NATIONAL RESEARCH UNIVERSITY
HIGHER SCHOOL OF ECONOMICS

Sergey Kichko

CORE-PERIPHERY VS HOME MARKET EFFECT: TRADE IN THE TRADITIONAL SECTOR AND THE DEMAND ADVANTAGE

BASIC RESEARCH PROGRAM
WORKING PAPERS

SERIES: ECONOMICS
WP BRP 159/EC/2017

***SERIES**: ECONOMICS*

Sergey Kichko*

Core-Periphery vs Home Market Effect: trade in the traditional sector and the demand advantage†

Abstract

We study the role of (i) initial differences in shares of immobile workers between countries which stand for the agglomeration forces, and (ii) positive trade costs in the traditional sector which are related to the dispersion forces, in shaping the spatial pattern of the developed and transition countries. We show that on the trade liberalization path in skill-intensive industries, keeping high trade barriers in less skill-intensive sectors is enough to protect a transition country from de-industrialization. If trade liberalization in a skill-intensive sector is accompanied by decreasing trade barriers in the traditional sector, the developed country has a higher probability to become a Core. When partial agglomeration is stable, it is characterized by the Home Market Effect (HME).

JEL Classification: R12, R13

Keywords: Core-Periphery model, partial agglomeration, Home Market Effect, monopolistic competition

*National Research University Higher School of Economics, Center for Market Studies and Spatial Economics. E-mail: skichko@hse.ru

†I am indebted to Evgeny Zhelobodko (1973-2013) for the initial idea of the paper. I am grateful to Krisitan Behrens, Alexander Tarasov, Jens Südekum, and Philip Ushchev for numerous valuable comments and suggestions. Kim Han Bock provided excellent research assistance. The study has been funded by the Russian Academic Excellence Project '5-100'. All remaining errors are mine.

1 Introduction

Empirical evidence suggests that labour markets behave differently under trade exposure. Thus, US market sectoral trade liberalization with China in 1990s-2000s in less skill-intensive manufacturing sectors (such as apparel, textiles, furniture, leather goods, luggage, rubber and plastic footwear, games and toys, etc.) results in shrinking of these sectors (Autor et al., 2013). However, rising of less skill-intensive industries in China and open trade with Eastern Europe after the fall of the iron curtain had a positive impact on the high-skilled industries (automobiles, machinery, electronic and medical equipment) in Germany (Dauth et al., 2014). Similar evidence is provided by Kovak (2011) based on the path of trade liberalization in Brazil. Hence, the impact of trade liberalization in different sectors on agglomeration patterns of developed and transition countries is ambiguous. Therefore, it is a priori unclear which trade policy transition countries should adopt to protect themselves from becoming peripheral regions due to the loss of high-skilled workers. Furthermore, initial differences between trade partners could play a crucial role in the formation of spatial equilibria and, therefore, should be taken into account.

Hence, the goal of this paper is to address the questions mentioned above by studying the interplay of two effects, i.e. trade costs in the traditional sector preventing agglomeration and asymmetry in immobile workers between countries fostering agglomeration in the bigger country. To this end, we develop a Core-Periphery model with these two new features. We note that the inverse relationship between the level of education and spatial mobility is well documented in the literature (Notowidigdo, 2010; Bound and Holzer, 2000). In what follows, within our framework we assume spatial mobility for high-skilled workers employed in an advanced manufacturing industry while less skilled workers employed in a less skill-intensive manufacturing sector are spatially immobile. Hence, we interpret the bigger country, i.e. country with an initial advantage in demand, as a developed country while the country with a demand disadvantage is a transition country. Intuitively, the developed country is more attractive for skilled mobile workers which is guaranteed by its demand advantage. Yet, we study the spatial pattern of developed and transition countries on the path of trade liberalization. In addition, due to the fact that mobility of labour between sectors is costly (Dix-Carneiro, 2014; Artuc et al., 2010), we assume that labour is immobile across sectors.

We summarize our **findings** as follows. On the path of trade liberalization in skill-intensive industries between the developed and transition countries, keeping high trade barriers in less skill-intensive sectors is enough to protect a transition country from de-industrialization. In this

case countries trade only skill-intensive good and partial agglomeration is stable for arbitrary trade costs in this sector. However, contrary to symmetric interior equilibrium obtained in Picard and Zeng (2005), we show that partial agglomeration is characterized by the Home Market Effect (HME) – when the country with an initial advantage attracts a disproportionately higher share of high-skilled mobile workers. The question of the presence of HME is not that trivial in a framework where costless trade assumption in the traditional sector is relaxed. Yet, Davis (1998) sheds some light on the importance of traditional sector trade costs. His findings show vanishing of HME under costly trade in the traditional sector while trade in this sector does not occur. Contrariwise, Takatsuka and Zeng (2012) within a footloose capital setting show that HME arises for the arbitrary level of trade costs in the traditional sector conditional on the existence of interior equilibrium with trade in skill-intensive good only. In this respect, our results for the footloose entrepreneur setting are similar to the footloose capital model by Takatsuka and Zeng (2012). Comparison of these two frameworks with the Davis' (1998) immobile factor setup leads to the conclusion that factor mobility is enough for HME to overcome the absence of trade in the traditional sector. The economic intuition for this result is as follows. When trade for a skill-intensive good is balanced, mobility of a factor (capital or mobile skilled labour) provides an additional degree of freedom. To be precise, the mobile factor distributes between countries such that it leads to a different type of advantage for firms in countries. On one hand, firms in the developed country use increasing returns to scale technology more intensively due to a higher market size regardless of higher production costs in the country. On the other hand, firms in the transition country enjoy lower production costs and softer competition at the domestic market.

If trade liberalization in the skill-intensive sector is accompanied by decreasing trade barriers in the traditional sector, countries engage in trade within both sectors. Trade in the traditional sector leads to instability of partial agglomeration for the intermediate range of skill-intensive sector trade costs while agglomeration emerges in one of the countries. However, the developed country has a higher probability to become a Core since it has a wider range of manufacturing trade costs for agglomeration stability. This confirms that immobile demand belongs to the agglomeration forces. Moreover, under high initial differences between countries agglomeration in the transition country never happens. Whence, the less developed country could protect their high-skilled intensive sectors by a protectionist policy in other sectors. Hence, the higher probability of agglomeration emerging in some countries than in others may at least partially explain the fact that technologically advanced sectors with increasing returns to scale tend to

establish in sparse locations (Fujita and Thisse, 2013).

Trade liberalization allows shipping a higher fraction of the traditional sector total output, which could be interpreted as an increase in productivity. Murphy et al. (1989) discuss the big push phenomena showing that an advancement in technology gives a rise to economic growth through an increase in individual incomes. Therefore, by analogy, trade liberalization in the traditional sector might be viewed as a source for the "spatial big push". Indeed, a decrease in trade costs in less skill-intensive sectors pushes the economy towards agglomeration. In other words, it fosters skill-intensive sector firms to cluster in the bigger market and, therefore, to use increasing returns to scale technology more intensively. Moreover, big push is more likely for the larger size of the market. This is precisely the case with the "spatial big push" when higher initial advantage in immobile demand of the developed country permits agglomeration to emerge easily.

Last, we study the impact of the countries' initial differences on the pattern of spatial equilibria. Particularly, we show that the price difference of the traditional sector good between countries is smaller when countries are quite similar. Therefore, mobile workers are less sensitive to the traditional good price. In addition, smaller asymmetry in immobile demand results in a low-skilled workers wage gap as well as the real wage difference between countries in both sectors. Consequently, the smaller the asymmetry between countries, the wider range of manufacturing trade costs guarantees the stability of partial agglomeration. Moreover, interior equilibrium is always a stable spatial structure for similar enough trade partners.

To sum up, we show that the developed country becomes a Core (while the transition country falls behind as a Periphery region) on the path of trade liberalization in skill-intensive sectors only if the latter is accompanied by liberalization in the traditional sectors. On the other hand, high trade costs in the traditional sector guarantee stability of partial agglomeration for arbitrary trade costs in skill-intensive sectors. Therefore, a protectionism policy implemented in traditional sectors by transition countries would be enough to prevent these countries from deindustrialization. In this case, a trade agreement only in advanced-technology sectors may lead to the targeted results - increased high-skilled activity in transition countries due to lower trade barriers instead of outward migration of high-skilled workers. In the opposite way, freer trade policy for the whole economy forced by policy-makers in developed countries results in concentration of economic activity in these countries at least at some stages of the trade liberalization path.

