b^w \tau^a (L + H(1 - \lambda))}{b^w (2L + H)} + \frac{\psi^a (\lambda b^w + c^w) H}{\psi^m b^w (b^w + 2c^w)(2L + H)}, \\
p_{22}^a &= \frac{\alpha^w (2L + H) - L - b^w \tau^a (L + H(1 - \lambda))}{b^w (2L + H)} + \frac{\psi^a (1 - \lambda b^w + c^w) H}{\psi^m b^w (b^w + 2c^w)(2L + H)}.
\end{align*}
\]

Therefore, the wage differential of unskilled workers is
\[
w_1^a - w_2^a = p_{11}^a - p_{22}^a = (2L - 1) \frac{H}{2L + H} \left[ \tau^a + \frac{\psi^a}{\psi^m (b^w + 2c^w)} \right]. \tag{3.19}
\]

The above result shows that the wage rate of the unskilled workers is higher in the more agglomerated region as long as \( \psi^a > 0 \) and/or \( \tau^a > 0 \).

According to (3.15), (3.16), and (3.17), all goods in the two sectors are traded if
\[
\tau^m < \frac{2\alpha^m}{2b^m + c^m H/\psi^m} \equiv \tau_{\text{trade}} \quad \text{and} \quad \tau^a < \frac{L - H \psi^a / \psi^m}{(H + L)(b^w + 2c^w)}.
\]

We assume the above conditions are satisfied in the subsequent discussion.

The utility differential between skilled workers in the two regions is \( V_1 - V_2 = S_2^m - S_1^m + S_1^p - S_2^p + w_1 - w_2 \), where
\[
S_1^m - S_2^m = -(2L - 1) \frac{\tau^m n^w \psi^a + (b^w + 2c^w) H \tau^a}{2L + H}, \quad \text{agricultural living expense effect(–)}
\]
\[
w_1 - w_2 = (2L - 1) \frac{n^w (b^m + c^m n^w)}{2(2b^m + c^m n^w)} \left[ 2\alpha^m \tau^m - \left( b^m + \frac{c^m H}{2\psi^m} \right) \left( \tau^a \right)^2 \right], \quad \text{market size effect(+)}
\]
\[
-(2L - 1) \frac{n^w (b^m + c^m n^w) \frac{L}{c^m n^w} \left( \tau^a \right)^2}{2(2b^m + c^m n^w) \psi^m} = \frac{\psi^a}{\psi^m} (w_1^a - w_2^a), \quad \text{competition effect(−)}
\]
\[
- \frac{H}{2L + H} \frac{\psi^a}{\psi^m} \left( b^w + 2c^w \right), \quad \text{labour cost effect(−)}
\]

according to (3.18) and (3.19). Note that the role of the A sector is described as the agricultural living expense effect and the labor cost effect. Both of them are negative, showing the dispersion forces coming from the agricultural sector. In contrast, the market size effect and the competition effect terms of \( w_1^m - w_2^m \) have different signs. They are balanced at equilibrium.

Consequently, it holds that
\[
V_1 - V_2 = (1 - 2\lambda) V(\tau^m),
\]

where \( V(\tau^m) = (\tau^m)^2 V_a - \tau^m V_b + V_c \), and where
\[
V_a = \frac{(b^m + c^m n^w) n^w}{2(2b^m + c^m n^w)} \left[ 3b^m (b^m + c^m n^w) + \frac{1}{2} (c^m n^w)^2 + \frac{L \tau^m}{\psi^m} (2b^m + c^m n^w) \right] > 0,
\]
\[
V_b = \frac{\alpha^m (b^m + c^m n^w) n^w}{(2b^m + c^m n^w)^2} (3b^m + 2c^m n^w) > 0,
\]
\[
V_c = \frac{H}{2L + H} \left[ \frac{\psi^a}{\psi^m} + \tau^a (b^w + 2c^w) \right]^2 > 0.
\]

According to Tabuchi and Zeng (2004), equilibrium \( \lambda = 1/2 \) is stable under many reasonable dynamics iff \( V(\tau^m) > 0 \), while full agglomeration is stable iff \( V(\tau^m) < 0 \). Note that \( V(\tau^m) \) is quadratic, having a minimal value of \( V_c - V_b^p / (4V_a) \). Meanwhile, \( V_b^p / (4V_a) \) depends on parameters in the M sector only. Since \( V_c \) is a quadratic function of \( \tau^a \), we are able to calculate the root of \( \min_{\tau^a} V(\tau^m) = 0 \), which is
\[
\tau^a = \sqrt{\frac{2L + H V_b^2}{H(b^a + 2c^a) 4V_a} - \frac{1}{b^a + 2c^a} \frac{\psi^a}{\psi^m}}.
\]

Figure 8 draws the graph of \( V(\tau^a) \) whose lower part also reveals how the parameters in the agricultural sector are related. Since \( V_c \) is positively related to \( \tau^a \) and \( \psi^a \), a larger value of these parameters corresponds to an upward shift of
The agglomeration equilibrium is stable if parameters fall in the area above $V(\tau_m)$ and the dispersion equilibrium is stable otherwise. The equilibrium stability is summarized as follows.

**Proposition 3.1.** $\lambda = 1/2$ is always stable if $\tau^a \geq \tau^a_*$. When $\tau^a < \tau^a_*$, there is a nonempty interval $[\tau^a_{m1}, \tau^a_{m2}]$ outside which $\lambda = 1/2$ is stable. The agglomeration is stable inside the interval.

By using a quasilinear framework, we are now able to explore the role of $\tau^a$ in an analytical way. Being consistent with the CES framework, the heterogeneous agricultural goods and their trade costs form a dispersion force. Industrial location again takes the form of dispersion $\rightarrow$ agglomeration $\rightarrow$ redispersion when the trade costs of manufactured goods fall. The bifurcation diagram is depicted in Fig. 9.

Comparing Fig. 9 with Fig. 6, we see that there is no overlap of the symmetric and the full stable equilibria. This is a feature of the quasilinear model of Ottaviano et al. (2002).

The analytical results verify the important effect of agricultural transport costs on firm location. As indicated by the arrow in Fig. 8, the economic activity need not (temporarily or permanently) agglomerate when the transport costs of both agricultural and manufacturing varieties simultaneously fall. This result is likely to be important for the countries that organize some economic integration by removing their internal barriers to trade and by improving the transportation infrastructure. The process of economic integration is able to provide improvements in economic efficiency as well as balance in economic development if trade costs are simultaneously reduced in agriculture and manufacturing.

This tractable model can be applied to examine the effects of some agricultural policies. For example, Picard and Zeng (2005) find the following facts. (i) Lump-sum transfers to farmers do not alter the location equilibrium. (ii) Subsidies to agricultural prices foster the dispersion of the manufacturing industry. (iii) Export subsidies for agricultural varieties increase the agglomeration of manufacturing.

In addition to the equilibrium analysis, we can further analyze the welfare in two regions. Since there are multiple stable equilibria, welfare analysis aims to answer whether the equilibrium is over- or underagglomerated. Two kinds of social optimum are applied. In the first-best situation, a planner is able to control the labor and product prices as well as the location of skilled workers. Due to the quasilinear preferences, the planner is able to compensate individuals through appropriate lump sum transfers. Meanwhile, in the second-best situation, the planner is able to control the location of skilled workers and firms but cannot control the labor or product prices. Picard and Zeng (2005) find that the
location patterns in the first- and the second-best situations all involve \( \text{dispersion} \rightarrow \text{agglomeration} \rightarrow \text{redispersion} \) when \( \tau^m \) falls and when \( \tau^a \) is small. They always involve symmetric location when \( \tau^m \) is large.

In the comparison of the equilibrium and optimal location, Picard and Zeng (2005) show that overurbanization crucially depends on the values of agricultural transport costs and on the firms’ requirement for local unskilled labor. Specifically, location equilibria lead to socially excessive agglomeration for intermediate values of manufacturing costs when \( \tau^a \) and \( \Phi^a \) are small. There is then overcrowding or overurbanization in the more industrialized regions. Firms and skilled workers do not internalize the negative externality on each other when they agglomerate in a region as they indirectly raise the labor cost of unskilled workers and the price of the local agricultural variety. This mechanism is parallel to the traditional congestion effect in cities. By contrast, location equilibria lead to socially excessive dispersion for small manufacturing transport costs. This suggests that there exists undercrowing or underurbanization in more industrialized regions. Here, firms and skilled workers leave the core region because the wages of unskilled workers are too high. However, redispersing increases the amount of exportation of manufactured goods leading to transportation waste that the planner wishes to avoid. Furthermore, when \( \tau^a \) and \( \Phi^a \) are not small, the transport cost intervals that support agglomeration in the equilibrium generally do not overlap.

The model remains tractable when we extend the single manufacturing sector to multiple manufacturing sectors. Using the dispersion force generated from the agricultural sector, Zeng (2006) finds that the redispersion for a small \( \tau^m \) is different from the dispersion for a large \( \tau^m \). More specifically, in the dispersion stage occurring when \( \tau^m \) is large, all industries disperse in the two regions. In contrast, in the redispersion stage occurring when \( \tau^m \) is small, some industries agglomerate in different regions, but the whole manufacturing firms disperse.

### 3.3 Studies on trade patterns

NTT is another line of Krugman’s work in spatial economics that explores the interaction of trade costs with increasing returns and monopolistic competition when labor is immobile. NTT focuses on trade between countries while NEG focuses on the location of production within countries. Shipment of goods within countries is similar to shipment of goods between countries; therefore, trade theory and geography economics are closely related. Ohlin (1933) tried to offer a unification of trade and location theory, stating that international trade theory cannot be understood except in relation to and as a part of the general location theory. Krugman (2009) also stated that the theory of international trade and the theory of economic geography are expected to be developed in tandem and in close relationship with each other.

Krugman’s benchmark work in 1980 provides a theoretical base for the home market effect (HME). This was a decade earlier than the core–periphery model, and Krugman was lucky that "nobody else picked up this $100 bill lying on the sidewalk in the interim."  

The HME is an advantage of a large country in terms of firm location, since a country with a relatively larger local demand succeeds in attracting a more-than-proportionate share of firms in a monopolistically competitive industry based on a model of IRS. In the presence of transport costs, firms tend to locate closer to large markets to save transport costs. The HME analysis is useful to explain the uneven distribution of economic activities across space and international trade.

While core–periphery models are based on two symmetric regions, most HME models assume two countries of different size.

#### 3.3.1 One factor

Helpman and Krugman (1985, Sect. 10.4) refine the trade model of Krugman (1980) by adding an agricultural sector. This is the first time the agricultural sector appears in the literature of NEG and NTT. The assumption of costless trade of the agricultural good greatly improves the tractability of models, and it is adopted by many later studies. Since labor is immobile, when wages are fixed, production shifting does not lead to expenditure shifting. The HME models seem to be able to address fewer effects and features than the core–periphery models. Furthermore, Davis (1998) finds that the assumption of costless agricultural trade is not innocuous, because the HME disappears if the transport costs for the agricultural good are the same as those for manufactured goods. Here we introduce Takatsuka and Zeng (2012a), who extend Davis’s framework for general trade costs in the agricultural sector.

The economy consists of two countries (1 and 2), two sectors (manufacturing, M, and agricultural, A), and one production factor (labor). The amount of labor in Country 1 is denoted by \( L_1 \) and the worldwide labor endowment is \( L^0 = L_1 + L_2 \). The share of labor in Country 1 (\( L_1/L^0 \)) is denoted by \( \theta \). We assume that Country 1 is larger so that \( \theta \in (1/2, 1) \). Workers hold the same preferences as in (3.1). Trade costs in the two sectors are also the same as in Sect. 3.1.

In this one-factor model, each worker owns one unit of labor, which is immobile across countries. In the production

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1. http://web.mit.edu/krugman/www/ohlin.html.
2. This definition of the HME in terms of firm share is first given by Krugman (1980, Sect. III), and is widely known among researchers in economic geography. There are other definitions of the HME. The HME in terms of trade pattern refers to the fact that the larger country is a net exporter of manufactured goods in an economy of two countries (Krugman, 1995, p. 1261), which is widely known among trade researchers. The HME in terms of wages refers to the fact that the wage rate in a larger market is higher (Krugman, 1991, p. 491).
of good $M$, each firm needs a marginal cost of $\rho$ units of labor and a fixed cost of $F$ units of labor. Meanwhile, in the production of good $A$, one unit of labor produces one unit of $A$. We assume that the consumption share of good $A$ is sufficiently large for both countries to constantly produce good $A$. We choose the labor in Region 2 as the numéraire so that $w_2 = 1$. The wage rate in Country 1 is denoted by $w_1 = w$. Then the prices of good $A$ in the two countries are

$$p_1^A = w, \quad p_2^A = w_2 = 1.$$  

(3.20)

Since wages are the only income of workers, the total expenditures in the two countries are

$$E_1 = L_1w, \quad E_2 = L_2.$$  

(3.21)

Meanwhile, the total cost of producing $q$ units of each variety of good $M$ in Country $i$ is $c_i(q) = Fw_l + \rho w_q q$.

The property of constant markup in Lemma 2.1 implies that the market price $p_i$ of varieties produced in Country $i$ and consumed in Country $j$ is

$$p_{11} = w, \quad p_{22} = 1, \quad p_{21} = \tau_m, \quad p_{12} = w\tau_m.$$  

(3.22)

Given the utility form of (3.1), the national demands (including iceberg costs) for varieties produced in the two countries are

$$q_1 = \mu p_1^A p_1^e E_1 + \tau_m \mu p_{12}^E E_2, \quad q_2 = \mu p_{12}^A p_2^e E_2 + \tau_m \mu p_{22}^A p_2^e E_1,$$

(3.23)

where $P_i$ is the price index of good $M$ in Country $i$ defined by

$$P_1 = [n_1(p_{11})^{1-\sigma} + n_2(p_{21})^{1-\sigma}]^{1/\sigma}, \quad P_2 = [n_1(p_{12})^{1-\sigma} + n_2(p_{22})^{1-\sigma}]^{1/\sigma}$$

(3.24)

and $n_i$ is the mass of firms in Country $i$. On the other hand, from (3.1) and (3.20), the national demands for good $A$ in the two countries are

$$d_1^e = \frac{(1 - \mu)E_1}{p_1^A}, \quad d_2^e = (1 - \mu)E_2,$$

(3.25)

respectively.

