POPULATION GROWTH AND ITS DISTRIBUTION BETWEEN CITIES: POSITIVE AND NORMATIVE ASPECTS

by

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Working Paper No.7-2003

March, 2003

The Foerder Institute for Economic Research
and
The Sackler Institute of Economic Studies

Forthcoming in: Regional Science and Urban Economics

Population Growth and its Distribution between Cities: Positive and Normative Aspects

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Final version: 27 January, 2003.

Abstract

This paper investigates positive and normative aspects of population distribution among cities when aggregate population is growing. On the positive level, the paper investigates how different allocation regimes, on the one hand, and different elasticities of substitution between housing and differentiated products, on the other, affect the characteristics of city-size distribution. On the normative level, the paper investigates the potential sources of market failures and their policy implications. It is shown that the sources of market failures are rent-sharing externality, price markup, and multiple equilibria. Because of the latter, a straightforward elimination of the rent-sharing externality and the price markup may reduce welfare even below its achievable level under laissez-faire allocation. It depends on the stage of the aggregate population growth at the time when the policy is introduced (i.e., history matters). When the social planner is fully informed, a transfer scheme which induces the economy to convergence to the global optima can be designed .

Keywords: Population Growth, Concentration, Dispersion, Market failure

JEL classification: H41, R12, R38, R48

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1 Introduction

This paper is concerned with the positive and normative aspects of population distribution among cities and the evolution of this distribution with growing population size. Specifically, the paper discusses the following issues:

1. Does concentration (inequality) of population partition between cities increase or decrease with aggregate population size?

2. To what extent are changes in the population partition between cities associated with aggregate population growth discontinuous?

3. What are the fundamental reasons for the market failure and what is the direction of the market bias in inducing the population partition between cities?

4. What information does a social planner need to determine whether the laissez-faire partition is excessively or insufficiently concentrated? In particular, is the information directly disclosed in the market sufficient to determine the direction of market bias?

5. What is the tax-subsidy design required to achieve a marginal improvement in the partition?

6. What is the tax-subsidy design required to induce convergence of the partition to its global optimum (when the planner is fully informed)?

Different patterns of urban growth, often conflicting, have been described, explained, and evaluated in the literature (e.g., see Henderson (1974, 1985, 1986, 1987), Miyao (1987), Eaton and Eckstein(1997), Anas (1992), Anas, Arnott, and Small (1998), Tabuchi (1998), Helpman (1998), Anas and Xiong (1999), Fujita, Krugman, and Venables (1999), Hadar (2001), Ottaviano, Tabuchi, and Thisse (2002)), and Anas (2002).

On the positive level, different results were reported on, among other things, the effect of population size on its partition between cities. In particular, some models imply that population size does not affect its partition between the cities[1]. Others imply negative correlation[2], or allow for both positive and negative correlation between population size and its concentration, depending on the parameters of the model.[3] Different results are also reported on the pattern of the dynamics of this association. Some models imply that, unless deterred by high migration costs, a new urban area's birth is associated with discontinuous bifurcation (also referred to as "panic migration"), that is, instantaneous loss of a considerable share of the established urban areas' population.[4] Others imply continuous process of adjustment.[5]

Even less agreement persists in the literature *on the normative level.* Some, studies assert that the population partition among cities is suboptimal, at least during some stages of urbanization, being biased *in favor of concentration* (they, therefore, recommend adopting alternative cycles of laissez faire and planning allocations, during which newly born cities are nurtured until they are viable). According to this approach, as the economy grows, the duration of these nurturing stages dwindles and vanishes asymptotically.[6] Others observe that when the laissez-faire population distribution is suboptimal, it is rather biased *against concentration*[7] and may persist, independently of population size, unless checked by

[1] For example, Krugman (1991) and Helpman's (1988) models imply such independence. In the long run, such independence of city-size structure is also implied by the standard local public good theory where cities are replicated (e.g., see Henderson and Ioannides (1981), Anas (1992), and Anas, Arnott, and Small (1998)).