Literature review. The answers to questions raised in the beginning are hardly given in

the existent literature on agglomeration theory for at least two reasons. First, most studies on different aspects of new economic geography (Krugman, 1991; Krugman and Venables, 1995; Tabuchi and Thisse, 2002; Ottaviano and Robert-Nicoud, 2006; Suedekum, 2006, Garrido-da-Silva et al., 2015) mainly focus on the impact of trade liberalization in the technologically advanced skill-intensive sector while a simplified assumption of costless trade in the traditional sector is generally applied. However, Rauch (1999) does not find empirical evidence on the significant difference in sectors' trade costs depending on the level of their differentiation. The results obtained by Fujita et al. (1999) suggest that trade barriers in the traditional sector may prevent de-industrialization of a country. To be precise, they show that introducing positive trade costs in the traditional sector leads to stability of symmetric equilibrium for arbitrary level of high-skilled sector trade costs while agglomeration is not stable for the advanced stages of trade liberalization in this sector. Picard and Zeng (2005) extend this approach by assuming significant difference in the differentiation between exported and locally produced traditional goods. They show that product differentiation leads to trade in the traditional sector for low enough trade costs due to consumers' love for variety. This shapes the spatial pattern in Fujita et al. (1999) by braking stability of the symmetric outcome under the presence of traditional sector trade. Hence, setting the appropriate level of sectoral trade barriers could protect countries from outward migration of high-skilled labour.

Second, the initial differences between developed and transition countries are underestimated by a widely used assumption of spatially symmetric distribution of less mobile workers. Several studies suggest that the initial differences in immobile demand between countries have a strong impact on spatial outcome. Thus, Baldwin et al. (2003) explain that the demand generated by immobile residents stands for the agglomeration forces. Indeed, producers gain from being located in a developed country due to closer proximity to a larger share of the immobile demand. More formally, Sidorov and Zhelobodko (2013) study the 'Core-Periphery' model with unequal shares of immobile workers in countries to show that agglomeration in a country with a larger part of the immobile demand is likely to occur. Therefore, it is easier for the developed country to attract mobile workers, effectively pushing transition countries to specialize in less skill-intensive production.

In the sequel, Section 2 presents the model, Section 3 examines the pattern of spatial equilibria and its changes under a decrease in traditional sector trade costs and immobile demand asymmetry while Section 4 concludes.

2 The model

Economy involves two countries, Home and Foreign, and two sectors producing a differentiated good and a homogeneous good, respectively. There are two types of consumers, L_M skilled mobile workers supplying inelastically one unit of labour required in the high-skilled manufacturing sector and L_A unskilled immobile workers doing the same in the traditional manufacturing sector. So, labour is sector specific. Let λ and $(1-\lambda)$ stand for the shares of mobile workers in Home and Foreign which are endogeneously determined in equilibrium, whereas φ and $(1-\varphi)$ are exogeneously given shares of low-skilled workers in the countries. For the sake of certainty, we assume that Home is the developed country with the initial advantage in demand, i.e. $\varphi > 1/2$.

Consumers. All consumers share the same preferences. Consumer's utility of type[1] $c = M, A$ in country k is given by

$$U(X_c^k,\, A_c^k) \equiv \left(\int_0^{N^k} \left(x_{ic}^{kk}\right)^{\frac{\sigma-1}{\sigma}} di + \int_0^{N^l} \left(x_{jc}^{lk}\right)^{\frac{\sigma-1}{\sigma}} dj \right)^{\mu \cdot \frac{\sigma}{\sigma-1}} \left(A_c^k\right)^{1-\mu}, \quad k,\, l = H,\, F, \tag{1}$$

where X_c^k is a vector of per capita consumption of differentiated good varieties x_{ic}^{kk} and x_{jc}^{lk} by consumer of type c, N^k is the mass of firms in country k, and A_c^k is homogeneous good consumption,.

Consumers of type c in country k maximize utility (1) subject to their budget constraint

$$\int_0^{N^k} p_i^{kk} x_{ic}^{kk} \mathrm{d}i + \int_0^{N^l} p_j^{lk} x_{jc}^{lk} \mathrm{d}j + p_a^k A_c^k = E_c^k,$$

where p_i^{kk}, p_j^{lk}, and p_a^k are prices for domestically produced variety i, imported variety j, and homogeneous good while E_c^k is the income of c type consumer in country k.

Note that CES preferences allow to aggregate individual demand of different types of agents in the same country. Hence, let x_i^{lk} be the aggregate country k demand for variety i produced in country l. Therefore, first order condition implies the aggregate demand for variety i:

$$x_i^{lk} = \frac{(p_i^{lk})^{-\sigma}}{P_k^{1-\sigma}} \mu E^k, \tag{2}$$

[1] Even though consumers share the same preferences, their consumption bundle could be unequal due to wage gap between mobile and immobile workers.

where E^k defines the total income in country k and P_k is a price index in k given by

$$P_k = \left(\int_0^{N^k} \left(p_i^{kk}\right)^{1-\sigma} \mathrm{d}i + \int_0^{N^l} \left(p_j^{lk}\right)^{1-\sigma} \mathrm{d}j \right)^{\frac{1}{1-\sigma}}. \tag{3}$$

Firms. The traditional sector produces a homogeneous good under a constant returns to scale technology[2] whereas each firm in the differentiated sector bears a fixed cost of F units and a marginal cost of c units of mobile labour. The total production cost is $C(q^k) = (F + cq^k)w_M^k$, where q^k is the firm output and w_M^k is the differentiated sector wage in the country k. Both sectors' goods require the "iceberg"-type trade costs, $\tau_M \geq 1$ and $\tau_A \geq 1$, respectively. Traditional sector labour in Foreign is chosen as a numeraire, and the corresponding wage is normalized to 1 while Home wage in the homogeneous sector is defined as w_A.

As is common in monopolistic competition, each variety of differentiated good is produced by a single firm and each firm produces one unique variety. We assume a continuum of firms in the skilled labour sector, such that the mass of firms in the sector is large enough to ignore the impact of each firm on the market.

Each differentiated firm i in country k maximizes its profit given by

$$\pi_i^k = (p_i^{kk} - cw_M^k)x_i^{kk} + (p_i^{kl} - c\tau_M w_M^k)x_i^{kl} - Fw_M^k.$$

Since total cost functions are identical across firms, we may drop index i. The first order condition of the producer's problem implies the following profit-maximizing prices

$$p^{HH} = \frac{w_M^H \cdot c \cdot \sigma}{\sigma - 1}, \quad p^{HF} = \frac{w_M^H \cdot \tau_M \cdot c \cdot \sigma}{\sigma - 1}, \tag{4}$$

$$p^{FF} = \frac{w_M^F \cdot c \cdot \sigma}{\sigma - 1}, \quad p^{FH} = \frac{w_M^F \cdot \tau_M \cdot c \cdot \sigma}{\sigma - 1}. \tag{5}$$

Short-run equilibrium. We define *short-run equilibrium* as a bundle of per-capita consumptions x^{ij} with corresponding prices p^{ij}, $i, j = H, F$, masses of firms N^H, N^F and wages w_M^H, w_M^F in countries, and relative wage w_A in the traditional sector satisfying the consumer's and producer's maximization problems as well as balances on labour markets and trade flows, consumer's budget constraints and zero-profit conditions for differentiated sector firms.

Zero-profit conditions imply that total firm outputs q^H and q^F are given by

[2]Behrens et al. (2014) show that the spatial pattern is independent of the technology in the second sector.

$$q^H = x^{HH} + \tau x^{HF} = \frac{F(\sigma - 1)}{c}, \tag{6}$$

$$q^F = x^{FF} + \tau x^{FH} = \frac{F(\sigma - 1)}{c}. \tag{7}$$

Combining (6) and (7) with the labour market clearing conditions in countries $\lambda L_M = N^H(F + cq^H)$ and $(1 - \lambda)L_M = N^F(F + cq^F)$, we obtain equilibrium masses of firms given by

$$N^H = \frac{\lambda L_M}{\sigma F}, \quad N^F = \frac{(1 - \lambda)L_M}{\sigma F}. \tag{8}$$

Normalization. We follow Fujita et al. (1999) and without loss of generality normalize the following variables (for details see Fujita et al., 1999, ch. 4). First, we set a marginal labour requirement in the differentiated sector $c = (\sigma - 1)/\sigma$. This normalization leads to the profit maximization prices (4)-(5) which take the form

$$p^{HH} = w_M^H, \quad p^{HF} = w_M^H \cdot \tau_M, \quad p^{FF} = w_M^F, \quad p^{FH} = w_M^F \cdot \tau_M \tag{9}$$

Second, we normalize a fixed labour requirement in the differentiated sector $F = \mu/\sigma$, therefore, equilibrium firm sizes (6)-(7) are given by

$$q^H = q^F = \mu. \tag{10}$$

Last, we normalize masses of two types of consumers $L_M = \mu$ and $L_A = 1 - \mu$. Therefore, (8) takes the form

$$N^H = \lambda, \quad N^F = 1 - \lambda. \tag{11}$$

After normalization equilibrium price indices (3) take the following form

$$P_H = \left(\lambda(w_M^H)^{1-\sigma} + (1 - \lambda)(\tau_M \cdot w_M^F)^{1-\sigma}\right)^{\frac{1}{1-\sigma}}, \quad P_F = \left((1 - \lambda)(w_M^F)^{1-\sigma} + \lambda(\tau_M \cdot w_M^H)^{1-\sigma}\right)^{\frac{1}{1-\sigma}}. \tag{12}$$