According to Lemma 2.1, the output (i.e., the total sales revenue divided by $p_i$) and labor input of each firm in two countries are

$$q_1 = q_2 = F\sigma, \quad l_1 = l_2 = F\sigma,$$

(3.26)

respectively. Thus, from (3.21), (3.22), (3.23), (3.24), and (3.26), the market-clearing conditions for varieties of good $M$ produced in the two countries are

$$\mu w^{-\sigma} \left[ \frac{\theta L^w w}{n_1 w^{1-\sigma} + n_2 \phi^m} + \frac{(1 - \theta)L^w \phi^m}{n_2 + n_1 \phi^m w^{1-\sigma}} \right] = F\sigma,$$

$$\mu \left[ \frac{(1 - \theta) L^w}{n_2 + n_1 \phi^m w^{1-\sigma}} + \frac{\theta L^w \phi^m}{n_1 w^{1-\sigma} + n_2 \phi^m w^{1-\sigma}} \right] = F\sigma.$$

(3.27)

If good $A$ is not traded between two countries, then trade in the $M$ sector is balanced and the HME disappears. Meanwhile, the total output of good $A$ is $(1 - \mu)L_1$ in Country 1 and $(1 - \mu)L_2$ in Country 2. Therefore, in this case, (3.26) gives

$$n_1 = \frac{\mu L_1}{F\sigma} = \frac{\mu L^w}{F\sigma}, \quad n_2 = \frac{\mu L_2}{F\sigma} = \frac{\mu(1 - \theta)L^w}{F\sigma}.$$  

(3.28)

Substituting (3.28) into (3.27), we obtain

$$\mathcal{F}_1(w) \equiv (w^{1-\sigma} - w\phi^m)\theta - (w^\sigma - \phi^m)(1 - \theta) = 0$$

(3.29)

after simplification, which determines the equilibrium wage when $A$ is not traded. Clearly, $F_1(w)$ decreases in $w$, and it holds that

$$\mathcal{F}_1(1) = (1 - \phi^m)(2\theta - 1) > 0,$$

$$\mathcal{F}_1((\tau_m)^{\frac{\sigma-1}{\sigma}}) = -\left( \frac{1}{\phi^m} - \phi^m \right)(1 - \theta) < 0,$$

where the inequalities are from $\theta \in (1/2, 1)$ and $\phi^m < 1$. Thus, (3.29) has a unique solution that lies in $(1, (\tau_m)^{\frac{\sigma-1}{\sigma}})$, subsequently denoted by $\tilde{w}$. This wage rate depends on $\tau_m$.

On the other hand, when $A$ is traded, we can show that it is impossible for Country 2 to be the importer. In other words, Country 1 necessarily imports $A$ so that $w = \tau^w$. Therefore, $\tilde{w}$ is actually the highest value of trade costs for good $A$ to be traded. Accordingly, we also use $\tilde{\tau}^w$ to denote $\tilde{w}$, indicating the fact that good $A$ is nontradable if and only if $\tau^w \geq \tilde{\tau}^w = \tilde{w}$. 
Takatsuka and Zeng (2012a) obtain the following results for the HME and $\tilde{\tau}^m$.

**Proposition 3.2.** (i) Good $A$ is tradable if and only if $\tau^a < \tilde{\tau}^m$. (ii) The HME is observed if $\tau^a < \tilde{\tau}^m$; otherwise, good $A$ is not traded and trade in good $M$ is balanced. (iii) $\tau^m$ increases in $\tau^a$ and $\theta$.

Figure 10 summarizes some results from the literature. Typically, good $A$ is tradable when $\tau^a = 1$. Helpman and Krugman (1985) examined the firms’ locations in this case and found the HME. Proposition 3.2 (ii) generalizes their result and shows that the HME is observed in the whole shaded area of Fig. 10 (i.e., $\tau^a < \tilde{\tau}^m$). Since $\tilde{\tau}^m < \tau^m$, the HME disappears when $\tau^a = \tau^m$. This special result was originally provided in Davis (1998), and the above result demonstrates that the HME generally disappears for all $\tau^a \geq \tilde{\tau}^m$. Yu (2005, p. 261) showed that good $A$ is not traded if $\tau^a \geq (\tau^m)^{1/\gamma}$, which is only a sufficient condition.

Since $\tau^a < \tilde{\tau}^m$ is the necessary and sufficient condition for observing the HME, we could investigate how parameters affect the HME property. Proposition 3.2 (iii) indicates that a larger trade cost of $A$ is necessary to obscure the HME when $\tau^m$ or $\theta$ is larger. This is because firms save more trade costs by locating in the larger country in such a situation.

**Proposition 3.3.** At the interior equilibrium with tradable $A$, (i) the firm mass in the larger country (resp. the smaller country) monotonically increases (resp. decreases) when $\tau^a$ falls, and (ii) the firm mass in the larger country (resp. the smaller country) evolves as a bell-shaped curve (resp. a U-shaped curve) when $\tau^m$ falls.

To understand Proposition 3.3 (i), we note that the relative wage in Country 1 increases in $\tau^a$ as long as $A$ is tradable, since it holds that $w = \tau^a$. The wage differential has two effects. On one hand, it affects the production side. As firms pay wages as production costs, more firms are attracted from Country 2 to Country 1 if $w$ or $\tau^a$ falls. On the other hand, it also has an impact on the demand side. When $w$ falls, the consumption of $A$ in Country 1 decreases. If $A$ is nontradable, then the decreased local demand for $A$ releases labor from the A sector to the M sector. As a result, the M sector in Country 1 expands in this specific case. However, if $A$ is tradable, then Country 1 decreases its import of $A$ from Country 2, and the deducted wage income in Country 1 shrinks the market size of good $M$ so that more firms of $M$ are likely to move out from country 1 to country 2 to save transport costs. Proposition 3.3 (i) shows that the former production-cost effect definitely dominates the latter income effect in our setup. Therefore, the firm mass in Country 1 (resp. Country 2) monotonically increases (resp. decreases) for a falling $\tau^a$. Such a change is shown by vector (I) in Fig. 10.

Helpman and Krugman (1985) conclude that a small country is deindustrialized when the $M$ markets are more integrated. Proposition 3.3 (ii) shows that their result is not valid when the trade costs of good $A$ are positive. Specifically, there is a redispersion process whereby firms return to the small country for a sufficiently small $\tau^m$. This is because the dispersion force of a higher wage in the larger country dominates the agglomeration force due to the market size. Such a change is shown by vector (II) in Fig. 10. In summary, the argument of Helpman and Krugman (1985) is true for a falling $\tau^a$ rather than $\tau^m$.

It is noteworthy that the symmetric equilibrium is always stable for any $\tau^a > 1$ in the core–periphery model of Fig. 3. In the HME model, if two countries are symmetric, the symmetric equilibrium is always stable even if $\tau^a = 1$. For asymmetric countries, we observe an asymmetric equilibrium of location continuously depending on $\tau^m$ and $\tau^a$.
3.3.2 Two factors

Since the Heckscher–Ohlin model, capital has played an important role in the study of international trade. Lucas (1990) documents that world capital markets are close to being free and competitive while labor is almost immobile across countries even inside EU. Accordingly, it is reasonable to consider capital mobile and labor immobile. Incorporating these features, Martin and Rogers (1995) establish a footloose capital (FC) model, which is now extensively applied to explore many trade problems.

Removing the assumption of costless trade of the agricultural good in Martin and Rogers (1995), Takatsuka and Zeng (2012b) explore the role of agricultural trade costs when mobile capital is a production factor in the M sector. This section mainly introduces their results.

We keep the notations in the previous one-factor model. The amounts of capital in Country 1 is denoted as $K_1$ and its counterpart in Country 2 as $K_2$. The worldwide endowments $L^w = L_1 + L_2$ and $K^w = K_1 + K_2$ are fixed. For simplicity, we further assume that each worker owns one unit of capital so that $K^w = L^w$. We let $\theta = L_1/L^w = K_1/K^w$. Country 1 is larger so that $\theta \in (1/2, 1)$.

We choose the agricultural good in Country 2 as the numéraire. The agricultural sector is modeled in the same way as in Sect. 3.3.1, so we have (3.20) again. In the production of good $M$, we now assume that each firm needs a marginal input of $\rho$ units of labor and a fixed input of one unit of capital. Thus, $n^w = K^w$ holds.

In the FC model, workers are immobile. Capital is immobile in the short run but mobile in the long run. Let $\lambda$ be the capital share employed in Country 1. As in Baldwin et al. (2003, p. 74), we straightforwardly assume that, in each country, $\theta$ of its employed capital belongs to Country 1, and $1 - \theta$ of the employed capital comes from Country 2, regardless of $\lambda$. In other words, the employed capital in each country comes from two countries with the same ratio $\theta : (1 - \theta)$, for any $\lambda$. Residents in the two countries receive the same average capital rent $\tilde{r} \equiv \lambda r_1 + (1 - \lambda) r_2$, where $r_i$ is the capital returns of firms in Country $i$.

In the short run, the total expenditure spent on goods and the total costs of producing $q$ units of varieties of good $M$ are, respectively,

$$E_1 = \omega \theta L^w + \tilde{r} L^w, \quad E_2 = (1 - \theta) L^w + \tilde{r} (1 - \theta) L^w,$$

$$c_1(q) = r_1 + \rho w q, \quad c_2(q) = r_2 + \rho q.$$  

Since the marginal input is the same as in Sect. 3.3.1, the equilibrium prices of manufactured goods are the same as (3.22) by Lemma 2.1. We also have the same expressions (3.23) for demands, (3.24) for price indices in the manufacturing sector, and (3.25) for demands in the agricultural sector.

In this two-factor model, Lemma 2.1 implies that the total outputs of varieties in the two countries are

$$q_1 = \frac{r_1 \sigma}{w} \quad \text{and} \quad q_2 = \frac{r_2 \sigma}{w},$$  

respectively. From (3.22), (3.23), (3.24), (3.30), and (3.31), the market-clearing conditions for varieties of good $M$ produced in countries 1 and 2 are

$$\mu w^{-\sigma} \left[ \frac{\theta (w + \tilde{r}) L^w}{n_1 w^{1-\sigma} + n_2 \phi^m} + \frac{(1 - \theta) (1 + \tilde{r}) L^w \phi^m}{n_2 + n_1 \phi^m w^{1-\sigma}} \right] = \frac{r_1 \sigma}{w},$$

$$\mu \left[ \frac{(1 - \theta) L^w}{n_2 + n_1 \phi^m w^{1-\sigma}} + \frac{\theta (w + \tilde{r}) L^w \phi^m}{n_1 w^{1-\sigma} + n_2 \phi^m} \right] = \frac{r_2 \sigma}{w},$$

respectively.

We now examine the interior long-run equilibrium in which $A$ is traded at cost $r^a$. In equilibrium, $n_1, n_2 \in (0, L^w)$ and $r_1 = r_2 = \tilde{r} \equiv r$ hold. If Country 1 imports good A, then we have $p^a = w = r^a$. By Eq. (3.32) and the facts of $w = r^a$, $r_1 = r_2$, and $L^w = n_1 + n_2$, we have

$$n_1 = \frac{\mu L^w \theta (r^a + \phi^m) (1 - \theta) (1 + r) \phi^m - (1 + r + (r^a - 1) \theta) \phi^m}{\sigma r^\mu},$$

$$n_2 = \frac{\mu L^w \phi^m (1 - \theta) (1 + r) + (r^a + r) \phi^m - (1 + r + (r^a - 1) \theta) \phi^m}{\sigma \mu} = \frac{\mu (1 - \theta + r^a \theta) \mu}{\sigma - \mu},$$

where $\phi^m \equiv (r^a)^{1-\sigma}$ is the trade freeness of good $A$. Note that (3.33) and (3.34) are true only if the RHS’s are in an open interval $(0, L^w)$. Otherwise, $n_1$ and $n_2$ are either 0 or $L^w$.

The import volume of good $A$ in Country 1, denoted by $IM^a(r^a)$, is equal to its demand $d_1^a$ subtracted by its supply:

\footnote{Since the main objective is to examine the HME without a comparative advantage, it is assumed that all residents in both countries have the same endowment of capital and that the two countries are different only in size, as in Martin and Rogers (1995) and Ottaviano and Thisse (2004, p. 2579).}
\[
\text{IM}^q(\tau^a) = (1 - \mu) \frac{\theta L^w(\tau^a + r)}{\tau^a} - (\theta L^w - nmq)
\]
where the latter two equalities are from \(d_1^q = (1 - \mu)E_1/p_1^q\), (3.31), and \(p_1^q = w = \tau^a\). It is noteworthy that both \(n_1\) and \(r\) depend on \(\tau^a\) as indicated in (3.33) and (3.35). Takatsuka and Zeng (2012b) prove that there is a unique solution of \(\text{IM}^q(\tau^a) = 0\) in \((1, \tau^m)\), which is denoted by \(\tilde{\tau}^a\).