Plugging (2) in (6)-(7) we obtain

$$\frac{(p^{HH})^{-\sigma}}{P_H^{1-\sigma}} E^H + \frac{\tau(p^{HF})^{-\sigma}}{P_F^{1-\sigma}} E^F = \frac{F(\sigma - 1)}{c},$$

$$\frac{(p^{FH})^{-\sigma}}{P_H^{1-\sigma}}E^H + \frac{\tau(p^{FF})^{-\sigma}}{P_F^{1-\sigma}}E^F = \frac{F(\sigma-1)}{c}.$$

Using normalization and profit maximization prices (4)-(5) we get

$$w_M^H = \left(\frac{E^H}{P_H^{1-\sigma}} + \tau_M^{1-\sigma}\cdot\frac{E^F}{P_F^{1-\sigma}}\right)^{\frac{1}{\sigma}}, \tag{13}$$

$$w_M^F = \left(\frac{E^F}{P_F^{1-\sigma}} + \tau_M^{1-\sigma}\cdot\frac{E^H}{P_H^{1-\sigma}}\right)^{\frac{1}{\sigma}}. \tag{14}$$

Now we are equipped to study the patterns of long-run spatial equilibria.

3 Stability of the long-run equilibria

The long-run spatial equilibrium is a situation where none of the mobile workers have any incentives in terms of individual welfare to migrate if none of the other mobile workers move to another country. We define the real wages of mobile workers ω^H and ω^F as the ratio of nominal wage w_M^i to the price index across sectors. Hence, internal spatial equilibrium, i.e. when $0 < \lambda^* < 1$ where λ^* is the equilibrium share of mobile workers in Home, satisfies the real wages equalization of the mobile workers between countries. Yet, agglomeration equilibrium is not necessarily characterized by real wages equalization. Indeed, if mobile workers are concentrated in Home, i.e. $\lambda = 1$, and $\omega^H > \omega^F$, agglomeration in Home is a stable spatial structure. However, in both cases the long-run equilibrium is stable when the ratio ω^H/ω^F decreases with the share λ of mobile workers in Home.

We note that trade in the traditional manufacturing sector does not arise if the relative wage w_A in the sector is below trade cost τ_A. Intuitively, the higher asymmetry φ in the homogeneous sector between countries, the higher the wage gap in this sector between countries, the easier trade in traditional sector arises.

3.1 Agglomeration

In this subsection we study the case when agglomeration is stable equilibria. In what follows, we focus on the case of agglomeration in Home, i.e. when $\lambda = 1$.

Under agglomeration, trade in advanced manufacturing sector is unilateral - only Home exports the differentiated good. For trade balance to hold, trade in the homogeneous sector arises which results in $w_A = \tau_A > 1$. Therefore, the total incomes of countries are given by

$$E_H = \mu w_M^H + \varphi(1-\mu)\tau_A, \tag{15}$$

$$E_F = (1-\varphi)(1-\mu). \tag{16}$$

The market clearing condition $\mu w_M^H = \mu(E_H + E_F)$ for the differentiated good pins down manufacturing wage w_M^H in Home:

$$w^H = 1 - \varphi + \varphi\tau_A.$$

Using (9) and (11) the advanced manufacturing price indices (12) take the form

$$P_H = w_M^H, \qquad P_F = \tau_M \cdot w_M^H. \tag{17}$$

Plugging (15)-(17) in (14), we obtain potential mobile workers wage in Foreign

$$w_M^F = \left(\frac{w_M^H}{\tau_M}\right)^{\frac{\sigma-1}{\sigma}} \left[(1-\varphi)\left((1-\mu)\tau_M^{2(\sigma-1)} + \mu\right) + \varphi\tau_A\right]^{\frac{1}{\sigma}}.$$

The relative real wage, therefore, is given by

$$\frac{\omega_H}{\omega_F} = \frac{w_M^H}{w_M^F} \cdot \left(\frac{P_F}{P_H}\right)^{\mu} \cdot \frac{1}{p_A^{1-\mu}} =$$

$$= \left(\frac{1-\varphi+\varphi\tau_A}{(1-\varphi)\left((1-\mu)\tau_M^{2(\sigma-1)} + \mu\right) + \varphi\tau_A}\right)^{\frac{1}{\sigma}} \cdot \frac{\tau_M^{\frac{\sigma-1+\mu\sigma}{\sigma}}}{\tau_A^{1-\mu}}. \tag{18}$$

Now we are equipped to discuss the patterns of agglomeration. Agglomeration in Home is stable if $\omega_H/\omega_F > 1$ for $\lambda = 1$. First, under free trade in high-skilled manufacturing, i.e. $\tau_M = 1$, real wages ratio (18) takes the form $\omega_H/\omega_F = \tau_A^{\mu-1} < 1$. Therefore, contrary to the CP model (Krugman, 1991), agglomeration is not stable for a range of low advanced manufacturing trade costs including free trade. The reason is that even when the trade in this sector is costless, space still matters and dispersion forces are still there as long as trade costs for the traditional

good are positive $\tau_A > 1$.

Second, when $\mu < (\sigma - 1)/\sigma$, (18) has a bell-shaped form and reaches its maximum at $\tau_M = \tau_M^m$. Therefore, depending on the characteristics of the economy, namely, asymmetry of the immobile workers φ, size of the advanced manufacturing sector μ, and traditional sector trade costs τ_A two cases arise: (i) $\frac{\omega_H}{\omega_F}(\tau_M^m) < 1$ and agglomeration is never stable and (ii) $\frac{\omega_H}{\omega_F}(\tau_M^m) > 1$ and agglomeration is stable for the intermediate value of advanced manufacturing trade costs $\tau_M^b < \tau_M < \tau_M^s$, where τ_M^b and τ_M^s are the solutions for the $\frac{\omega_H}{\omega_F}(\tau_M) = 1$.

In the case $\frac{\omega_H}{\omega_F}(\tau_M^m) > 1$, similar to the CP model, high trade costs $\tau_M > \tau_M^s$ result in instability of agglomeration while Core-Periphery structure arises when trade costs are intermediate, i.e. $\tau_M^b < \tau_M < \tau_M^s$. Agglomeration stability is the consequence of smaller significance of trade costs which allows firms to serve the foreign market without big losses on transportation. However, when trade is highly liberalized, i.e. $\tau_M < \tau_M^b$, the crucial role is played by trade costs in the traditional sector. Therefore, even for low trade costs in the high-skilled sector dispersion forces are strong enough to break the stability of agglomeration.

Third, we show in Appendix A that behavior of (18) with respect to advanced manufacturing trade costs τ_M depends on whether $\mu > (\sigma-1)/\sigma$ or not. This condition is the same to the 'black-hole' condition in the CP model which guarantees that agglomeration is stable for any range of trade costs. However, under the presence of positive trade costs in the traditional sector it is not the case - relatively large advanced manufacturing sector results in agglomeration stability only for high values of trade costs τ_M above some threshold τ_M^n. The reason is, again, the high impact of trade costs in the traditional sector on the spatial equilibrium when trade costs in the high-skilled sector are low. The following Proposition summarizes our findings.

Proposition 1. *Agglomeration in Home is stable if and only if (i)* $\tau_M^b < \tau_M < \tau_M^s$ *and* $\frac{\omega_H}{\omega_F}(\tau_M^m) > 1$ *in a case of not too large advanced manufacturing sector,* $\mu < (\sigma - 1)/\sigma$*, and (ii)* $\tau_M > \tau_M^n$ *when advanced manufacturing sector is large enough,* $\mu > (\sigma - 1)/\sigma$*.*

In the following analysis we focus on the first case and discuss the impact of two new features - positive trade costs in the traditional sector and unequal distribution of immobile workers between countries, on the patterns of agglomeration.

First, the relative real wage (18) has a U-shaped form with respect to advanced manufacturing trade costs. We show in Appendix A that an increase in traditional sector trade costs τ_A shifts (18) down and, therefore, the higher trade costs in the homogeneous sector τ_A, the smaller the interval of advanced manufacturing trade costs (τ_M^b, τ_M^s) of agglomeration stability. When trade costs are relatively high $(\tau_M > \tau_M^s)$, the higher τ_A the more deeply trade in high-skilled

manufacturing has to be liberalized for agglomeration to arise. However, further liberalization in advanced manufacturing breaks agglomeration for higher trade costs τ_M^b. Therefore, a positive traditional sector trade cost stands for an additional dispersion force. Moreover, there exists a threshold value τ_A^n, such that for every $\tau_A > \tau_A^n$ agglomeration is unstable for any level of trade costs in the advanced manufacturing sector.