Meanwhile, we can show that Country 1 never exports good A. Therefore, good A is not traded if and only if \(\tau^a \geq \tilde{\tau}^a\). Next we consider an interior equilibrium when \(A\) is nontradable. The labor input in the A sector is equal to the demand for good A, which is

\[
d_1^q = \frac{(1 - \mu)(r + w)\theta L^w}{w} \quad \text{and} \quad d_2^q = (1 - \mu)(r + 1 - \theta)L^w
\]
in Countries 1 and 2, respectively. Therefore, the labor inputs in the IRS sector are

\[
\rho q_1 n_1 = \theta L^w - \frac{(1 - \mu)(r + w)\theta L^w}{w} = \frac{[\mu w - (1 - \mu)r]\theta L^w}{w} \quad \text{(3.36)}
\]
\[
\rho q_2 n_2 = (1 - \theta)L^w - (1 - \mu)(r + 1 - \theta)L^w = [\mu - (1 - \mu)r](1 - \theta)L^w
\]
respectively. From (3.31) and (3.36), we have

\[
\frac{n_1}{\theta L^w} = \frac{\mu - (1 - \mu)w}{(1 - \theta)w} \quad \text{and} \quad \frac{n_2}{(1 - \theta)L^w} = \frac{\mu - (1 - \mu)r}{r(\sigma - 1)}.
\]
The equalities of \(n_1 + n_2 = n^w = L^w\) lead to \(r = (1 - \theta + w\theta)\mu/(\sigma - \mu)\). Then we have

\[
\frac{n_1}{n_1 + n_2} = \frac{n_1}{L^w} = \theta + \frac{\theta(1 - \theta)(\sigma - \mu)(w - 1)}{(1 + (w - 1)\theta)(\sigma - 1)}.
\]

This equation implies that the firm share in Country 1 is larger than \(\theta\) if and only if \(w > 1\). It is known that an interior equilibrium exists and \(w = \tilde{w}_1\) \((\ast)\) holds if and only if

\[
\tilde{w}_1 < w_{\text{bound}} \equiv \frac{\sigma - 1 + \theta(1 - \mu)}{\theta(1 - \mu)}.
\]
Thus, in the interior-equilibrium case, the larger country ends up with a more-than-proportionate share of firms.

Finally, a full agglomeration in the large country is possible. In this corner equilibrium, \(A\) is tradable if \(\tau^a < w_{\text{bound}}\). Otherwise, \(A\) is nontradable.

The above results are summarized as follows.

**Proposition 3.4.** There is a threshold value, \(\tilde{\tau}^a \equiv \min\{\tilde{\tau}^a, w_{\text{bound}}\} < \tau^m\), of the transport cost of good A so that (i) the larger country imports good A if \(\tau^a < \tilde{\tau}^a\); otherwise, good A is not traded and (ii) the HME is always observed.

The relationships among various threshold values are depicted in Fig. 11. Note that \(\tilde{\tau}^a\) has a bell shape with respect to \(\tau^m\), which is in contrast to the monotone shape in Fig. 10 for the one-factor case. This reveals the dispersion force of the agricultural trade costs, exactly as we have observed in the core–periphery models.

The above HME results are derived under the CES preferences. As in the core–periphery models, the quasilinear

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**Fig. 11.** Existence of the HME: The two-factor case.
preferences usually bring in stronger tractability. In fact, Zeng and Kikuchi (2009) modify the model of Sect. 3.2 to examine the HME when there are two production factors and heterogeneous agricultural goods. Their analytical results show the existence of the HME as long as trade in the two sectors is not blocked by large trade costs, which is consistent with Proposition 3.4.

4. Resource Goods

Many productions require some specific natural resources. The changing oil price tells us how indispensable such resources are for economic development. However, there are cases in which natural resources might be more of an economic curse than a blessing. Such a “resource curse” (Auty, 1993) refers to the counterintuitive phenomenon wherein countries rich in natural resources are unable to use that wealth to boost their economies, and thus economic growth is lower in those countries than in others. Numerous reports document that in Angola, Algeria, Libya, Nigeria, and Venezuela, oil wealth has failed to generate development and has instead caused deep-seated corruption and internal strife over oil income, retarding growth. In contrast, economies and regions with only limited access to natural resources, such as Japan, Germany, Korea, Singapore, and Switzerland, experienced remarkably high economic growth rates.

Such a resource curse is evidently related to political and social consequences, such as low-quality institutions, corruption, rent seeking, armed conflicts, and government policies. We are more interested in exploring its economic mechanisms. It is also considered to be related to the trade of manufactured goods. This “Dutch Disease” phenomenon is well-known in history. It originated with the discovery of the Groningen Gas Field in 1959 in the northern Netherlands. The discoveries of natural gas in the Netherlands inflicted some adverse effects on the manufacturing sector. Corden and Neary (1982) and Corden (1984) are early theoretical studies on the topic that clearly demonstrate that an increase in natural resources will raise the labor demands in both the extraction industry and the nontradable sector, driving workers away from manufacturing and raising the relative price of the nontradable good. However, their setting is a small open economy with fixed prices of manufactured goods. All goods are either freely traded or nontradable. In other words, trade and transport costs are not explicitly modeled. However, they are essential factors because the world economy becomes increasingly more integrated under globalization.

The agricultural sector in Sect. 3 can be interpreted more broadly. Indeed, it can be replaced by a resource sector because the production of resource goods requires local resources and has to be conducted locally. In this way, Takatsuka et al. (2015) construct a general equilibrium model to reveal Dutch disease. Explicitly incorporating the trade costs of resource goods, they find that reducing these costs may aggravate the resource curse.

As in the models of a small open economy, the existence of nontradable goods is important for us to disclose some puzzles. A recent paper by Morales (2021) establishes an NEG model to analyze the transfer paradox. This paradox refers to the well-known fact that a region can be hurt by accepting an income transfer. His results show that the trade costs in the agricultural sector play an important role. The results are helpful for us to study the Hometown Tax Donations policy in Japan.

Travel and tourism create a lot of jobs in many countries. Their direct, indirect, and induced impacts accounted for 10.3% of global GDP in 2019. To restart the Japanese economy following the damage caused by the coronavirus, the Japanese government ran the Go to Travel campaign, offering big discounts on travel inside Japan in 2020. Zeng and Zhu (2011) build a model with a nontradable sector to analyze tourism using the general-equilibrium approach. The results are suggestive for us to examine this kind of tourism policy.

This section introduces the above three models to show how to apply the general equilibrium approach to solve economic mysteries in our real world.

4.1 Dutch disease

Viewing the agricultural goods as resource goods, Takatsuka et al. (2015) are able to examine the effects of resource booms to clarify the conditions under which Dutch disease may occur. They find two key factors that can determine whether a resource is a blessing or may cause Dutch disease. One is the transport costs of both manufactured goods and resource goods, and the other is how much resource goods are used as intermediate inputs in manufacturing production.

Some historic facts in Barbier (2005) show that the transport costs of resource goods are related. Resource-abundant countries benefit from their windfalls in the early stages of opening to international trade. In particular, from 1870 to 1913, many economies grew rapidly after opening up their previously closed economies. Unfortunately, however, since 1918, raw material and mineral commodities have become cheaply available even in resource-poor countries/regions. The technology of pipeline transport reduces the long-distance transportation costs of resources like oil and gas. Now very few resource-abundant developing economies are able to join the world’s developed economies. The periphery is trapped in a perpetual state of underdevelopment and remains specialized in the production and export of primary products (Barbier, 2005, p. 92).

Meanwhile, a lot of resource goods are used both as intermediate and final goods. For example, wood is directly

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4. https://wttc.org/Research/Economic-Impact
consumed to build houses and used to produce paper; corn and beets are directly consumed and used as petroleum substitutes for fuel sources. Incorporating such facts into the model provides new insights on the mechanisms of Dutch disease.

The model of heterogeneous agricultural goods in Sect. 3.1.2 can be borrowed. Assuming the mobility of firms rather than workers, Takatsuka et al. (2015) utilize the following utility function:

$$U = M^{1-\mu-\eta}A_1^\mu A_2^\eta,$$

(4.1)

where $M$ is the composite manufactured good of (3.2) and $A_1$ and $A_2$ are interpreted as the resource goods of two regions with the same population $L$. Parameters $\mu$ and $\eta$ stand for expenditure shares of $A_1$ and $A_2$, respectively, and

$$\mu, \eta > 0; \mu + \eta < 1. \quad (4.2)$$

In (3.8), two agricultural goods are bound by a CES function. In contrast, two resource goods are combined using a simpler Cobb–Douglas function in (4.1). The production of resource goods $A_1$ and $A_2$ is also similar to the production of heterogeneous agricultural goods in Sect. 3.1.2. One unit of labor yields one unit of output so we have

$$p_{11} = w, \quad p_{12} = w\tau^a, \quad p_{22} = 1, \quad \text{and} \quad p_{21} = \tau^a,$$

(4.3)

where $p_{kj}$ is the price of the resource good produced in region $k$ and sold in region $j$ ($k, j \in \{1, 2\}$), $w$ is the wage rate in Region 1, and the labor in Region 2 is chosen as the numéraire. We do not distinguish between skilled and unskilled workers here.

In contrast, manufacturing requires three inputs: labor and the two resource goods. Each firm has the following cost structure: a fixed cost of $f$ and marginal cost of $(\sigma - 1)/\sigma$, with a Cobb–Douglas production function:

$$f + \frac{\sigma - 1}{\sigma} x = f^\alpha A_1^\beta A_2^\gamma,$$

(4.4)

where $l$ stands for labor input and $\alpha$, $\beta$, and $\gamma$ are the cost shares of each input, satisfying $\alpha + \beta + \gamma = 1$. In other words, (4.4) specifies the amount of the three inputs required to produce $x$ units of the manufactured good. Then $\hat{\mu} \equiv \mu + \beta(1 - \mu - \eta)$ (resp. $\hat{\eta} \equiv \eta + \gamma(1 - \mu - \eta)$) is the sum of the direct and indirect expenditure shares of $A_1$ (resp. $A_2$) for each consumer. In addition, the following assumptions are imposed:

$$\alpha \in \left(\frac{1}{2\sigma}, 1\right], \quad \beta, \gamma \in [0, 1), \quad (4.5)$$

$$\hat{\eta} < \frac{1}{2}. \quad (4.6)$$

The inequality $\alpha \geq 1/(2\sigma)$ in (4.5) requires that either $\alpha$ or $\sigma$ be not too small, which is always satisfied if $\beta + \gamma \leq 1/2$. The first inequality in (4.6) implies that the expenditure share is larger on $A_1$ than on $A_2$. Due to this feature, we say Region 1 has a "resource advantage" over Region 2. Like the no-black-hole condition, the second inequality of (4.6) is imposed to exclude a too-strong agglomeration force of the resource goods, which especially implies $\mu, \eta < 1/2$.

Let $\Gamma \equiv \alpha^{-\beta}\beta^{-\gamma}\gamma^{-\gamma}$. By cost minimization,

$$\alpha \Gamma u_k^{\alpha - 1}(p_{ik}^a)^\gamma(p_{ik}^a)^\gamma \quad \text{units of labor,} \quad (4.7)$$

$$\beta \Gamma u_k^{\beta - 1}(p_{ik}^a)^\beta(p_{ik}^a)^\gamma \quad \text{units of $A_1$, and}$$

$$\gamma \Gamma u_k^{\gamma - 1}(p_{ik}^a)^\gamma(p_{ik}^a)^\gamma \quad \text{units of $A_2$}$$

are required in region $k \in \{1, 2\}$ to produce one unit of the composite input. Moreover, $f + (\sigma - 1)/\sigma$ units of the composite good are needed to produce $x$ units of a manufactured variety, resulting in the total costs of [using (4.3)]

$$c_1(x) = \Gamma \left( f + \frac{\sigma - 1}{\sigma} x \right) u^{\alpha + \beta}(\tau^a)^\gamma,$$

$$c_2(x) = \Gamma \left( f + \frac{\sigma - 1}{\sigma} x \right) u^\beta(\tau^a)^\beta.$$  

The fixed markup property of Lemma 2.1 implies

$$p_{11} = \Gamma u^{\alpha + \beta}(\tau^a)^\gamma, \quad p_{22} = \Gamma u^\beta(\tau^a)^\beta,$$

$$p_{21} = p_{22} \tau^m, \quad p_{12} = p_{11} \tau^m,$$

where $p_{kj}$ is the price of a variety produced in region $k$ and sold in region $j$ ($k, j \in \{1, 2\}$).

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3This $\eta$ is different from that of (3.8).

4They are different from the parameters in (3.14).

5To avoid the situation in which the forces working toward agglomeration always prevail, Fujita et al. (1999) impose such a condition in their Chapter 4.
For convenience of exposition, more notations are introduced here:

\[ \Phi \equiv w - (1 + w)\hat{\mu}, \quad \Psi \equiv 1 - \hat{\eta}(1 + w) \]  

(4.8)

Note that \((L + Lw)\hat{\mu}\) is the two-region total expenditure for \(A_1\), which requires an input of \(L(1 + w)\hat{\mu}/w\) workers in Region 1. Then \(L\Phi\) and \(L\Psi\) are, respectively, the total labor costs for the manufacturing sector in Regions 1 and 2. Both of them are positive, so we have \(w \in [w, \bar{w}]\).

Using the market-clearing conditions for the resource goods, manufacturing goods, and labor, we obtain an equation implicitly identifying the relationship between \(w\) and \(\phi^m\) in equilibrium:

\[
\mathcal{F}_2(w, \phi^m) \equiv \mathcal{C}_4(w) + \mathcal{C}_5(w)\phi^m + \mathcal{C}_6(w)(\phi^m)^2 = 0,
\]  

(4.9)

where

\[
\mathcal{C}_4(w) \equiv -\Psi + \alpha(1 - \mu - \eta),
\]

\[
\mathcal{C}_5(w) \equiv w^\alpha\Psi(t^a)^{\gamma - \beta} - w^\alpha\Phi(t^a)^{\delta - \gamma},
\]

\[
\mathcal{C}_6(w) \equiv \Phi - \alpha(1 - \mu - \eta).
\]

Unfortunately, the wage equation (4.9) is generally not explicitly solvable. Let \(\bar{w}\) be the solution implicitly given by (4.9). Including the possibility of a corner solution, the equilibrium wage rate is

\[
w = \begin{cases} 
\bar{w}, & \text{if } \bar{w} > \bar{w} \\
\bar{w}, & \text{if } \bar{w} \in [w, \bar{w}], \\
w, & \text{if } \bar{w} < w
\end{cases}
\]

and the equilibrium firm share is

\[
\lambda = \begin{cases} 
1, & \text{if } \bar{w} > \bar{w} \\
\Phi + \bar{w}\Psi(t^a)^{\gamma - \beta}, & \text{if } \bar{w} \in [w, \bar{w}], \\
0, & \text{if } \bar{w} < w
\end{cases}
\]  

(4.10)

Note that \(\bar{w} \in [w, \bar{w}]\) holds iff \(\Phi(\bar{w}) > 0\) and \(\Psi(\bar{w}) > 0\).

Equipped with this model, Takatsuka et al. (2015) are able to investigate the effects of resource booms, i.e., a certain resource suddenly becoming more important or fashionable so that it takes a higher expenditure share. Specifically, the following four types are examined:

(B1) A boom in Region 1’s resource good as a final good,
(B2) A boom in Region 2’s resource good as a final good,
(B3) A boom in Region 1’s resource good as an intermediate good, and
(B4) A boom in Region 2’s resource good as an intermediate good.

The above events are modeled by respectively increasing \(\mu, \eta, \beta, \) and \(\gamma\). Note that these cases cannot be completely isolated. For example, in (B1), an increase in \(\mu\) mainly implies more consumption of \(A_1\) as a final good. However, it also leads to less consumption of manufacturing goods, decreasing the use of \(A_1\) as an intermediate input. In addition, since \(\alpha + \beta + \gamma = 1\), a change in \(\beta\) (resp. \(\gamma\)) may alter both \(\gamma\) (resp. \(\beta\)) and \(\alpha\). For simplicity, we fix \(\gamma\) when \(\beta\) changes and fix \(\beta\) when \(\gamma\) changes, while allowing \(\alpha\) to adjust to satisfy \(\alpha + \beta + \gamma = 1\). In other words, the resource good that experiences a boom substitutes for labor in production if it is used as an intermediate good.

The effects on welfare are also examined here. To emphasize that the real wages depend on the trade freeness in both the manufacturing sector and the resource sector, we use the following notations:

\[
\omega_1(\phi^m, \phi^a) \equiv w \cdot P_1^{(1-\mu-\eta)}(p_{11}^a)^{-\mu}(p_{21}^a)^{-\eta}
\]

\[
\omega_2(\phi^m, \phi^a) \equiv 1 \cdot P_2^{(1-\mu-\eta)}(p_{12}^a)^{-\mu}(p_{22}^a)^{-\eta}
\]

For convenience of comparison, we concentrate on two special cases in the following analysis. Section 4.1.1 explores the situation when manufactured goods are freely traded, while Sect. 4.1.2 explores the situation when resource goods are freely traded. See Takatsuka et al. (2015) for the case of general transportation costs.
4.1.1 The case of $\tau^m = 1$

In this case, for manufactured goods, the market-access advantage disappears, so industrial location is determined by the balance of the supplier access and the production cost. Specifically, when transport costs of resource goods are high, the region whose resource is more intensively used in manufacturing is more attractive to firms, since access to this resource is more important. However, when transport costs of resource goods are low, the reverse occurs.

The wage equation is solvable when $\phi^m = 1$. Let $\phi^a = 1/\tau^a$, which is called the trade freeness of resource goods. The solution for (4.9) is

$$\tilde{w} = (\phi^a)^{\frac{\mu}{\mu - \eta}},$$

(4.11)

which is increasing or decreasing with $\phi^a$, depending on whether $\beta < \gamma$ holds. In addition, from (4.8), (4.10), and (4.11), we have

$$\lambda = \frac{\Phi}{\Phi + \Psi} = \frac{\tilde{w}(1 + \tilde{w})\mu}{(1 - \tilde{\mu} - \tilde{\eta})(1 + \tilde{w})},$$

for an interior equilibrium. In particular, when $\phi^a = 1$, we get

$$\lambda = \lambda \equiv \frac{1 - 2\tilde{\mu}}{2\alpha(1 - \mu - \eta)} \in \left(0, \frac{1}{2}\right).$$

This suggests that if $\phi^a$ is sufficiently large, the region with a resource advantage accommodates fewer firms. This is exactly the so-called Dutch disease in terms of industry share. In fact, if manufacturing firms are evenly distributed, the wage rate in Region 1 is higher because Region 1 produces a more highly used resource good. The higher wage rate drives out manufacturing firms since the supplier-access effect is now negligible, and thus, Region 1 has fewer firms.

Takatsuka et al. (2015) show the following more precise result. If $\beta > \gamma$ (resp. $\beta < \gamma$), (i) the equilibrium wage rate $w$ in Region 1 monotonically decreases (resp. increases) with $\phi^a \in (0, 1)$, and $w \in [\underline{w}, \overline{w}]$ (resp. $w \in [\overline{w}, \underline{w}]$), and (ii) the industry share $\lambda$ in Region 1 monotonically decreases (resp. increases) with $\phi^a \in (0, 1)$, and $\lambda \in [\underline{\lambda}, \overline{\lambda}]$ (resp. $\lambda \in [\overline{\lambda}, \underline{\lambda}]$). In other words, $\beta > \gamma$ results in $w \geq \overline{w}$ and $\lambda > 1/2$ for a small $\phi^a$. Making better use of one’s resources as manufacturing inputs attracts firms to the region. This motivates local governments to support resource development.

However, a fall in $\tau^m$ (i.e., an increase in $\phi^a$) represents integration of the resource markets, which weakens the tendency of industry agglomeration in the region with a resource advantage. Eventually, Dutch disease in terms of industry share occurs for a sufficiently large $\phi^a$.

The left panel in Fig. 12 plots two numerical examples showing how the equilibrium wage rate is related to $\phi^a$. The solid curve is the case of $\beta > \gamma$ while the dashed curve is the case of $\beta < \gamma$. Other parameters are $\mu = 0.4$, $\eta = 0.35$, and $\sigma = 5$. This setting satisfies our assumptions (4.2), (4.5), and (4.6). The right panel of Fig. 12 plots the equilibrium firm share. We see that a corner equilibrium occurs when $\phi^a$ is small, but it evolves to an interior one when $\phi^a$ increases in both examples.

Regarding resource booms, we explore their effects on the equilibrium firm share $\lambda$. For (B3) and (B4), we employ three representative values: (i) $\lambda$ at $\phi^a = 1$ (i.e., $\lambda$); (ii) $\bar{\phi}$, satisfying $\bar{w}(\bar{\phi}) = \overline{w}$ for $\beta > \gamma$; and (iii) $\phi^m$, satisfying $\tilde{w}(\phi^m) = \underline{w}$ for $\beta < \gamma$. In other words, $\bar{\phi}$ (resp. $\phi^m$) is the maximum value of $\phi^a$, bringing about $\overline{w}$ (resp. $\underline{w}$), i.e., full agglomeration in Region 1 (resp. 2). From (4.11), we have

$$\bar{\phi} = \frac{\overline{w}}{\overline{w} - \eta}, \quad \phi^m = \frac{\underline{w}}{\underline{w} - \eta}.$$  

Their results are as follows.

---

The definition of trade freeness depends on the models used. It has a different form in (3.33).
Proposition 4.1. Effects of resource booms if $\phi^m = 1$

(B1) $\frac{\partial \lambda}{\partial \mu} < 0$,  
(B2) $\frac{\partial \lambda}{\partial \eta} > 0$,  
(B3) $\frac{\partial \lambda}{\partial \beta} < 0$ and $\frac{\partial \phi^A}{\partial \beta} > 0$ if $\beta > \gamma$,  
(B4) $\frac{\partial \lambda}{\partial \gamma} > 0$ and $\frac{\partial \phi^A}{\partial \gamma} > 0$ if $\beta < \gamma$.

The inequality in (B1) of Proposition 4.1 implies that an increase in resource consumption as a final good drives out manufacturing firms, because extraction of the resources raises the local wage rate. However, if the resource boom is used as an intermediate input, then it attracts firms to the region. (B3) in Proposition 4.1 shows that if $\beta > \gamma$ and the transportation costs of resource goods are high, such a resource boom strengthens the tendency for Region 1 to have all manufacturing firms. Meanwhile, the results on $\lambda$ indicate that the reverse may occur when the transportation costs of resource goods are negligible.

The contrasting results of (B3) and (B4) show the ambiguous impact on $\lambda$, which is also displayed in the right panel of Fig. 12. $\beta > \gamma$ ($\beta < \gamma$) holds for the solid (dashed) line. The dashed line is lower when $\phi^a$ is low but becomes higher when $\phi^a$ is large.

Since the manufactured goods are freely traded, we have $P_1 = P_2$ and

$$\frac{\omega_2(1, \phi^a)}{\omega_1(1, \phi^a)} = (\phi^a)^{\mu-n} \frac{1}{w}. \quad (4.12)$$

In an interior equilibrium, the wage rate is given by (4.11). The following results on the relative welfare are immediately obtained.

$$\frac{\omega_2(1, \phi^a)}{\omega_1(1, \phi^a)} \leq 1 \text{ and } \frac{\partial }{\partial \phi^a} \omega_2(1, \phi^a) \geq 0 \text{ if } \mu - \eta > \frac{\gamma - \beta}{\alpha} \text{ and } \phi^a \in (0, 1).$$

In the case of a corner equilibrium, (4.12) may be either bigger or smaller than 1, depending on the parameters $\beta$, $\gamma$, $\mu$, and $\eta$. In general, the resource advantage does not necessarily give a region higher welfare, and the advantage decreases with integration of the resource-good market. Thus, there is the possibility of a Dutch disease in terms of welfare.

4.1.2 The case of $\tau^a = 1$

When resource goods are freely traded, access to the resource suppliers is not important and is replaced by access to the markets of manufactured goods.

Let

$$w^+ = \frac{\bar{\mu}}{\bar{\eta}} \in (1, \bar{w}).$$

Takatsuka et al. (2015) show the following results: (i) the equilibrium wage rate $w$ in Region 1 monotonically decreases in $\phi^m [0, 1)$, and $w \in [1, w^+]$; and (ii) the mass of firms decreases in Region 1 and increases in Region 2 with respect to $\phi^m$.

Thus, when the manufactured goods markets in the two regions become more integrated, some firms in Region 1 will move to Region 2 to save on wage payment, lowering $w$. This process continues, until finally wages are equalized across regions when transportation in manufacturing is completely free at $\phi^m = 1$.

The above conclusions can be observed via the solid curves in Fig. 13, which provides a simulation example of $\sigma = 4$, $\mu = 0.32$, $\eta = 0.3$, $\alpha = 0.7$, $\beta = 0.2$, and $\gamma = 0.1$. Our assumptions (4.2), (4.5), and (4.6) hold in this setting. Panels (a) and (b) show how the nominal wage rate $w$ and the firm share in Region 1 depend on the trade freeness $\phi^m$. They show that, when trade freeness $\phi^m$ increases, both the wage rate $w$ and the industry share $\lambda$ decrease. The wage curve converges to $w = 1$, while the industry share curve cuts through the line of $\lambda = 1/2$ at a low level of $\phi^m$, leading directly to Dutch disease in terms of industry share. These results are similar to those in Fig. 12 when $\beta > \gamma$, although here we do not have full agglomeration. It is noteworthy that the market-access effect works as a centripetal force for Region 1 here, while the supplier-access effect plays this role in the previous case.

It is easy to see how a resource boom impacts wages. Given that labor in Region 2 is chosen as the numéraire, a decrease in $w$ implies an increase in the wage rate in Region 2.

We now analyze the impact of a resource boom on the industry share. Unlike the case of freely transported manufactured goods, here the equilibrium industry share is not analytically solvable. To gain more tractability, we employ three representative values: (i) $\lambda$ at $\phi^m = 0$ (i.e., $\lambda$), (ii) $\lambda$ at $\phi^m = 1$ (i.e., $\lambda$), and (iii) $\phi$ satisfying $\lambda(\phi) = 1/2$. Proposition 4.2 summarizes the comparative static results.

Proposition 4.2. (Effects of resource booms if $\phi^a = 1$). For $\phi^m \in (0, 1]$, the equilibrium wage rate $w$ increases in
(B1) and (B3) but decreases in (B2). Furthermore, we have

\[
\frac{\partial \lambda}{\partial \mu} > 0, \quad \frac{\partial \lambda}{\partial \eta} < 0, \quad \frac{\partial \phi}{\partial \mu} < 0, \quad (B2) \quad \frac{\partial \lambda}{\partial \eta} < 0, \quad \frac{\partial \lambda}{\partial \eta} > 0, \quad \frac{\partial \phi}{\partial \eta} > 0,
\]

\[
\frac{\partial \lambda}{\partial \beta} > 0, \quad \frac{\partial \lambda}{\partial \beta} < 0, \quad \frac{\partial \phi}{\partial \beta} < 0, \quad (B4) \quad \frac{\partial \lambda}{\partial \gamma} > 0, \quad \frac{\partial \phi}{\partial \gamma} > 0;
\]

In addition, \(\frac{\partial \phi}{\partial \beta}\) and \(\frac{\partial \lambda}{\partial \gamma}\) are both negative (positive) if the relative resource advantage in Region 1 is small (large).

In summary, our spatial economy model shows that the effects of resource booms on industrial location depend on how resources are used as well as on the trade freeness of the manufacturing sector. In particular, a resource boom in intermediate goods strengthens the tendency for the region to become the “home market,” while a resource boom in final goods weakens it. These results indicate the importance of developing industries that can effectively utilize resources in production rather than in consumption only. They are complementary to the results with free transportation of resource goods (see Proposition 4.1). Unlike the previous case, the impacts of the resource boom in final goods on industry shares can be positive in the present case, because the market access effect exerts a centripetal force here, and thus, a rise in regional income due to resource booms can attract firms.