Second, it is easy to verified that the relative real wage (18) increases with the size of the homogeneous sector in Home φ. In other words, the higher share of immobile workers is in a country, the more attractive for high-end manufacturing firms this country is, and, as a consequence, the wider is the interval (τ_M^b, τ_M^s) where agglomeration is stable. Therefore, we formally confirm the conventional wisdom that immobile demand in CP model stands for the agglomeration force.

We note that our analysis as well as Proposition 1 also hold for the Foreign country. The only difference is in the threshold values of trade costs. Based on the discussion above, agglomeration in Foreign is stable for the smaller interval $(\tilde{\tau}_M^b, \tilde{\tau}_M^s)$ of trade costs where $\tilde{\tau}_M^b > \tau_M^b$, $\tilde{\tau}_M^s < \tau_M^s$. The pattern of agglomerations in the countries are presented on Figure 1.

Last, to illustrate our findings, we run simulations for the $\mu < (\sigma - 1)/\sigma$ case with the following parameters of the model: $\mu = 0.4$, $\tau_A = 1.1$, $\varphi = 0.52$. The agglomeration in the country with a higher traditional sector (Home) is stable for the advanced manufacturing trade costs belonging to the interval $1.05 < \tau_M < 1.63$ whereas in Foreign agglomeration is stable for $1.10 < \tau_M < 1.56$. As we discussed above, agglomeration in Home is stable for a wider interval of trade costs since it hosts a higher share of immobile workers $\varphi = 0.52$.

3.2 Partial agglomeration

In this section we study stability of the interior equilibrium which is partial agglomeration due to unequal shares of immobile workers between countries. Under the presence of trade costs in the traditional sector wages in this sector are not equalized between countries. If the difference in shares of immobile workers in countries is small enough or homogeneous sector trade costs are high enough, trade in this sector does not arise. A higher asymmetry in distribution of immobile workers leads to a deeper wage gap, therefore, trade arises easier in this sector. We study both cases when (i) relative wage in the traditional manufacturing sector is smaller than trade costs and trade does not arise and (ii) relative wage equals to trade costs and trade arises.

Without loss of generality we focus on the case when Home has an initial advantage in

immobile workers $\varphi > 1/2$. The total incomes in countries are given by

$$E_H = \lambda\mu w_M^H + \varphi(1-\mu)w_A, \tag{19}$$

$$E_F = (1-\lambda)\mu w_M^F + (1-\varphi)(1-\mu). \tag{20}$$

Plugging (19)-(20) into the balance at the differentiated good market

$$\mu(E_H + E_F) = \lambda\mu w_M^H + (1-\lambda)\mu w_M^F,$$

we obtain

$$w_M^F = \frac{(1-\varphi) + \varphi w_A}{\lambda w_M + (1-\lambda)}, \tag{21}$$

where $w_M = w_M^H / w_M^F$ is a relative wage in this sector.

Plugging (12), (19), (20), and (21) in (23) we obtain the equation for the relative wage w_M as a function of mobile workers share λ:

$$\left(1 + \frac{\varphi}{1-\varphi} w_A\right)\left[\frac{\lambda}{1-\lambda}\left(\tau_M^{\sigma-1} - w_M^{\sigma}\right) - \left(w_M^{\sigma}\tau_M^{\sigma-1} - 1\right) w_M^{\sigma-1}\right] = (1-\mu)(\tau_M^{2(\sigma-1)} - 1)\left(\frac{\lambda}{1-\lambda} w_M - \frac{\varphi}{1-\varphi} w_A\right) w_M^{\sigma-1}. \tag{22}$$

In the following subsections we study in details of the two above mentioned cases with and without trade in the traditional manufacturing sector.

3.2.1 Partial agglomeration without trade in the traditional sector

In this subsection we assume that trade costs in the traditional sector are higher than the relative wage in this sector and partial agglomeration is characterized by trade in advanced manufacturing only.

Since traditional sectors in countries are separated, total production in the homogeneous sector in each country is equal to the total consumption in that country, therefore

$$\varphi(1-\mu)w_A = (1-\mu)E_H,$$

$$(1-\varphi)(1-\mu) = (1-\mu)E_F.$$

Plugging (19)-(20) into the last two equations we obtain mobile workers wages in countries

$$w_M^H = \frac{\varphi}{\lambda} w_A, \tag{23}$$

$$w_M^F = \frac{1-\varphi}{1-\lambda}. \tag{24}$$

Taking the ratio of (23) and (24), we get the relative wage w_M

$$w_M = \frac{\frac{\varphi}{1-\varphi}}{\frac{\lambda}{1-\lambda}} \cdot w_A. \tag{25}$$

Plugging (25) in (22), the relationship between relative wage w_M and share λ of mobile worker takes the form:

$$\frac{\lambda}{1-\lambda}\left(\tau_M^{\sigma-1} - w_M^{\sigma}\right) = \left(w_M^{\sigma}\tau_M^{\sigma-1} - 1\right) w_M^{\sigma-1} \tag{26}$$

We note that (26) does not directly include the share φ of immobile workers and traditional sector trade costs τ_A. Moreover, (26) characterizes (up to the normalization we choose) the relative mobile workers wage in equilibrium when $\tau_A = 1$ and $\varphi \neq 1/2$ (Sidorov and Zhelobodko, 2013) as well as when traditional sector produces under monopolistic competition (Behrens et al., 2014).

Formula (26) implies that the relative wage in advanced manufacturing varies in the following interval:

$$\frac{1}{\tau_M^{\frac{\sigma-1}{\sigma}}} \leq w_M \leq \tau_M^{\frac{\sigma-1}{\sigma}}. \tag{27}$$

The long-run equilibrium is characterized by equal real wage in both countries. This condition is given by

$$\frac{\omega_H}{\omega_F} = \frac{w_M^H}{w_M^F} \cdot \frac{P_F^{\mu}}{P_H^{\mu} w_A^{1-\mu}} = 1. \tag{28}$$

To study the stability of the long-run equilibrium we first totally differentiate (26) with respect to the share λ of mobile workers in Home and obtain

$$\frac{dw_M}{d\lambda} = \frac{\left(w_M^{\sigma}\tau_M^{\sigma-1} - 1\right) w_M}{\lambda(1-\lambda)\left((2\sigma-1)(w_M^{\sigma}\tau_M^{\sigma-1} - 1) + \sigma\left(\frac{\lambda}{1-\lambda} w_M + 1\right)\right)} > 0, \tag{29}$$

since the nominator is positive due to (27).

Equations (23)-(25) imply that the ratio (12) of price indices takes the form

$$\frac{P_F}{P_H} = w_M^{\frac{\sigma}{\sigma-1}}. \tag{30}$$

Plugging (25) and (30) in (28), we get the relative real wage as a function of the relative nominal wage

$$\frac{\omega_M^H}{\omega_M^F} = \left(\frac{\varphi}{1-\varphi}\right)^{1-\mu} \cdot \frac{w_M^{\mu \cdot \frac{2\sigma-1}{\sigma-1}}}{\left(\frac{\lambda}{1-\lambda}\right)^{1-\mu}}. \tag{31}$$

Second, by differentiating (31) with respect to λ and plugging (29), we obtain

$$\frac{d\left(\frac{\omega_M^H}{\omega_M^F}\right)}{d\lambda} = B \cdot \left(\frac{(2\sigma-1)(\mu\sigma-\sigma+1)\left(w_M^\sigma \tau_M^{\sigma-1}-1\right) - (1-\mu)(\sigma-1)\sigma\left(1+\frac{\lambda}{1-\lambda}w_M\right)}{(\sigma-1)\left((2\sigma-1)(w_M^\sigma\tau_M^{\sigma-1}-1)+\sigma\left(1+\frac{\lambda}{1-\lambda}w_M\right)\right)}\right), \tag{32}$$

where B is a positive constant.

The $\mu < (\sigma-1)/\sigma$ case. In the case when high-skilled manufacturing sector is not too large, $d\left(\frac{\omega_M^H}{\omega_M^F}\right)/d\lambda < 0$, therefore the interior equilibrium is stable for any level of trade costs. This result is in line with Fujita et al. (1999) who study the CP model with positive trade costs in the traditional sector but equal shares of immobile workers in countries, i.e. $\varphi = 1/2$. In both cases when $\varphi = 1/2$ (Fujita et al., 1999) and low asymmetry in immobile workers (current case) trade does not arise which results in the same pattern of dispersion stability. We conclude that the key point for partial agglomeration stability is the presence of trade in the traditional sector. We show in the next subsection that the partial agglomeration stability pattern changes when trade in the traditional sector emerges.

However, since countries host unequal shares of immobile workers, the equilibrium shares λ^* and $(1-\lambda^*)$ of mobile workers are not equal in countries. This question is related to what we know as a Home Market Effect (HME) – the country with an initial advantage (for example, higher share φ of immobile workers) attracts in the equilibrium a disproportionately higher share of mobile workers making these differences between countries deeper. On one hand, Davis (1998) concludes that under the presence of high enough trade costs in the traditional sector HME disappears while trade in the traditional sector does not take place. On the other hand,

Takatsuka and Zeng (2012) within a footloose capital setting show that HME arises for the arbitrary level of the traditional sector trade costs conditional on the stability of the interior equilibrium without traditional sector trade. Therefore, it is a priory ambiguous whether the equilibrium share of mobile workers λ^* is greater or smaller than φ when Home is more populated with immobile workers, i.e. $\varphi > 1/2$.

To address this question, we compute the equilibrium relative wage w_M^* in high-skilled manufacturing as a solution to the equation $\frac{\omega_H}{\omega_F}(w_M^*) = 1$. Setting (31) equal to 1 we obtain

$$w_M^*(\lambda^*) = \left(\frac{1-\varphi}{\varphi}\frac{\lambda^*}{1-\lambda^*}\right)^{\frac{(1-\mu)(\sigma-1)}{\mu(2\sigma-1)}}. \tag{33}$$

To study how unequal distribution of immobile workers between countries affects the long-run equilibrium we take the derivative of (33) with respect to φ :

$$\frac{dw_M^*}{d\varphi} = \frac{(1-\mu)(\sigma-1)}{\mu(2\sigma-1)} \cdot \frac{w_M^*}{\lambda^*(1-\varphi)} \cdot \left(\frac{1-\varphi}{1-\lambda^*} \cdot \frac{d\lambda^*}{d\varphi} - \frac{\lambda^*}{\varphi}\right). \tag{34}$$

The second step is to differentiate (26) with respect to φ

$$\tau_M^{\sigma-1}\left(\frac{\frac{d\lambda}{d\varphi}}{(1-\lambda)^2} - (2\sigma-1)w_M^{2\sigma-2}\frac{dw_M}{d\varphi}\right) = \frac{\frac{d\lambda}{d\varphi}}{(1-\lambda)^2}w_M^{\sigma} + \sigma\frac{\lambda}{1-\lambda}w_M^{\sigma-1}\frac{dw_M}{d\varphi} - (\sigma-1)w_M^{\sigma-2}\frac{dw_M}{d\varphi}$$

and using (34) we obtain the behavior of the equilibrium share of mobile workers

$$\frac{d\lambda^*}{d\varphi} = \frac{\lambda^*(1-\lambda^*)}{\varphi(1-\varphi)} \cdot \frac{(1-\mu)(\sigma-1)(2\sigma-1)\left((w_M^*)^{\sigma}\tau_M^{\sigma-1}-1\right) + (1-\mu)\sigma(\sigma-1)\left(\frac{\lambda^*}{1-\lambda^*}w_M^*+1\right)}{(\sigma-1-\mu\sigma)(2\sigma-1)\left((w_M^*)^{\sigma}\tau_M^{\sigma-1}-1\right) + (1-\mu)\sigma(\sigma-1)\left(\frac{\lambda^*}{1-\lambda^*}w_M^*+1\right)}. \tag{35}$$

It is readily verified that the $\mu < (\sigma-1)/\sigma$ condition guarantees that $\frac{d\lambda}{d\varphi} > 0$. Moreover, one can note that $\frac{d\lambda}{d\varphi} > 1$, therefore, the developed country (with a higher share $\varphi > 1/2$ of immobile workers) attracts a disproportionately higher share $\lambda^* > \varphi > 1/2$ of mobile workers in equilibrium. Therefore, partial agglomeration is always stable and HME takes place for arbitrary levels of trade costs in the advanced manufacturing sector if trade does not occur in the traditional sector. This result contrasts with Takatsuka and Zeng (2012) who show that interior equilibrium exists only under additional assumptions. However, they observe HME condition on the existence of the interior equilibrium. In this sense, our results for the footloose entrepreneur

setting are similar to the footloose capital setting by Takatsuka and Zeng (2012). Comparing these two frameworks with the Davis' (1998) immobile factor setup leads to the conclusion that factor mobility is enough for HME to overcome the absence of trade in the traditional sector. The economic intuition for this result is as follows. When trade in the advanced manufacturing sector is balanced, mobility of a factor (capital or mobile skilled labour) brings an additional degree of freedom. To be precise, the mobile factor distributes between countries such that it leads to different type of advantage for firms in countries. On one hand, firms in the developed country use increasing returns to scale technology more intensively due to a higher market size regardless of the higher production costs in the country. On the other hand, firms in the transition country enjoys lower production costs and softer competition at the domestic market. Simultaneously, balance of the intra-undustry trade pins down wage difference between countries.

As to mobile workers, HME implies that relative wage (33) of mobile workers $w_M^*(\lambda^*) > 1$. On one hand, mobile workers enjoy a wider range of domestically produced varieties since $N^H = \lambda^* > 1/2$. On the other hand, they suffer from more expensive traditional good in Home due to

$$w_A^*(\lambda^*) = \frac{1-\varphi}{\varphi}\frac{\lambda^*}{1-\lambda^*}w_M^* > 1.$$

Here the former effect always dominates the latter and the developed country always attracts a higher share of mobile workers. Moreover, lower price of the homogeneous good in Foreign allows mobile workers in Foreign to reach the same real wage level as in Home although their nominal wage $w_M^F = \frac{1-\varphi}{1-\lambda} < 1$ is even smaller than Foreign immobile workers'.

However, it is not the case of immobile workers. The ratio ω_A^H/ω_A^F of their welfare in countries is given by

$$\frac{\omega_A^H}{\omega_A^F} = \frac{w_A}{P_H^\mu w_A^{1-\mu}}P_F^\mu = \left(w_A \cdot \frac{P_F}{P_H}\right)^\mu.$$

Using (25), (30), and (33) it takes the following form

$$\frac{\omega_A^H}{\omega_A^F}(\lambda^*) = \frac{1-\varphi}{\varphi}\cdot\frac{\lambda^*}{1-\lambda^*} > 1$$

Therefore, immobile workers in the developed country are better-off than those in the transition country and the higher share φ of immobile workers in Home the bigger the gap of their

welfare between countries.

The $\mu > (\sigma - 1)/\sigma$ case. Here we study the stability of partial agglomeration when the advanced manufacturing sector is large enough. First, we note that the nominator in the parenthesis of the (32) increases with trade costs in high-skilled sector. Moreover, for a high enough value of trade costs it becomes positive since $w_M \leq \tau_M^{\frac{\sigma-1}{\sigma}}$.

One can note that (26) and (33) do not include μ, therefore, relative wage w_M and Home share λ of mobile workers do not depend on μ in equilibrium. Now it is readily verified that (32) monotonically increases with μ. Moreover, for a low value of $\mu \to (\sigma - 1)/\sigma$ (32) is negative whereas for high values of $\mu \to 1$ (32) is positive. This implies that partial agglomeration is unstable for any values of trade costs in advanced manufacturing $\tau_M > \tau_M^*$, where τ_M^* is the threshold value decreasing with the size μ of this sector.

So, when an economy shows a tendency to free trade in advanced manufacturing, i.e., $\tau_M \to 1$, the (32)

$$\frac{d\left(\frac{\omega_M^H}{\omega_M^F}\right)}{d\lambda}|_{\tau_M=1} = -B \cdot (1-\mu) < 0$$

and the partial agglomeration is a stable.

The following Proposition summarizes our findings.

Proposition 2. *Assume positive trade costs in the traditional sector and a higher share of immobile workers in Home ($\varphi > 1/2$). Then the partial agglomeration without trade in homogeneous good (i) is stable and HME arises in the developed country, i.e. $\lambda^* > \varphi > 1/2$, when the advanced manufacturing sector is not too large $\mu < (\sigma - 1)/\sigma$; (ii) is stable if and only if advanced manufacturing trade costs are below a threshold value τ_M^* in the case when this sector is large enough, i.e. $\mu > (\sigma - 1)/\sigma$.*

We summarize our findings by plotting the pattern of long-run equilibria presented in Figure 1. Figure 1 corresponds to the case when high-skilled sector is not too large, $\mu < (\sigma - 1)/\sigma$, and the absence of trade in the traditional sector. For the sake of convenience, we omit the unstable equilibria which lie between stable ones.