There are some examples in which governments adopt policies to encourage the use of natural resources as manufacturing inputs. For instance, Yunnan Province in China is known for its forest resource. Governments there have thus, a rise in regional income due to resource booms can attract firms. There are some examples in which governments adopt policies to encourage the use of natural resources as manufacturing inputs. For instance, Yunnan Province in China is known for its forest resource. Governments there have adopted tax benefits and other measures to develop the local paper pulp industry since 2002, and succeeded in attracting manufacturing inputs. For instance, Yunnan Province in China is known for its forest resource. Governments there have thus, a rise in regional income due to resource booms can attract firms.

Accordingly, although the price index may be higher in Region 1 for a small \(\phi^m\), the higher income there makes the residents better off than those in Region 2. In contrast, the opposite becomes true for a large \(\phi^m\) (\(\neq 1\) though), because more firms choose to locate in Region 2 in this case, making the price index there lower than in Region 1, and thus the income differential \(w - 1\) becomes sufficiently small. This is a typical Dutch disease in terms of welfare.

Figure 14 confirms Proposition 4.3 via a numerical example. The parameters are the same as in Fig. 13. We see that the welfare of Region 2 increases in \(\phi^m\), while that of Region 1 decreases first and then increases. The welfare level is higher in Region 1 than in Region 2 for a low \(\phi^m\) but then becomes lower for a high \(\phi^m\). This theoretical result explains an interesting phenomenon in Young (2000), who reports that in the 1980s and early 1990s, many local governments imposed barriers against interregional trade within China, hoping to increase local welfare and reduce the income gap between those regions and more advanced ones. However, such protective local policies were almost completely abandoned voluntarily in this century in favor of free trade and the free migration of labor. The goal of such new policies is to attract more manufacturing industries.

Finally, a recent paper of Fujita and Hamaguchi (2019) rebuilds the framework of Krugman (1991) by introducing an
additional sector of brand agricultural products. Their model shows that highly differentiated brand agricultural goods can be sustained in the periphery even when the transport costs are high. Their brand agricultural goods are similar to the resource goods in this section in the sense that the products are differentiated and transported costly. However, they are different in the sense that an IRS technology and the homogeneous land resource are assumed in Fujita and Hamaguchi (2019). Nevertheless, the results are consistent in the sense that high transport costs in a remote region are not disastrous if the local product is highly differentiated.

4.2 Income transfer

In addition to the resource curse, the transfer paradox is also interesting. It is a situation in which an agent is hurt by accepting a gift of income, the donor of which is made better off. By introducing nontradable goods, Yano and Nugent (1999) reveal a mechanism showing how the transfer paradox is created in small countries.

Although the model built in Sect. 3.1.2 is unable to bring in a fully analytical solution to the long-run equilibrium in order to explore the effects of agricultural trade costs, it can be extended to examine the effects of a slight income transfer. We have two reasons to focus on a small income gift. On one hand, most income gifts in our real world are only a small part of the total income. On the other hand, taking differentiation is a convenient and effective way to analyze the effect of a small change in income.

The model is established by Morales (2021), who finds that deindustrialization in the recipient region may happen even when the two regions are originally symmetric if trade costs are low. To show the mechanism, a nontradable sector is incorporated into the model of heterogeneous agricultural goods in Sect. 3.1.2. For expositional clarity, the subsequent analysis assumes $\tau^d = 1$.

We make two changes to the model of Morales (2021). First, we assume that the income transfer is between immobile unskilled workers. In other words, the income transfer is from unskilled workers in Region 1 to unskilled workers in Region 2, while mobile skilled workers do not receive or give any income gifts. This simplifies the analysis of a long-term equilibrium. Second, while Morales (2021) assumes the same elasticity in the manufacturing and agricultural sectors, we differentiate them to gain more results regarding the agricultural sector without sacrificing too much convenience.

A nontradable sector (or a “service sector”) is added to the model of Sect. 3.1.2. The utility of (3.1) is replaced by

$$U = M^{\mu_1} S^{\mu_2} A^{\lambda - \mu},$$

where $\mu = \mu_1 + \mu_2$. The agricultural goods in the two regions are differentiated, so $A$ takes the form of (3.8).

Let $t$ be the tax rate that is imposed on the income of each unskilled worker in Region 1. The tax income, $tLw^a_1$, is transferred to unskilled workers in Region 2. Thus, the disposable incomes in the two regions are

$$Y^d_1 = Y_1 - tLw^a_1, \quad Y^d_2 = Y_2 + tLw^a_1,$$

respectively, where $Y_1$ and $Y_2$ are given by (3.5).

Assuming that the services and agricultural goods are produced under perfect competition, with unskilled workers as the only production input, their units are chosen to be the output of one unskilled worker. In Region $r = 1, 2$, the labor input in the nontradable sector is

---

10The paradox is clearer when the trade costs of the agricultural goods are positive. However, the expressions are too complicated.
\[ L_r^* = \mu_2 \frac{Y_r^0}{w_r^0}, \quad (4.13) \]

and the labor input in the agricultural sector is

\[ L_r^0 = (1 - \mu) \frac{(w_r^0)^{\gamma-\eta}}{(w_r^0)^{\gamma-\eta} + (w_r^0)^{\gamma-\eta}} \frac{Y_r^0 + Y_r^0}{w_r^0}. \quad (4.14) \]

As in Sect. 3.1.2, we choose the unskilled labor in Region 2 as the numéraire so that \( w_2^0 = 1 \). The labor-clearance condition of the unskilled workers leads to \( L_r^0 = L_1 - L_2^0 \). Thus, Eqs. (4.13), (4.14), and (3.9) give the following expressions of wage rate \( w_r \) for \( r = 1, 2 \):

\[
\begin{align*}
    w_1 &= \frac{L((w_r^0)^{\gamma}(1 - \mu_2 + t\mu_2)(\sigma - \mu_1) + w_r^0[t\mu_2(\sigma + 1 + \mu_2)] - (1 - \mu_2)\sigma}, \\
    w_2 &= \frac{L((1 - \mu_2 - t\mu_2 w_r^0)(\sigma - \mu_1) + (w_r^0)^{\gamma-1}\mu_1(\sigma - 1 + \mu_2) - (w_r^0)^{\gamma}[t\mu_2(\sigma - \mu_1) + (1 - \mu_2)\sigma]}{(1 - \lambda)H(\sigma - \mu_1)(\sigma - 1 + \mu_2)(w_r^0)^{\gamma-1} + 1},
\end{align*}
\]

\[ L_1 = \frac{L((\sigma - 1)(1 - (1 - t)\mu_2)(\sigma - \mu_1) + w_r^0[t\mu_2(\sigma + 1 + (1 - t)\mu_2)] - (1 - \mu_2)\sigma]}{(\sigma - \mu_1)(\sigma - 1 + \mu_2))((w_r^0)^{\gamma-1} + 1}.
\]

Furthermore, the regional incomes are

\[
\begin{align*}
    Y_1 &= \frac{w_r^0 L}{\sigma - 1 + \mu_2} \left[ \frac{\sigma}{\sigma - \mu_1} \frac{(w_r^0)^{\gamma}(\sigma - \mu_1) + w_r^0(\sigma - 1 + \mu_2)}{(w_r^0)^{\gamma} + (w_r^0)^{\gamma}} + t\mu_2, \\
    Y_2 &= \frac{L}{\sigma - 1 + \mu_2} \left[ \frac{\sigma}{\sigma - \mu_1} \frac{\sigma - \mu_1 + (w_r^0)^{\gamma-1}(\sigma - 1 + \mu_2) - (w_r^0)^{\gamma}(1 - \mu) - tw_r^0\mu_2}{1 + (w_r^0)^{\gamma-1}}, \right.
\end{align*}
\]

and the national income is

\[ Y^n = Y_1 + Y_2 = \frac{\sigma L}{\sigma - \mu_1}(w_r^0 + 1), \quad (4.17) \]

which replaces (3.12) due to the nontradable sector. None of the above expressions depend on \( \lambda \) explicitly. Therefore, Lemma 3.1 holds again.

The trade balance between the two regions is described by

\[
\begin{align*}
    \mu_1 n^w &\left[ \frac{\phi^\mu(1 - \lambda)}{P_1^{\gamma-\eta}} (Y_1 - tLw_r^0) - \frac{\phi^\mu(1 - \lambda)}{P_1^{\gamma-\eta}} (Y_2 + tLw_r^0) \right] \nonumber \\
    &+ \frac{1 - \mu}{(w_r^0)^{\gamma-\eta} + 1} \left[ Y_1 - tLw_r^0 - Y_2 + tLw_r^0 \right] + tLw_r^0 = 0,
\end{align*}
\]

(4.18)

where \( P_1 \) and \( P_2 \) are price indices given by (3.4).

Let \( s_r = Y_r / Y^n \) be the income share in Region 1. Equation (4.18) has a more convenient form in terms of \( s_r \):

\[
\begin{align*}
    &\mathcal{B} \equiv \mu_1 \left\{ \phi^\mu(1 - \lambda) \frac{(w_r^0)^{\gamma-\eta}}{(w_r^0)^{\gamma-\eta} + (1 - \lambda)\phi^\mu} \left[ s_r \frac{(\sigma - \mu_1)tw_r^0}{\sigma(w_r^0 + 1)} \right] - \frac{\phi^\mu(1 - \lambda)}{P_1^{\gamma-\eta}} \frac{(w_r^0)^{\gamma-\eta}}{(w_r^0)^{\gamma-\eta} + 1} \right\} \\
    &+ \frac{1 - \mu}{(w_r^0)^{\gamma-\eta} + 1} \left[ s_r \frac{(\sigma - \mu_1)tw_r^0}{\sigma(w_r^0 + 1)} - \frac{1 - s_r}{\sigma(w_r^0 + 1)} \right] \left[ (w_r^0)^{\gamma-\eta} \right] + \frac{(\sigma - \mu_1)w_r^0}{\sigma(w_r^0 + 1)} = 0.
\end{align*}
\]

\[
\begin{align*}
    &4.2.1 \textbf{ Short-run analysis} \\
    &\text{In a short-run equilibrium, the distribution of skilled workers, } \lambda, \text{ is fixed. Since (4.16) and (4.17) do not depend on } \lambda, \text{ they are valid in our short-run analysis.} \\
    &\text{Substituting (4.16) into (4.19), we obtain an equation implicitly giving } w_r^0 \text{ as a function of } t. \text{ For a small } t, \text{ the implicit function theorem yields}
\end{align*}
\]

\[
\begin{align*}
    &\frac{dw_r^0}{dt} \bigg|_{t=0} = \left. \frac{\partial \mathcal{B}}{\partial w_r^0} \right|_{t=0} + \left. \frac{\partial \mathcal{B}}{\partial w_r^0} \right|_{t=0} = 0 < 0,
\end{align*}
\]

(4.20)

where the inequality comes from
where \((4.20)\) is applied and

\[
\frac{\partial B}{\partial t} \bigg|_{t=0} + \frac{\partial B}{\partial s_y} \frac{\partial s_y}{\partial t} \bigg|_{t=0} = \frac{w_1^r(\sigma - \mu_1)}{(1 + w_1^r)^\sigma(\sigma - 1 + \mu_2)} \nonumber \\
\times \left\{ \mu_2 \sigma + \frac{\mu_1(\sigma - 1)\lambda(1 - \lambda)(1 - \phi^m)^{\sigma - 1}(1 - \lambda)^2}{\lambda + (\mu_1^r)^{\sigma - 1}(1 - \phi^m)} \right\} > 0,
\]

\[
\frac{\partial B}{\partial w_1^r} \bigg|_{t=0} = \frac{(w_1^r)^\eta(1 - \lambda)\mu_1(\sigma - 1)\phi^m}{[(w_1^r)^\eta(1 - \lambda) + w_1^r\phi^m]^2} \left\{ \frac{(w_1^r)^\eta(1 - \lambda)}{\lambda + (w_1^r)^\eta(1 - \lambda)\phi^m} \right\} [1 - (\phi^m)^2]s_y + C_7
\]

\[
+ \frac{(w_1^r)^\eta(\eta - 1)(1 - \mu)}{[w_1^r + (w_1^r)^\eta(\eta + 1)]^2} > 0,
\]

\[
\frac{\partial B}{\partial s_y} \bigg|_{t=0} = 1 - \mu + \frac{(1 - \lambda)\mu_1\phi^m}{(w_1^r)^\eta(1 - \lambda) + (\mu_1)^\eta(\sigma + 1)} + \lambda\mu_1\phi^m > 0,
\]

\[
\frac{\partial^2 B}{\partial s_y^2} \bigg|_{t=0} = \frac{\lambda(1 - \lambda)^2}{1 + (w_1^r)^\eta(\eta + 1)}(\mu_2 + \sigma - 1) + \frac{\sigma - \mu_1}{1 + (w_1^r)^\eta(\eta + 1)} > 0,
\]

and where \((4.21)\) is due to

\[
C_7 = 1 - \left[ \frac{\lambda}{\lambda + (w_1^r)^\eta(1 - \lambda)\phi^m} \right] [1 - (\phi^m)^2]s_y > 0.
\]

Thus, a slight income transfer increases the relative wage rate of the unskilled workers in the recipient region in the short run. This effect also decreases the total income, \(V^w\), according to \((4.17)\). The rising labor cost of unskilled workers in Region 2 may push industrial firms out of the country. To observe this, we focus on the labor input in the industrial sector in Region 2, assuming a slight tax imposed on the symmetric equilibrium \(\lambda = 1/2\), in which \(w_1^r = 1\).