3.2.2 Partial agglomeration with trade in the traditional sector

We turn to study the case when trade in the traditional sector arises. First, we combine (25) with (33) to obtain the relative immobile workers' wage under the absence of trade:

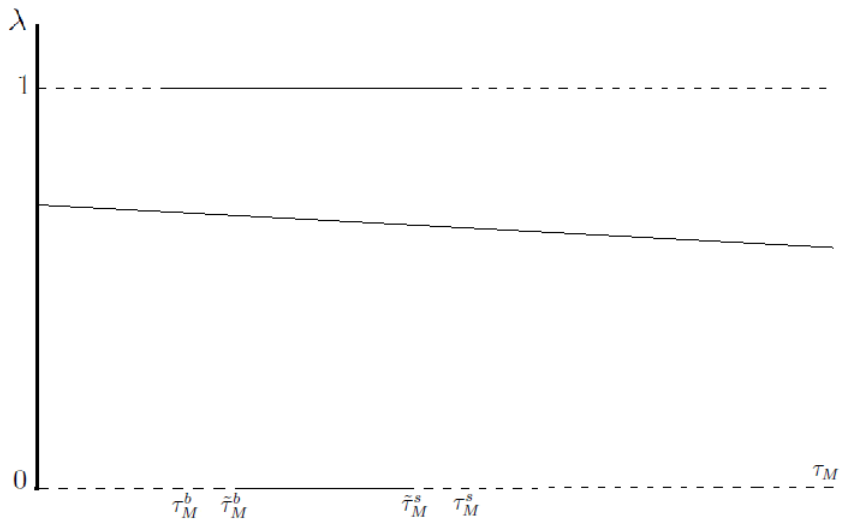

Figure 1: Pattern of spatial equilibria under the absence of trade in the traditional sector.

$$w_A = \left(\frac{1-\varphi}{\varphi} \cdot \frac{\lambda^*}{1-\lambda^*} \right)^{\frac{\sigma-1+\mu\sigma}{\mu(2\sigma-1)}}. \tag{36}$$

Trade in the traditional sector arises when wage given by (36) satisfies $w_A \geq \tau_A$. Note that w_A increases with initial asymmetry of immobile workers φ since $\lambda^* > \varphi > 1/2$. Therefore, the higher asymmetry in φ the higher the relative wage in the traditional sector (36). Hence, trade in the traditional sector arises when this asymmetry is high enough. Although, trade is more likely to arise when trade costs τ_A are low.

Plugging (12), (21) and $w_A = \tau_A$ in (28) and (22) we obtain the system of equilibrium equations given by

$$\left(1 + \frac{\varphi}{1-\varphi}\tau_A\right)\left[\frac{\lambda}{1-\lambda}\left(\tau_M^{\sigma-1} - w_M^{\sigma}\right) - \left(w_M^{\sigma}\tau_M^{\sigma-1} - 1\right)w_M^{\sigma-1}\right] = (1-\mu)(\tau_M^{2(\sigma-1)}-1)\left(\frac{\lambda}{1-\lambda}w_M - \frac{\varphi}{1-\varphi}\tau_A\right)w_M^{\sigma-1},$$

$$\frac{w_M}{\tau_A^{1-\mu}} \cdot \left(\frac{\frac{\lambda}{1-\lambda}\tau_M^{\sigma-1} + w_M^{\sigma-1}}{\tau_M^{\sigma-1}w_M^{\sigma-1} + \frac{\lambda}{1-\lambda}} \right)^{\frac{\mu}{\sigma-1}} = 1. \tag{37}$$

The two equations (37) pin down the equilibrium share λ^* of mobile workers and the relative wage w_M^* in the advanced sector for a given asymmetry of immobile workers φ and levels of trade costs τ_M and τ_A.

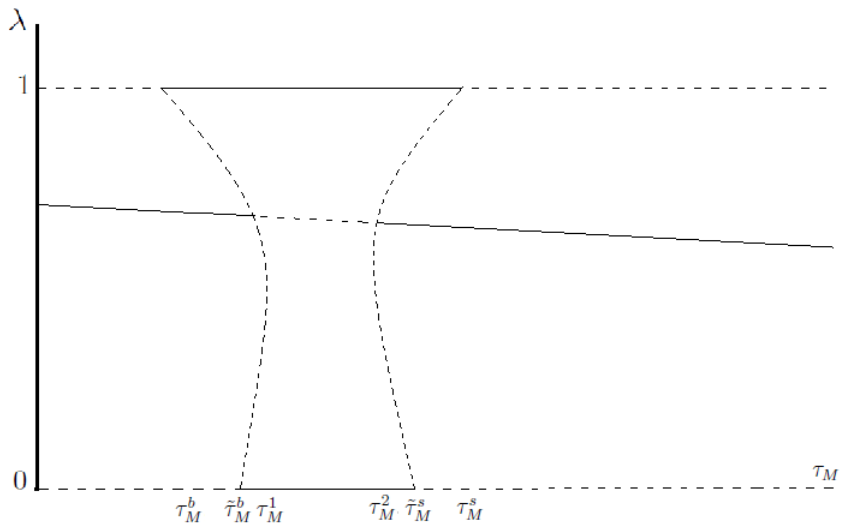

Figure 2: Pattern of spatial equilibria with trade in the traditional sector.

Our simulations show that the pattern of long-run equilibria may differ from the case of absent trade in the traditional sector depending on the size of the advanced sector. To be precise, for the low enough differentiated good sector, $\mu < (\sigma-1)/\sigma$, contrary to the absence of trade in traditional sector case, trade in the traditional sector leads to instability of partial agglomeration for the intermediate level of trade costs $\tau_M^1 < \tau_M < \tau_M^2$ in skilled sector. Combining these findings with Proposition 1, we conclude that for the trade costs (i) $\tau_M < \tau_M^b$ and $\tau_M > \tau_M^s$ only partial agglomeration is stable; (ii) $\tau_M^b < \tau_M < \tau_M^1$ and $\tau_M^2 < \tau_M < \tau_M^s$ both types of equilibrium in Home are stable; (iii) $\tau_M^1 < \tau_M < \tau_M^2$ only Core-Periphery structure is stable.

We note that agglomeration in Foreign is stable for the the intermediate levels of trade costs $\tilde{\tau}_M^b < \tau_M < \tilde{\tau}_M^s$. This interval is smaller for the Foreign since $\varphi < 1/2$, i.e. $\tau_M^b < \tilde{\tau}_M^b < \tilde{\tau}_M^s < \tau_M^s$. Therefore, for the trade costs $\max(\tilde{\tau}_M^b, \tau_M^1) < \tau_M < \min(\tilde{\tau}_M^s, \tau_M^2)$ interior equilibrium and agglomeration in both Home and Foreign are stable.

We present the pattern of long-run equilibria in Figure 2 which corresponds to the case when trade in the traditional sector arises and the advanced sector is not too large, $\mu < (\sigma-1)/\sigma$.

Therefore, traditional sector trade acts as an agglomeration force confirming that trade barriers in this sector is an additional force preventing agglomeration. In the next Section we discuss the impact of countries' inequality φ in immobile demand and the trade costs τ_A in the traditional sector on stability of the long-run equilibria.

3.3 Evolution of the spatial equilibria

In this section we discuss how initial inequality of countries φ and trade liberalization in traditional sector τ_A shape the pattern of spatial equilibria. First, in Section 3.3.1, we look at changes in long-run equilibria under a decrease in initial inequality in immobile demand φ. Second, in Section 3.3.2, we discuss the impact of the traditional sector trade liberalization on spatial equilibria.

3.3.1 Inequality in immobile workers' distribution

We start with the case of high initial inequality of countries in terms of immobile demand, i.e. φ is close to 1. In this case the traditional sector is concentrated in Home. As we discussed in the previous Section, under high enough φ trade in the traditional sector is likely to arise and the pattern of spatial equilibria is presented in Figure 2. Note that, depending on other parameters, agglomeration in Foreign may never be stable.

Now suppose that the initial countries' inequality φ monotonically decreases to 1/2. Decrease in φ has a different impact on the advanced sector trade costs intervals for stability of different types of spatial equilibria. First, we study the changes in the interior equilibrium under a decrease in φ. It leads to a decreasing interval of (τ_M^1, τ_M^2) where partial agglomeration is unstable due to the fact that the equilibrium wage w_A in the traditional sector given by (36) decreases. Moreover, once (36) becomes smaller than τ_A, i.e. when the asymmetry φ is low enough, this interval becomes empty and partial agglomeration is stable for arbitrary levels of advanced manufacturing trade costs while countries trade only the differentiated good.

Second, a decrease in φ results in a decreasing interval (τ_M^b, τ_M^s) where agglomeration in Home is stable and an increase of the interval $(\tilde{\tau}_M^b, \tilde{\tau}_M^s)$ for stability of agglomeration in Foreign. Naturally, a decrease in initial inequality makes countries more similar which results in more similar patterns of agglomeration stability in countries. In the limiting case, when $\varphi = 1/2$ countries are equal in term of immobile workers and the intervals for the agglomeration stability are the same, $\tau_M^b = \tilde{\tau}_M^b$ and $\tau_M^s = \tilde{\tau}_M^s$. In this limiting case the pattern of long-run equilibria presented in Figure 4.3 (Fujita et al., 1999, page 104).