Using \((4.15)\), we have

\[
\frac{dL^w_{2r}}{dt} \bigg|_{t=0, \lambda \leftarrow \frac{1}{2}, w_1^r \leftarrow 1} = \frac{dL^w_{2r}}{dt} \bigg|_{t=0, \lambda \leftarrow \frac{1}{2}, w_1^r \leftarrow 1} + \frac{dL^w_{2r}}{dt} \bigg|_{t=0, \lambda \leftarrow \frac{1}{2}, w_1^r \leftarrow 1} \nonumber \\
= \frac{(\sigma - \mu_1)[2\mu_2 + (1 - \mu)\eta]}{2\phi^m \mu_1(2\sigma - 1 + \phi^m)(\sigma - 1 + \mu_2) + \eta(1 - \mu)(1 + \phi^m)[\sigma(1 + \phi^m) - \mu_1(1 - \phi^m)]} \nonumber \\
\times \left\{ \phi^m + \frac{(1 - \mu)\sigma}{[2\mu_2 + (1 - \mu)\eta]\phi^m} \right\} (\phi^m - \phi_{sr}^m),
\]

where \((4.20)\) is applied and

\[
\phi_{sr}^m = \phi^m \sqrt{\frac{\mu^2(2\sigma - 1)^2 + 2(1 - \mu)\mu_2\eta + (1 - \mu)^2\eta^2 + 2\mu_2(2\sigma - 1)}{\mu_2(2\sigma - 1)^2 + 2(1 - \mu)\mu_2\eta + (1 - \mu)^2\eta^2 + 2\mu_2(2\sigma - 1)}} \in [0, 1].
\]

Expression \((4.22)\) indicates that \(L^w_{2r}\) shrinks by a slight income transfer from Region 1 if and only if \(\phi^m > \phi_{sr}^m\). If the motivation of income transfer is to help Region 2 to develop the industrial sector, this result shows that the aim may fail if trade is sufficiently free. Note that \(\phi_{sr}^m = 1\) if \(\mu_2 = 0\). Therefore, the motivation is always successful if there are no nontradable goods. On the other hand, since \(\phi_{sr}^m\) increases with \(\eta\), this effect is stronger when the agricultural goods are less substitutable.

### 4.2.2 Long-run analysis

Ignoring a constant \(\mu_1^{\mu_1} \mu_2^{\mu_2} (1 - \mu)^{1 - \mu}\), the indirect utility of skilled workers in region \(r\) is

\[
V_r = \frac{w_r}{P_r^w(p_r^w)^\sigma(P_r^w)^{1-\mu}}, \quad r = 1, 2,
\]

where \(p_r^w\) is the price of a local service (nontradable good), which is supposed to be equal to \(w_r^w\), the wage rate of unskilled workers in region \(r\). In the long run, skilled workers are mobile across regions. We use the following dynamic system to model the migration of skilled workers:

\[
\frac{d\lambda}{dt} = \lambda(1 - \lambda)\Delta V,
\]

where \(\Delta V \equiv V_1 - V_2\) is the utility differential between the two regions. This is the so-called replicator dynamic, which is a positive definite dynamic (Tabuchi and Zeng, 2004).

Therefore, in an interior long-run equilibrium, equality \(\Delta V = 0\) holds, which is written as
\[
\Delta V = \frac{[1 + (u_1^0)^{\frac{1}{\alpha}}\frac{1}{\alpha-1}]^{\frac{1}{\alpha-1}}(\sigma - \mu_1)(\sigma + 1 - \mu_2)}{(u_1^0)^{\alpha}(\sigma - \mu_1)(\sigma + 1 - \mu_2)} L \left(\frac{H}{F}\right)^{\frac{1}{\alpha}} \left[1 + \frac{1}{\lambda} [(u_1^0)^{-\alpha}(1 - (1 - t)\mu_2)\sigma - \mu_1] + \frac{1}{(u_1^0)^{\alpha}(1 - (1 + \mu_1)(1 - \mu_2)]\sigma - \mu_1] + \frac{1}{1 - \lambda} [(u_1^0)^{\alpha}(1 - \lambda)\sigma - \mu_1] - [(u_1^0)^{-\alpha}(1 - \lambda)\sigma - \mu_1] + \frac{1}{1 - \lambda} \right] \times [1 - \lambda + (u_1^0)^{\alpha}(\lambda\phi^m)^{\frac{1}{\alpha}}]
\]

\[= 0. \quad (4.24)\]

To emphasize that \(\Delta V\) depends on \(t, u_1^0, \text{and} \lambda\), it is henceforth also denoted by \(\Delta V(t, u_1^0, \lambda)\). Similarly, the LHS of (4.19) is denoted as \(\mathcal{B}(t, u_1^0, \lambda)\) when \(s_0\) is substituted according to (4.16) and (4.17). Thus, for a given tax rate \(t\), we have two equations (4.24) and \(\mathcal{B}(t, u_1^0, \lambda) = 0\) to determine two unknowns \(u_1^0\) and \(\lambda\) in a long-run equilibrium. Denote the equilibrium by \(E_0 = [u_1^0(t), \lambda(t)]\). We focus on a small income transfer from Region 1 to Region 2 when the symmetric distribution is stable.

According to Tabuchi and Zeng (2004), the stability of symmetric equilibrium \(E_0 = [u_1^0(0), \lambda(0)] = [1, 1/2]\) is equivalent to

\[
0 > \left. \frac{d\Delta V(0, u_1^0, \lambda)}{d\lambda} \right|_{E_0} = \left. \frac{\partial \Delta V(0, u_1^0, \lambda)}{\partial \lambda} \right|_{E_0} + \left. \frac{\partial \Delta V(0, u_1^0, \lambda)}{\partial u_1^0} \right|_{E_0} \left. \frac{du_1^0}{d\lambda} \right|_{E_0}
\]

\[
= - \frac{G_3}{G_4} G_0 + G_1\phi^m + G_2(\phi^m)^2,
\]

where

\[
G_0 = (1 - \mu)\eta\mu_1 + \mu_2^2 + (\sigma - 1 - 2\mu_1)\sigma_1,
\]

\[
G_1 = 2[\eta\mu_1^2 - \mu_2^2](\eta - 1)(1 - \mu_2 + \sigma - \eta(1 - \mu_2)(\sigma + 1)\sigma
\]

\[
+ \mu_1(\sigma - 1)[3 + 2\mu_2 + (\eta - 5)\sigma_1 - 2\sigma^2 + \mu_2(4\sigma - 5)]],
\]

\[
G_2 = (\mu_1 + \sigma - 1)[\eta(1 - \mu_1 + 2\mu_1)(\sigma - 1) + 2\mu_1\mu_2 + \eta(1 - \mu_2 - \mu_1)] > 0,
\]

\[
G_3 = 2^{\frac{1}{\alpha}} + \frac{1}{\alpha} H^{\frac{1}{\alpha}} L^{\frac{1}{\alpha}} M^{\frac{1}{\alpha}}(1 + \phi^m)^{\frac{1}{\alpha}} > 0,
\]

\[
G_4 = (\sigma - \mu)(\sigma - 1)[2\mu_1(\sigma_2 + \sigma - 1)\phi^m(2\sigma - 1 + \phi^m) + \eta(1 - \mu)(1 + \phi^m)](\sigma(1 + \phi^m) - \mu_1(1 - \phi^m))] > 0.
\]

Since \(G_3\) and \(G_4\) are positive, we assume

\[
G \equiv G_0 + G_1\phi^m + G_2(\phi^m)^2 > 0
\]

when we analyze the effect of an income transfer on the symmetric equilibrium.

Now we are able to examine the effect of a slight income transfer from Region 1 to Region 2 on firm location and the relative wage rate of unskilled workers. Taking the total differential of \(\mathcal{B}(t, u_1^0, \lambda) = 0\) and \(\Delta V(t, u_1^0, \lambda) = 0\) with respect to \(t\) at \(E_0\), we obtain

\[
\frac{\partial \mathcal{B}(t, u_1^0, \lambda)}{\partial t} \bigg|_{E_0} + \frac{\partial \mathcal{B}(t, u_1^0, \lambda)}{\partial u_1^0} \bigg|_{E_0} (u_1^0)'(0) + \frac{\partial \mathcal{B}(t, u_1^0, \lambda)}{\partial \lambda} \bigg|_{E_0} \lambda'(0) = 0,
\]

\[
\frac{\partial \Delta V(t, u_1^0, \lambda)}{\partial t} \bigg|_{E_0} + \frac{\partial \Delta V(t, u_1^0, \lambda)}{\partial u_1^0} \bigg|_{E_0} (u_1^0)'(0) + \frac{\partial \Delta V(t, u_1^0, \lambda)}{\partial \lambda} \bigg|_{E_0} \lambda'(0) = 0.
\]

Solving for \(\lambda'(0)\) and \((u_1^0)'(0)\) from the above two equations, we have

\[
\lambda'(0) = \frac{(\sigma - \mu)(\sigma - 1)}{2\sigma G} G_5, \quad (u_1^0)'(0) = \frac{2(\sigma - \mu_1)(1 - \phi^m)}{\sigma G} G_6,
\]

where

\[
G_5 = \mu_2^2[\sigma - 1)(1 - \phi^m)^2 + \mu_2(2\sigma - 1) + \sigma(\mu_1 - \eta - \mu)](1 - (1 - \phi^m)) + \mu_2(1 - \phi^m)^2,\]

\[
G_6 = \mu_1(\sigma - 1)[\mu_1(1 - \phi^m) - (\sigma - 1)(1 + \phi^m)] + \mu_2[\sigma(1 + \phi^m) - (\sigma - 1)(1 - \phi^m)].
\]

The above results indicate some interesting facts. First, the existence of a nontradable sector is very important in analyzing the effect of income transfer. Note that under the no-black-hole condition of \(\sigma > 1 + \mu_1\), we have
for \( \phi^m \in (0, 1) \). Therefore, without the nontradable sector, a slight income transfer promotes industrialization and increases the relative wage rate of unskilled workers in the recipient region. This result supports the motivation of income transfer. However, when \( \mu_2 > 0 \), we have

\[
G_5|_{\mu_2=0} = -\mu_1(1 - \mu_1)(\sigma - 1)[1 - (\phi^m)^2] - 2\mu_1^2(\sigma - 1)(1 - \phi^m)\phi^m - \eta\sigma(1 - \mu_1)[1 - (\phi^m)^2] < 0,
\]

\[
G_6|_{\mu_2=0} = -\mu_1(\sigma - 1)\left[(\sigma - 1 - \mu_1)(1 - \phi^m) + 2(\sigma - 1)\phi^m\right] < 0,
\]

for \( \phi^m \in (0, 1) \). Therefore, without the nontradable sector, a slight income transfer promotes industrialization and increases the relative wage rate of unskilled workers in the recipient region. This result supports the motivation of income transfer. However, when \( \mu_2 > 0 \), we have

\[
G_5|_{\phi^m=0} = -(1 - \mu)[(\sigma + \eta) - \mu_1] < 0,
\]

\[
G_5|_{\phi^m=1} = 4\mu_2\sigma(\mu_1 + \sigma - 1) > 0.
\]

Since \( G_5 \) is a quadratic function of \( \phi^m \), there is a threshold value, \( \phi^m_{05} \in (0, 1) \), such that \( G_5 > 0 \) for all \( \phi^m \in (\phi^m_{05}, 1) \). In other words, a slight income transfer always deindustrializes the recipient region if trade in the manufacturing sector is free enough, as long as some nontradable goods exist.

Furthermore, \( G_6 \) might also be positive when \( \sigma \) is small, which is in contrast to the result of (4.20) on the short-run equilibrium. In other words, both \( \lambda'(0) \) and \( (u^d_1)'(0) \) might be positive. Figure 15 plots a numerical result showing how the effect of a slight income transfer on the firm share (i.e., \( \lambda'(0) \)) depends on \( \phi^m \). The parameters are specified as

\[
\mu_1 = 0.2, \quad \mu_2 = 0.6, \quad \sigma = 1.6, \quad \eta = 5.
\]

(4.25)

Note that we also plot \( G \) in the figure (the dotted curve) to show that the condition of \( G > 0 \) is met. We find that \( \lambda'(0) \) (the solid curve) and \( (u^d_1)'(0) \) are positive when \( \phi^m \) is large. In summary, we have the following.

**Proposition 4.4.** A slight income transfer from Region 1 to Region 2 will deindustrialize the recipient region and reduce the nominal wages of unskilled workers in the recipient region when trade costs of the manufactured goods are low, even when the two regions are symmetric.

In addition to the existence of a nontradable sector, the heterogeneity of the agricultural goods is also crucial to deriving the interesting result on the firm location. More specifically, we have

\[
\frac{dG_5}{d\eta} = -(1 - \mu)\sigma[1 - (\phi^m)^2] < 0.
\]

Therefore, \( G_5 \) is more likely to be positive if the agricultural goods are more heterogeneous. In fact, the short-run equilibrium analysis reveals that the income transfer increases the relative wage rate of unskilled workers in Region 2 immediately [see (4.20)]. Consequently, the marginal cost in manufacturing production rises so that more firms move to Region 1 to reduce labor costs.

Recall that the motivation of the Hometown Tax Donations policy in Japan is to promote economic development in remote regions, so the above theoretical results on income transfer suggest that the policy is effective in regions whose agricultural good is not differentiated too much and the trade costs in the manufacturing sector are not too low.

Although income transfer may deindustrialize the recipient region, the welfare change is not likely to be paradoxical. Figure 16 shows the result on the change in the welfare of unskilled workers in the two regions. Let \( V_r(t) \) be the indirect utility of unskilled workers in Region \( r \) when the tax rate on the income of unskilled workers in Region 1 is \( t \). The curves are \( V_1'(0) \) in the numerical example of (4.25). We can see that \( V_1'(0) < 0 \) and \( V_2'(0) > 0 \) for all \( \phi^m \in [0, 1] \). This is because the direct effect of a change in income is stronger than the indirect effect of a change in firm location.
4.3 A model for tourism

Promoting tourism is considered to be an effective policy in many countries because it attracts foreign currency, generates employment, and promotes regional economic activity.

To investigate the effect of tourism on other sectors, Zeng and Zhu (2011) reformulate the FC model by adding tourism as a nontradable sector. The homogeneous agricultural sector remains to equalize the wage rates in the two countries. Production in the tourism sector inputs the local (natural) resource as a factor. The resource costs are explicitly incorporated in the model in order to generate the income effect in the tourism sector.

Specifically, there are three factors: labor, capital, and natural resources. The world population is denoted by $L_w$; of them are in Country 1, and $(1 - \theta)$ of them are in Country 2. As an FC model, we assume that $\theta > 1/2$. The world-capital endowment is denoted by $K_w$ and is equally shared by all workers. There are $\theta K_w$ units of capital in Country 1 and $(1 - \theta) K_w$ units of capital in Country 2. The world endowment $S^w$ of natural resources is denoted by $S^w$: $\varepsilon$ of them are located in Country 1 and $1 - \varepsilon$ of them in Country 2.

The distribution of endowments is summarized in Table 1. Labor and natural resources are immobile between countries but physical capital is mobile. As in Sect. 3.3.2, the share of capital employed in Country 1 is denoted by $\theta$. The employed capital in each country comes from the two countries with the same ratio $\theta$ for any $\lambda$. Therefore, the average capital returns in two countries are always the same.

There are three kinds of products: the numeraire good $A$ produced in the agricultural sector, tourism goods $T_i$ produced in the tourism sector of Country $i$, and the composite manufactured good of (3.2).

The preferences of consumers in Country $i = 1, 2$ are described by the following Cobb-Douglas utility functions:

$$U_i = (T_1^\gamma T_2^{1-\gamma})^\mu A^{(1-\mu)(1-\xi)}$$

where parameters satisfy $\mu \in (0, 1)$, $\xi \in [0, 1)$, $\gamma \in [0, 1]$. Note that $T_1$ and $T_2$ take a Cobb-Douglas form inside the tourism sector, and therefore, they are differentiated. If $\gamma = 1$ (resp. 0), tourism services are provided in Country 1 (resp. Country 2) only. Consuming the foreign tourism good requires traveling to the other country. To ease the burden of notations, we do not address the traveling costs here. Interested readers can refer to Sect. 6 of Zeng and Zhu (2011) for a more complete discussion.

Now we turn to production. The agricultural sector is the simplest one, supplying the homogeneous good under perfect competition using labor as the only input of a CRS technology. The productivity is normalized to 1. The population in each country is assumed to be large enough for the country to produce the agricultural good. The transport of the agricultural good is free; therefore, the wages in both countries are the same, $w_1 = w_2 = 1$. The tourism sector supplies the tourism goods under perfect competition using labor and natural resources under a CRS technology. We assume Leontief technology in the production of tourism goods. Two factors (labor and natural resources) are,

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11The units of natural resources and tourism goods will be introduced later.
therefore, not substitutable, which is an important feature of nonrenewable resources in ecotourism. For simplicity, the
unit of natural resources and the unit of tourism goods are chosen so that one unit of natural resources and one unit of
labor\(^{12}\) produce one unit of tourism goods in both countries. Therefore, the cost of one unit of tourism services in
Country \(i\) is \(w_1 + s_i\), where \(s_i\) is the price of natural resources in Country \(i\). We will see in the equilibrium analysis that
this Leontief technology helps us to capture the resource-movement effect. The natural resources, such as underground
hot springs, beaches, and mountains, are owned by the national governments, and the resource rents, \(s_i\), are uniformly
distributed among local residents.

The manufacturing sector is also simpler than the model in Sect. 4.1. Offering a continuum of varieties of
differentiated goods, monopolistically competitive firms use labor and capital under IRS. Natural resources are not
input to the manufacturing production. We choose the units of manufactured goods and capital so that in order to
produce a variety \(v\), the firm needs a fixed input requirement of one unit of capital and a marginal input requirement of
\((\sigma - 1)/\sigma\) units of labor. The masses of firms in the two countries are \(n_1 = \lambda K^w\) and \(n_2 = (1 - \lambda)K^w\). In this model,
only the products in the manufacturing sector incur transportation costs, we simply use \(\tau\) to denote their iceberg trade
cost, and \(\phi = \tau^{-1}\) denotes their trade freeness. By Lemma 2.1, the equilibrium prices are \(p_{ii} = 1\) and \(p_{ij} = \tau\) for
\(i, j = [1, 2], i \neq j\). Therefore, the manufacturing price indices are simply

\[
P_1 = \left(1 + \phi(1 - \lambda)\right)K^w \quad \text{and} \quad P_2 = \left(\phi(1 + 1 - \lambda)\right)K^w.
\]

In the short run, capital is not mobile. We then obtain the capital returns as follows:

\[
r_1 = \frac{\mu(1 - \xi)}{\sigma K^w} \left[\frac{E_1}{\lambda + \phi(1 - \lambda)} + \frac{E_2}{\phi\lambda(1 - \lambda)}\right],
\]

\[
r_2 = \frac{\mu(1 - \xi)}{\sigma K^w} \left[\frac{\phi}{\lambda + \phi(1 - \lambda)} + \frac{E_2}{\phi\lambda(1 - \lambda)}\right].
\]

(4.26)

The expenditure consists of workers’ wages and the rents of capital and natural resources, noting that the natural
resources of a country are owned by the government and that their rents are shared among the national inhabitants:

\[
E_1 = \theta K^w [\lambda r_1 + (1 - \lambda) r_2] + \theta L^w + \varepsilon S^w s_1,
\]

\[
E_2 = (1 - \theta) K^w [\lambda r_1 + (1 - \lambda) r_2] + (1 - \theta) L^w + (1 - \varepsilon) S^w s_2.
\]

(4.27)

Since all of the tourism goods in the two countries are consumed, rents \(s_1\) and \(s_2\) are nonnegative, and the above
expenditures are positive: \(E_1 > 0, E_2 > 0\).

The prices of all goods in a short-run equilibrium are summarized in Table 2.

We introduce three more notations here. Because labor is large enough for the agricultural good to be produced in
both countries, the labor input in the traded sectors (including the agricultural sector and the manufacturing sector) is

\(L^{trade} \equiv L^w - S^w > 0\).

When the resource share is different from the labor share (say, \(\varepsilon > \theta\)), extra labor \(L^{move} \equiv (\varepsilon - \theta)S^w\) is employed in the
tourism sector of Country 1, which causes some loss in the traded sectors. This is the resource-movement effect
with nontraded goods in the literature (Corden and Neary, 1982).

Since the wage rates of workers are \(w_1 = w_2 = 1\), the value of the extra labor is \(L^{move}\) again. Note that the total
expenditure in the world is \(E^w\); the value share of the labor moving from the traded sector to the tourism sector is,

\[
Q^{move} \equiv \frac{L^{move}}{E^w}.
\]

(4.28)

The total worldwide spending on traded goods is \((1 - \xi)E^w\), and share \(\mu\) of it is the expenditure on manufactured
goods. Lemma 2.1 implies that the operating profit is simply the total sales revenue times \(1/\sigma\). A straightforward

| Country 1 | Country 2 |
|-----------|-----------|
| Labor     |          |
| Natural resources | \(w_1 = 1\) | \(w_2 = 1\) |
| Capital   | \(s_1\) | \(s_2\) |
| Agricultural goods | \(p_{i1}' = 1\) | \(p_{i2}' = 1\) |
| Tourism goods | \(p_i' = 1 + s_i\) | \(p_i' = 1 + s_i\) |
| Manufactured goods | \(p_{i1} = 1, p_{i2} = \tau\) | \(p_{i2} = 1, p_{i2} = \tau\) |

\(^{12}\)We assume that \(S^w\) is small enough that the value of tourism services in the two countries is completely consumed. Particularly, \(S^w = 0\) if \(\xi = 0\), which corresponds to the case with no tourism sector. This implies no production of tourism services if there is no demand, so our model is consistent with the traditional NEG model of two sectors.
calculation reveals that the total payment to capital worldwide is \((\mu/\sigma)(1-\xi)E^w\). Thus the labor value in the traded sector is \(L^\text{trade} = (1-\xi)E^w - (\mu/\sigma)(1-\xi)E^w\). We then obtain another expression for (4.28):

\[
Q^\text{move} = (1-\xi) \frac{\sigma - \mu}{\sigma} L^\text{move} = (1-\xi) \frac{\sigma - (\xi \theta)L^w}{\sigma} = (1-\xi) S^w - S^w.
\]

In the long run, physical capital moves in search of the highest nominal reward. The dynamic system of (4.23) becomes

\[
\dot{\lambda} = (r_1 - r_2)(1 - \lambda)\lambda.
\]

To explore the essential relationship between the tourism and manufacturing sectors, we mainly focus on an interior long-run equilibrium, in which \(r_1 = r_2\), \(\lambda \in (0, 1)\). The equilibrium share of the manufacturing firms is determined as follows.

**Proposition 4.5.** In a long-run interior equilibrium, the industrial share in Country 1 is

\[
\lambda^r \equiv \lambda^0 + \lambda^1 + \lambda^\text{move},
\]

where

\[
\lambda^0 = \theta + \left( \theta - \frac{1}{2} \right) \frac{2\phi}{1 - \phi}, \quad \lambda^1 = \frac{\xi(1 + \phi)(\gamma - \theta)}{1 - \phi}, \quad \lambda^\text{move} = - \frac{1 + \phi}{1 - \phi} Q^\text{move}.
\]

Furthermore, this equilibrium is always stable.

In the long-run equilibrium \(\lambda^r\), the common capital rent in two countries is

\[
r_1 = r_2 = \frac{\mu L^\text{trade}}{(\sigma - \mu)K^w}.
\]

This expression is independent of the natural resource share \(\varepsilon\). The reason is that capital is not used in the tourism sector.

The expression \(\lambda^0\) of (4.29) is the firm share in Country 1 when there is no tourism sector as in a standard NEG model. The fact that \(\lambda^0 > \theta\) is known as the home market effect in terms of firm share.

The impact of the tourism sector on the manufacturing sector can be seen from \(\lambda^1\) and \(\lambda^\text{move}\) in (4.30). Specifically, \(\lambda^1\) represents the income effect of Country 1’s tourism services. This term is negative iff \(\gamma < \theta\), i.e., the tourism services in Country 1 are less-than-proportionately preferred to those of Country 2. Note that the negativeness of \(\lambda^1\) does not require \(\gamma < 1/2\). This is because Country 2’s consuming population \((1 - \theta)L^w\) of \(T_1\) is less than Country 1’s consuming population \(\theta L^w\) of \(T_2\). Meanwhile, this income effect is larger when trade is freer and/or the tourism sector is more important, because

\[
\frac{\partial \xi(1 + \phi)}{\partial \phi} \left( \frac{1}{1 - \phi} \right) > 0, \quad \frac{\partial \xi(1 + \phi)}{\partial \xi} \left( \frac{1}{1 - \phi} \right) > 0.
\]

In contrast, \(\lambda^\text{move}\) captures the (labor) resource-movement effect. This term is positive iff \(\varepsilon < \theta\), i.e., Country 1 has less-than-proportionate natural resources. In other words, a disadvantage in natural resources results in a more agglomerated manufacturing share there. This is the resource curse in terms of firm share discussed in Sect. 4.1. This result is derived from our assumptions of the Cobb–Douglas utility function and Leontief technology in the production of tourism services. In fact, since the consumption share on the tourism services is fixed, the fewer the tourism goods, the higher their prices. Due to Leontief technology, the natural-resources income in a country with fewer natural resources is higher, which attracts more manufacturing firms according to the income effect. This is enlarged by the resource-movement effect: having fewer natural resources requires less labor in the tourism sector, and more labor can be employed in the manufacturing sector. Moreover, the resource-movement effect is greater when trade is freer and/or the tourism sector is less important, because

\[
\frac{\partial (1 + \phi)}{\partial \phi} \left( \frac{1}{1 - \phi} \right) > 0, \quad \frac{\partial Q^\text{move}}{\partial \xi} < 0.
\]

To attract more firms in the manufacturing sector, the income effect and the resource-movement effect tell us that we need higher quality rather than a greater quantity of tourism service. This is because two effects increase \(\lambda^r\) when \(\gamma > \theta\) and \(\varepsilon < \theta\).

Researchers in spatial economics find that it is often hard to detect the HME in empirical studies (e.g., Davis and Weinstein, 1999 and 2003). Basically, this is because the real world is much more complicated than the two-sector models of HME in the literature. Incorporating the tourism sector, \(1 - \lambda^r > 1 - \theta\) holds (i.e., the HME in the larger country can be observed) if and only if
The LHS of (4.31) is increasing in φ. Therefore, (4.31) is more easily satisfied in the case of a larger φ (freer trade). The LHS decreases in γ, which means that the Country 2’s manufacturing share is larger if Country 1’s tourism services are less preferred. On the other hand, the LHS is increasing in ε − θ (through Qmove). Therefore, the HME is less explicit if the share of natural resources in Country 1 is smaller.

This equilibrium result allows us to revisit Dutch disease. Corden and Neary (1982) develop a small open economy model to clarify how the exploitation of natural resources is related to a decline in the manufacturing sector. They use the resource-movement effect and the spending effect13 to identify the impact of a resource boom on the economy. In the resource-movement effect, the resource boom will increase the demand for labor, which will cause production to shift toward the booming sector, away from the manufacturing sector. In their small open economy model, deindustrialization is strengthened by the spending effect. This increases the demand for labor in the nontradable sector, further shifting labor away from the manufacturing sector.