To summarize, a decrease in initial inequality shuts down one of the sources of agglomeration forces, namely, trade in the traditional sector. To be precise, a decrease in φ decreases the difference in price of the traditional sector good between countries. This, in turn, makes mobile workers less sensitive to traditional good price when they choose their location. In

addition, smaller asymmetry in immobile demand decreases the mobile workers' wage gap as well as the real wage difference between countries in both sectors in the short-run. As a consequence, the smaller the asymmetry in the distribution of immobile workers, the wider range of advanced manufacturing trade costs guarantees that partial agglomeration is stable in the long-run. Moreover, for low enough trade costs τ_M partial agglomeration is always a stable spatial structure.

Hence, the initial advantage of a country increases the probability of Core formation in this country. However, on the path of trade liberalization in the advanced sector countries are likely to experience a 'de-ndustrialization' as we observe this process in the developed countries starting in the second half of the XX century.

3.3.2 Trade liberalization in the traditional sector

We start our analysis at the point where trade costs τ_A in the traditional sector are high and discuss how a decrease in τ_A shapes the spatial equilibria. Under high enough τ_A trade in the traditional sector does not arise and the pattern of spatial equilibria is characterized by Figure 1. Although, depending on other parameters, agglomeration may be unstable in both countries under high trade costs in the traditional sector. Therefore, Core-Periphery structure occurs on the path of trade liberalization in the differentiated good sector only if it is accompanied by liberalization in the traditional sector. So, it is clear from the policy point of view that protectionism policy implemented for the traditional sector in transition countries would be enough to protect these countries from de-industrialization. In this case, a sectoral trade agreement may lead to the targeting results - an increase of the advanced manufacturing activity in different size countries due to lower trade barriers without the increase in initial differences among countries.

As in the previous section we, first, discuss the impact of trade liberalization in the traditional sector on the partial agglomeration. At some point on the path of trade liberalization in the traditional sector trade arises. This breaks the stability of interior equilibrium for the interval (τ_M^1, τ_M^2) of the trade costs in advanced sector as shown in Figure 2. Further decrease in trade costs τ_A results in an expansion of the interval (τ_M^1, τ_M^2). In the limiting case when trade in the traditional sector is free, $\tau_A = 1$, partial agglomeration is stable only for high enough trade costs $\tau_M > \tau_M^2$ while τ_M^1 becomes equal to 1. This is the case of free trade in the traditional sector presented in Figure 2 in Sidorov and Zhelobodko (2013, page 213).

Second, trade liberalization in the traditional sector makes agglomeration stable for lower

trade costs τ_M, i.e. threshold values τ_M^b and $\tilde{\tau}_M^b$ decrease. In the limiting case of free trade in the traditional sector, $\tau_A = 1$, agglomeration in both Home and Foreign is stable for all values of trade costs below thresholds τ_M^s and $\tilde{\tau}_M^s$, respectively. In other worlds, $\tau_M^b = \tilde{\tau}_M^b = 1$.

One can relate trade liberalization to productivity improvement. Naturally, a decrease in trade costs allows to ship a higher fraction of the traditional good which could be interpreted as an increase in productivity. Murphy et al. (1989) introduce the big push phenomena showing that an improvement in technology gives a rise to economic growth through increasing individual incomes. Therefore, by analogy with big push, trade liberalization in the traditional sector might be viewed as a source for the "spatial big push". Indeed, trade liberalization in the traditional sector pushes the equilibrium towards agglomeration. In other words, it makes advanced manufacturing sector firms cluster in the bigger market and use increasing returns to scale technology more intensively. Moreover, big push is more likely to happen if the size of the market is high. This is also the case with the "spatial big push" when higher initial advantage in immobile demand φ of developed country permits agglomeration to emerge easily.

In this subsection we discussed how spatial pattern transforms from the case of costly trade in the traditional sector, presented in Figure 2, to the case of free trade (Sidorov and Zhelobodko, 2013, Figure 2). We show that trade costs in the traditional sector is related to the dispersion forces since (i) trade liberalization in the traditional sector leads to instability of partial agglomeration under intermediate level of trade costs τ_M and then for the low and intermediate level of τ_M, and (ii) trade liberalization in the traditional sector fosters emerging agglomeration for the lower trade costs in advanced manufacturing sector. In other worlds, decrease in τ_A increases the range of trade costs τ_M where agglomeration is stable and does the opposite for the interior equilibrium.

4 Conclusion

In this paper we studied the joint impact of trade costs in the traditional sector and initial inequality in immobile workers between developed and transition countries shape the spatial pattern of equilibria. We show that a higher share of immobile demand in the developed country results in a higher probability of agglomeration in this country. This confirms the conventional wisdom on the agglomeration nature of immobile demand in the new economic geography models. The Home market effect is one of the manifestations of this nature. However, positive trade costs in the traditional sector decrease the disproportional advantage of developed

country to the initial level if trade costs in the traditional sector are high enough (Davis, 1998).

Therefore, contrary to the trade costs in the advanced sector which are shown to stand for both agglomeration and dispersion forces (Baldwin et al., 2003), trade costs in the traditional sector are related to the dispersion forces solely. The higher trade costs in homogeneous sector are, the more likely partial agglomeration is stable and the opposite holds for full agglomeration. This result is in line with Picard and Zeng (2005) who show that under linear demand system interior equilibrium is always stable when trade costs in the manufacturing sector are high.

To summarize, in this paper we shed additional light on the nature of dispersion and agglomeration forces in the new economic geography models and discuss the role of costly trade in the traditional sector as well as the asymmetry in distribution of immobile workers on the pattern of long-run spatial equilibria.

References

[1] Artuc, E., Shubham C., and McLaren, J. (2010). Trade Shocks and Labor Adjustment: A Structural Empirical Approach. *American Economic Review*, 100(3), 1008-1045

[2] Autor, D. H., Dorn, D., and Hanson, G. H. (2013). The China syndrome: Local labor market effects of import competition in the United States. *American Economic Review,* 103(6), 2121–68.

[3] Baldwin, R., Forslid, R., Martin, P., Ottaviano, G.I.P., and Robert-Nicoud F. (2003). *Public policies and economic geography.* Princeton: PUP.

[4] Behrens, K., Kichko, S., Zhelobodko, E. 2014. Competition in the traditional sector does not matter for the 'Core–Periphery' model. *Economics Letters,* 122, 94–99.

[5] Bound, J., and Holzer H.J. (2000). Demand Shifts, Population Adjustments, and Labor Market Outcomes during the 1980s. *Journal of Labor Economics*, 18(1), 20-54.

[6] Dauth, W.,Findeisen, S., and Suedekum J. (2014). The rise of the East and the Far East: German labor markets and trade integration. *Journal of the European Economic Association,* 12(6), 1643-1675.

[7] Davis, D. R. (1998). The Home Market, Trade, and Industrial Structure. *American Economic Review*, 1264–1276.

[8] Dix-Carneiro, R. (2014). Trade liberalization and labor market dynamics. *Econometrica* 82(3), 825-885.

[9] Fujita, M., Krugman, P., and Venables, A.J. (1999). *The Spatial economy: cities, regions, and international trade.* MIT Press, Cambridge, Massachusetts.

[10] Fujita, M., and Thisse, J.-F. (2013). *Economics of agglomeration: cities, industrial location, and globalization.* Cambridge university press.

[11] Garrido-da-Silva, L., Castro, S.B. and Vasconcelos, P.B. (2015). Discrete dynamics for the core-periphery model. *Spatial Economic Analysis*, 10(1), 36-51.

[12] Kovak, B. K. (2011). Local labor market effects of trade policy: Evidence from Brazilian liberalization, 1960.

[13] Krugman, P. (1991). Increasing returns and economic geography. *Journal of Political Economy,* 99(3), 483–99.

[14] Krugman, P., and Venables, A.J. (1995). Globalization and the Inequality of Nations. *The Quarterly Journal of Economics,* 110(4), 857–880.

[15] Murphy, K. M., Shleifer, A., and Vishny, R.W. (1989). Industrialization and the Big Push. *Journal of Political Economy,* 97(5), 1003–1026.

[16] Notowidigdo, M.J. (2011). *The incidence of local labor demand shocks.* No. w17167. National Bureau of Economic Research.

[17] Ottaviano, G.I.P., and Robert-Nicoud, F. (2006). The 'genome'of NEG models with vertical linkages: a positive and normative synthesis. *Journal of Economic Geography,* 6(2), 113–139.

[18] Picard, P. M., and Zeng D.-Z. (2005). Agricultural sector and industrial agglomeration. *Journal of Development Economics,* 77, 75–106.

[19] Rauch, J. E. (1999). Networks versus markets in international trade. *Journal of international Economics,* 48(1), 7–35.

[20] Sidorov, A. V., and Zhelobodko E. (2013). Agglomeration and spreading in an asymmetric world. *Review of Development Economics,* 17(2), 201–219.

[21] Suedekum, J. 2006. Agglomeration and regional costs of living. *Journal of Regional Science,* 46(3), 529–543.

[22] Tabuchi, T., and Thisse J.-F. (2002). Taste heterogeneity, labor mobility and economic geography. *Journal of Development Economics,* 69(1), 155–177.

[23] Takatsuka, H., and Zeng D.-Z. (2002). Mobile capital and the home market effect. *Canadian Journal of Economics/Revue canadienne d'économique,* 45(3), 1062-1082.

5 Appendix A

First, we study the behavior of (18) with respect to advanced manufacturing trade cost:

$$\frac{d\left(\frac{\omega_H}{\omega_F}\right)}{d\tau_M} = \left[\left(\frac{(1-\varphi+\varphi\tau_A)\tau_M^{\sigma-1+\mu\sigma}}{(1-\varphi)\left((1-\mu)\tau_M^{2(\sigma-1)}+\mu\right)+\varphi\tau_A}\right)^{\frac{1}{\sigma}}\cdot\frac{1}{\tau_A^{1-\mu}}\right]'_{\tau_M} =$$

$$= \frac{\tau_A^{(1-\mu)(1-\sigma)}}{\sigma\tau_A^{1-\mu}}\cdot\left[\left(\frac{(1-\varphi+\varphi\tau_A)\tau_M^{\sigma-1+\mu\sigma}}{(1-\varphi)\left((1-\mu)\tau_M^{2(\sigma-1)}+\mu\right)+\varphi\tau_A}\right)^{\frac{1}{\sigma}}\cdot\frac{1}{\tau_A^{1-\mu}}\right]^{1-\sigma}\left[\frac{(1-\varphi+\varphi\tau_A)\tau_M^{\sigma-1+\mu\sigma}}{(1-\varphi)\left((1-\mu)\tau_M^{2(\sigma-1)}+\mu\right)+\varphi\tau_A}\right]'_{\tau_M} =$$

$$= \frac{(1-\varphi+\varphi\tau_A)\tau_M^{\sigma-2+\mu\sigma}}{\sigma\tau_A^{(1-\mu)\sigma}}\left(\frac{\omega_H}{\omega_F}\right)^{1-\sigma}\left[\frac{(1-\varphi)(1-\mu)\left(\mu\sigma-(\sigma-1)\right)\tau_M^{2(\sigma-1)}+(\mu\sigma+\sigma-1)\left[(1-\varphi)\mu+\varphi\tau_A\right]}{\left[(1-\varphi)\left((1-\mu)\tau_M^{2(\sigma-1)}+\mu\right)+\varphi\tau_A\right]^2}\right].$$

Therefore, if $\mu > (\sigma-1)/\sigma$ which is similar to the 'black-hole' condition in classical agglomeration models, the relative real wage increases with trade costs τ_M. Moreover, since $\frac{\omega_H}{\omega_F}(\tau_M = 1) < 1$ there is a threshold value of trade costs τ_M^n which is the solution for the $\frac{\omega_H}{\omega_F}(\tau_M) = 1$ such that when $\tau_M > \tau_M^n$ the agglomeration equilibrium is always stable.

In the case of $\mu < (\sigma-1)/\sigma$ the relationship between relative real wages and trade costs in advanced sector is bell-shaped. Depending on characteristics of the economy, namely, asymmetry of the immobile workers φ, the size of the advanced sector μ, and homogeneous sector trade costs τ_A, the agglomeration equilibrium is (i) never stable or (ii) stable for the intermediate value of trade costs $\tau_M^b < \tau_M < \tau_M^s$, where τ_M^b and τ_M^s are the solutions for the $\frac{\omega_H}{\omega_F}(\tau_M) = 1$. The relative real wage reaches its maximum at the level of trade cost τ_M^m which is the solution for

$$\frac{d\left(\frac{\omega_H}{\omega_F}\right)}{d\tau_M}=0.$$

After simplification, we get

$$\tau_M^m=\left(\frac{((1-\varphi)\mu+\varphi\tau_A)(\sigma-1+\mu\sigma)}{(1-\varphi)(1-\mu)(\sigma-1-\mu\sigma)}\right)^{\frac{1}{2(\sigma-1)}}.$$

Now we turn to study how the relative real wage reacts to changes in trade costs in homogeneous sector:

$$\frac{d\left(\frac{\omega_H}{\omega_F}\right)}{d\tau_A}=\left[\left(\frac{1-\varphi+\varphi\tau_A}{(1-\varphi)\left((1-\mu)\tau_M^{2(\sigma-1)}+\mu\right)+\varphi\tau_A}\cdot\frac{1}{\tau_A^{(1-\mu)\sigma}}\right)^{\frac{1}{\sigma}}\cdot\tau_M^{\frac{\sigma-1}{\sigma}+\mu}\right]'_{\tau_A}=$$

$$=\frac{\tau_M^{\frac{\sigma-1}{\sigma}+\mu}}{\sigma}\cdot\left(\frac{\omega_H}{\omega_F}\right)^{1-\sigma}\frac{\varphi\left[(1-\varphi)\left((1-\mu)\tau_M^{2(\sigma-1)}+\mu\right)+\varphi\tau_A\right]-\varphi(1-\varphi+\varphi\tau_A)}{\left[(1-\varphi)\left((1-\mu)\tau_M^{2(\sigma-1)}+\mu\right)+\varphi\tau_A\right]^2}\cdot\frac{1}{\tau_A^{(1-\mu)\sigma}}-$$

$$-\frac{\tau_M^{\frac{\sigma-1}{\sigma}+\mu}}{\sigma}\cdot\left(\frac{\omega_H}{\omega_F}\right)^{1-\sigma}\frac{(1-\mu)\sigma}{\tau_A^{(1-\mu)\sigma-1}}\frac{1-\varphi+\varphi\tau_A}{(1-\varphi)\left((1-\mu)\tau_M^{2(\sigma-1)}+\mu\right)+\varphi\tau_A}=$$

$$=\frac{(1-\mu)\tau_M^{\frac{\sigma-1}{\sigma}+\mu}\left(\tau_M^{2(\sigma-1)}(1-\varphi)\left[\varphi-\sigma\tau_A(1-\varphi+\varphi\tau_A)(1-\mu)\right]-\varphi(1-\varphi)-\sigma\tau_A(1-\varphi+\varphi\tau_A)\left[(1-\varphi)\mu+\varphi\tau_A\right]\right)}{\sigma\tau_A^{(1-\mu)\sigma}\left[(1-\varphi)\left((1-\mu)\tau_M^{2(\sigma-1)}+\mu\right)+\varphi\tau_A\right]^2}\cdot\left(\frac{\omega_H}{\omega_F}\right)^{1-\sigma}.$$

Under the $\mu<(\sigma-1)/\sigma$ condition we obtain

$$\frac{d\left(\frac{\omega_H}{\omega_F}\right)}{d\tau_A}<\left(\frac{\omega_H}{\omega_F}\right)^{1-\sigma}.$$

$$\cdot\frac{(1-\mu)\tau_M^{\frac{\sigma-1}{\sigma}+\mu}\left(\tau_M^{2(\sigma-1)}(1-\varphi)\left[\varphi-\sigma\tau_A(1-\varphi+\varphi\tau_A)(1-(\sigma-1)/\sigma)\right]-\varphi(1-\varphi)-\sigma\tau_A(1-\varphi+\varphi\tau_A)\left[(1-\varphi)\mu+\varphi\tau_A\right]\right)}{\sigma\tau_A^{(1-\mu)\sigma}\left[(1-\varphi)\left((1-\mu)\tau_M^{2(\sigma-1)}+\mu\right)+\varphi\tau_A\right]^2}=$$

$$= -\frac{(1-\mu)\tau_M^{\frac{\sigma-1}{\sigma}+\mu}\left(\tau_M^{2(\sigma-1)}(1-\varphi)\left[\varphi(\tau_A^2-1)+\tau_A(1-\varphi)\right]+\varphi(1-\varphi)+\sigma\tau_A(1-\varphi+\varphi\tau_A)\left[(1-\varphi)\mu+\varphi\tau_A\right]\right)}{\sigma\tau_A^{(1-\mu)\sigma}\left[(1-\varphi)\left((1-\mu)\tau_M^{2(\sigma-1)}+\mu\right)+\varphi\tau_A\right]^2}\cdot\left(\frac{\omega_H}{\omega_F}\right)^{1-\sigma}<0.$$

Contact details:

Sergey Kichko

National Research University Higher School of Economics, Center for Market Studies and Spatial Economics. E-mail: skichko@hse.ru

Any opinions or claims contained in this Working Paper do not necessarily reflect the views of HSE.