We now use the general-equilibrium model to examine the effect of various tourism booms. Some authors, such as Copeland (1991) and Nowak et al. (2003) have applied the nontraded-good model to tourism study and examined the interdependence between tourism and the rest of the economy. The assumption of a small open country is maintained in all papers, and their results show that a tourism boom may bring losses in various economies.

In the framework here, the spending effect works in opposition to the resource-movement effect, and thus the net effect is a tradeoff between them. Specifically, a tourism boom in Country 1 is characterized by the following three aspects:

(i) a larger ε, which results in a larger supply of Country 1’s tourism services;
(ii) a larger γ, which represents a larger demand for Country 1’s tourism services; and
(iii) a larger ξ, which represents a larger demand for tourism.

Noting that λmove of (4.30) decreases in ε (through Qmove), the resource-movement effect is observed in (i). This confirms that a simple increase in the quantity of Country 1’s natural resources causes deindustrialization in that country. On the other hand, the expenditure in Country 1 increases through (ii) because E1 increases in γ. Unlike the small open economy models, this spending effect, represented by the income effect in λ1, increases the manufacturing share in Country 1. In fact, we have

$$\frac{\partial \lambda^1}{\partial \gamma} = \frac{\xi(1 + \phi)}{1 - \phi} > 0.$$  

In other words, a quality improvement of Country 1’s tourism services increases γ, which results in industrialization rather than deindustrialization in Country 1. In fact, the price of imported goods is endogenously determined in this setup, which is different from the small open economy model of Corden and Neary (1982). For this reason, a larger γ results in greater revenue in Country 1, which causes more expenditure by Country 1 on manufactured goods and attracts more firms to Country 1. In total, the net effect of a tourism boom on the manufacturing share is a tradeoff between the deindustrialization effect of (i) and the industrialization effect of (ii).

Interestingly, empirical studies show that the relation between a tourism boom and economic development is uncertain, even in small countries. For example, Balaguer and Cantavella-Jorda (2002), Dritsakis (2004), Durbarry (2004), and Kim et al. (2006) find that tourism is a major factor of overall long-run economic growth in Spain, Greece, Mauritius and Taiwan, while Oh (2005) argues that tourism expansion does not cause economic growth in Country 1 Korea.

We can see the tradeoff relationship again in (iii). For simplicity, we analyze a special case in which Country 1 is the only country with tourism, i.e., ε = 1, γ = 1. This is very close to the European situation, in which most tourism resources are concentrated in Country 1, e.g., Italy. In this case, (4.29) is simplified as

$$\lambda^e = \theta + \left(\theta - \frac{1}{2}\right) \frac{2\phi}{1 - \phi} + \frac{(1 + \phi)(1 - \theta)(\sigma L^{\text{trade}} + (\sigma - \mu)S^w)}{(1 - \phi)\alpha L^{\text{trade}}} \left[\frac{\xi - (\sigma - \mu)S^w}{\alpha L^{\text{trade}} + (\sigma - \mu)S^w}\right].$$

The first two items represent the industry share in Country 1 without tourism. The last term is positive iff

$$\xi > \xi^e \equiv \frac{(\sigma - \mu)S^w}{\alpha L^{\text{trade}} + (\sigma - \mu)S^w}.$$  

Therefore, if the tourism boom is big enough, such that ξ > ξe, then the spending effect is stronger than the resource moving effect, and the tourism engenders industrialization. Otherwise, the resource-movement effect dominates, and the industry share decreases.

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13The spending effect refers to the extra revenue brought in by the resource boom.
5. Conclusion

Since Ohlin (1933), many researchers have noticed that trade and geography are inseparable. Krugman contributes to both sides and establishes close fields of NTT and NEG, represented by Krugman (1991) and Krugman (1980), respectively.

By introducing several studies on the nonmanufacturing sector in both NEG and NTT, this paper shows that both NEG and NTT are important tools for solving various mysteries of economic activity in the era of economic globalization. We are able to observe a nonmonotonic relationship between industrial location and manufacturing trade costs when agricultural goods are heterogeneous and/or agricultural trade costs are considered. These techniques can also be applied to investigate other nonmanufacturing sectors, such as the resource sector and the tourism sector. We give examples to show how the theoretical results can be applied to analyze the policies of Hometown Tax Donations and Go to Travel. More applications are expected in the future.

Both geography models and trade models have some merits and defects. In the NEG models, the CES function does not bring analytical solutions. The tractability is improved by using a quasilinear function. In contrast, NTT models are more tractable. However, the assumption of labor immobility makes it difficult to apply them to examine domestic problems. On the other hand, core–periphery models assume the symmetric size of regions, which is an assumption far from the real world. In addition, the existence of multiple equilibria makes the analysis of regional policies inconvenient.

In the NEG models, the peripheral region ends up losing all of its industry. There are some interesting papers discussing policy interventions in depressed areas to reverse the decline of the peripheral region. See Gruber and Soci (2010) for a survey.

Currently, NEG seems to have more followers than NTT. For example, a Google Scholar search in September 2020 showed that Krugman (1991) has 16,700 citations, while Krugman (1980) has only 5,210, in spite of the fact that he started NTT a decade earlier before NEG. More intensive works in NEG now definitely encourage more meaningful studies on NTT in future.

The consumer preferences are modeled by a CES or quasilinear utility function in this survey. They are popular but the CES setup fails to capture variable firm-level markups in globalizing markets while the quasilinear setup does not have the income effect. Recent papers (e.g., Chen and Zeng, 2018; Behrens et al., 2020; Zeng and Peng, 2021) show that some results may change if preferences are modeled by more general functions.

Finally, this paper focuses on the case of two countries/regions. The case of multiple countries/regions is much more complicated, even if the agricultural sector takes the simplest form. See Fujita et al. (1999, Chapter 6), Tabuchi et al. (2005), Behrens et al. (2009), Zeng and Uchikawa (2014), and Takayama et al. (2020). Moreover, we mainly focus on how nonmanufacturing sectors result in structural economic changes. The dynamic interactions are more difficult. Interested readers may refer to Zhang (2017), González-Val and Pueyo (2019), and Wang et al. (2020).

REFERENCES

[1] Auty, R. M., Sustaining Development in Mineral Economies: The Resource Curse Thesis, Routledge, London (1993).
[2] Balaguer, L., and Cantavella-Jorda, M., “Tourism as a long-run economic growth factor: The Spanish case,” Applied Economics, 34: 877–884 (2002).
[3] Baldwin, R. E., Forslid, R., Martin, P., Ottaviano, G., and Robert-Nicoud, F., Economic Geography and Public Policy, Princeton University Press, Princeton (2003).
[4] Barbier, E. B., Natural Resources and Economic Development, Cambridge University Press, Cambridge, U.K. (2005).
[5] Behrens, K., Lamorgese, A.-R., Ottaviano, G., and Tabuchi, T., “Beyond the home market effect: Market size and specialization in a multi-country world,” Journal of International Economics, 79: 259–265 (2009).
[6] Behrens, K., Mion, G., Murata, Y., and Suedekum, J., “Quantifying the gap between equilibrium and optimum under monopolistic competition,” Quarterly Journal of Economics, 135: 2299–2360 (2020).
[7] Chen, C.-mu, and Zeng, D.-Z., “Mobile capital, variable elasticity of substitution, and trade liberalization,” Journal of Economic Geography, 18: 461–494 (2018).
[8] Copeland, B. R., “Tourism, welfare and de-industrialization in a small open economy,” Economica, 58(232): 515–529 (1991).
[9] Corden, W. M., “Booming sector and Dutch disease economics: Survey and consolidation,” Oxford Economic Papers, 36: 359–380 (1984).
[10] Corden, W. M., and Neary, J. P., “Booming sector and de-industrialization in a small open economy,” Economic Journal, 92: 825–848 (1982).
[11] Crozet, M., and Trionfetti, F., “Trade costs and the home market effect,” Journal of International Economics, 76: 309–321 (2008).
[12] Davis, D. R., “The home market effect, trade and industrial structure,” American Economic Review, 88: 1264–1276 (1998).
[13] Davis, D. R., and Weinstein, D., “Economic geography and regional production structure: An empirical investigation,” European Economic Review, 43: 379–407 (1999).
[14] Davis, D. R., and Weinstein, D., “Market access, economic geography, and comparative advantage: An empirical assessment,” Journal of International Economics, 59: 1–23 (2003).
[15] Dixit, A. K., and Stiglitz, J. E., “Monopolistic competition and optimum product diversity,” The American Economic Review,
ZENG

67: 229–240 (1977).

[16] Dritsakis, N., “Tourism as a long-run economic growth factor: An empirical investigation for Greece using causality analysis,” *Tourism Economics*, 10: 305–316 (2004).

[17] Durbarry, R., “Tourism and economic growth: The case of Mauritius,” *Tourism Economics*, 10: 389–401 (2004).

[18] Forslid, R., and Ottaviano, G. I. P., “An analytically solvable core–periphery model,” *Journal of Economic Geography*, 3: 229–240 (2003).

[19] Fujita, M., and Hamaguchi, N., “Brand agriculture and economic geography: When are highly differentiated products sustainable in the remote periphery?” *Review of Urban and Regional Development Studies*, 31: 169–202 (2019).

[20] Fujita, M., Krugman, P. R., and Venables, A. J., The Spatial Economy: Cities, Regions and International Trade, MIT Press (1999).

[21] Fujita, M., and Thisse, J.-F., *Economics of Agglomeration: Cities, Industrial Location and Globalization*, 2nd ed., Cambridge University Press (2013).

[22] González-Val, R., and Pueyo, F., “Natural resources, economic growth and geography,” *Economic Modelling*, 83: 150–159 (2019).

[23] Gruber, S., and Soci, A., “Agglomeration, agriculture, and the perspective of the periphery,” *Spatial Economic Analysis*, 5: 43–72 (2010).

[24] Helpman, E., and Krugman, P. R., *Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition, and the International Economy*, MIT Press, Cambridge (1985).

[25] Kim, H. J., Chen, M.-H., and Jang, S., “Tourism expansion and economic development: The case of Taiwan,” *Tourism Management*, 27: 925–933 (2006).

[26] Krugman, P. R., “Scale economies, product differentiation, and the pattern of trade,” *American Economic Review*, 70: 950–959 (1980).

[27] Krugman, P. R., “Increasing returns and economic geography,” *Journal of Political Economy*, 99: 483–499 (1991).

[28] Krugman, P. R., Increasing returns, imperfect competition and the positive theory of international trade, Grossman, G. M., and Krugman, P. R., *American Economic Review: Papers and Proceedings*, forthcoming: 409–436 (2021).

[29] Lucas, R. E., “Why doesn’t capital flow rich to poor countries?” *American Economic Review: Papers and Proceedings*, 80: 92–96 (1990).

[30] Martin, P., and Rogers, C. A., “Industrial location and public infrastructure,” *Journal of International Economic*, 39: 335–351 (1995).

[31] Morales, J. R., “Perpetuating regional asymmetries thorough income transfers,” *Spatial Economic Analysis*, forthcoming: Doi:10.1080/17421772.2020.1714705 (2021).

[32] Nowak, J.-J., Sahli, M., and Sgro, P. M., “Tourism, trade and domestic welfare,” *Pacific Economic Review*, forthcoming:

[33] Ottaviano, G. I. P., Tabuchi, T., and Thisse, J.-F., “Agglomeration and trade revisited,” *International Economic Review*, 43: 409–436 (2002).

[34] Ottaviano, G. I. P., Tabuchi, T., and Thisse, J.-F., “Stability and sustainability of urban systems under commuting and transportation costs,” *Regional Science and Urban Economics*, 44: 103553 (2020).

[35] Tabuchi, T., and Zeng, D.-Z., “Stability of spatial equilibrium,” *Journal of Regional Science*, 44: 641–660 (2004).

[36] Tabuchi, T., Thise, J.-F., and Zeng, D.-Z., “On the number and size of cities,” *Journal of Economic Geography*, 5: 423–448 (2005).

[37] Takatsuka, H., Zeng, D.-Z., and Zhao, L., “Resource-based cities and the Dutch disease,” *Resource and Energy Economics*, 40: 57–84 (2015).

[38] Toulemonde, E., “Does the market deliver the right technology?” *Economics Letter*, 150: 95–98 (2017).

[39] Wang, J., Huang, X., Gong, Z., and Cao, K., “Dynamic assessment of tourism carrying capacity and its impacts on tourism economic growth in urban tourism destinations in China,” *Journal of Destination Marketing and Management*, 10: 100383 (2020).

[40] Young, A., “The Razor’s edge: Distortions and incremental reform in the People’s Republic of China,” *Quarterly Journal of Economics*, 115: 1091–1135 (2000).

[41] Yu, Z., “Trade, market size, and industrial structure: Revisiting the home market effect,” *Canadian Journal of Economics*, 38: 255–272 (2005).
[51] Zeng, D.-Z., “Redispersion is different from dispersion: Spatial economy of multiple industries,” The Annals of Regional Science, 40: 229–247 (2006).
[52] Zeng, D.-Z., and Kikuchi, T., “Home market effect and trade costs,” Japanese Economic Review, 60: 253–270 (2009).
[53] Zeng, D.-Z., and Peng, S.-K., “Symmetric tax competition and welfare with footloose capital,” Journal of Regional Science, forthcoming: Doi:10.1111/jors.12517 (2021).
[54] Zeng, D.-Z., and Uchikawa, T., “Ubiquitous inequality: The home market effect in a multicountry space,” Journal of Mathematical Economics, 50: 225–233 (2014).
[55] Zeng, D.-Z., and Zhu, X., “Tourism and industrial agglomeration,” Japanese Economic Review, 62: 537–561 (2011).
[56] Zhang, W.-B., “Spatial agglomeration and economic development with the inclusion of interregional tourism,” Economic Annals, 62: 93–128 (2017).