[2] e.g., Anas (2002).

[3] Hadar (2001).

[4] See Anas (1992) and Anas, Arnott, and Small (1998).

[5] See, for example, Helpman (1998) and Hadar (2001).

[6] See Anas (1992) and Anas, Arnott, and Small (1998).

[7] Tabuchi (1998), Helpman (1998), and Hadar (2001).

appropriate urban policy.[8]

These conflicting views on the direction of the market bias and their policy implications are reminiscent of the controversy regarding the desirability of an urban policy designed to contain the growth of large cities (the two opposing views are summarized by Tolley and Crihfield (1987), on the one hand, and Mills and Hamilton (1989), on the other).[9]

The present paper uses a simple and quite general setup to respond to the six questions presented above. *On the positive level*, the model allows for both the possibility that aggregate population size is positively and negatively correlated with concentration of population partition between cities. It depends on whether, in the relevant interval of population growth, housing and differentiated goods are substitutes or complements.[10] In addition, it is shown that the process of bifurcation may be continuous or discontinuous, depending on,

[8] In the above discussion, we ignored the analysis by Fujita, Krugman, and Venables (1999) and restricted our attention to the type of models suggested, for example, by Anas (1992), Tabuchi (1998), Helpman (1998), and Hadar (2001). There are two reasons for this. First, whereas the centrifugal force in Anas (1992), Tabuchi (1998), Helpman (1998), and Hadar (2001) are inherent in the economic structure of the cities themselves, the centrifugal force in Fujita, Krugman, and Venables (1999) is generated either by immobile farmers (see also Krugman (1991)) or by the increase in the derived demand for agricultural land resulting from population increases (see also Fujita and Krugman (1995)). We view this approach irrelevant to modern economies (see Pines (2001)). Second, whereas Anas (1992), Tabuchi (1998), Helpman (1998), and Hadar (2001) are also concerned with the normative issues of the allocation, Fujita, Krugman, and Venables (1999) restrict their analysis to positive aspects only, relegating the treatment of the normative ones to subsequent research.

[9] The issues raised in this debate were:

1. What are the sources of the market failures and, in particular, what roles are played by the positive externalities associated with agglomeration, on the one hand, and the negative externalities associated with unpriced transportation congestion and pollution as well as fiscal externalities, on the other?
2. In what direction is the laissez-faire allocation biased? In particular, are the larger urban areas excessively large?
3. What are the implications of the answers to the above questions regarding the need for a population dispersion policy as a first-best or, alternatively, as a second-best solution?

See a more detailed description and evaluation of this debate in Papageorgiou and Pines (1999) and Papageorgiou and Pines (2000).

[10] Hadar (2001) obtained these results through simulations; in this study it is proved analytically.

among other things, the land ownership regime.

On the normative level, our model identifies the fundamental sources for market failure: Rent sharing externality, pricing markup, which is equivalent to undervaluation of labor productivity, and multiple equilibria. Based on this, the paper explores the issue of enhancing efficiency by using taxes and subsidies under complete and incomplete information.

The remainder of the paper is organized as follows:

Section 2 presents the basic setup upon which this paper is based.

Section 3 describes two laissez-faire allocation regimes. Under the first, the rent revenue in each city is redistributed equally to the local residents; under the second, it is distributed equally to every individual, independently of residential location.

Section 4 portrays a first-best allocation regime implemented by an omnipotent planner.

Section 5 explores the features of population partition and its evolution as a function of aggregate population growth. It analyzes the common and the distinctive implications of the three allocation regimes. This analysis implies that, as a function of aggregate population size, the common characteristics of the population partition between cities crucially depends on whether the quantity index of the differentiated goods, on the one hand, and housing, on the other, are substitutes or complements.

Section 6 is concerned with the normative aspects of the evolving population partition between the cities. Like in Krugman (1991) and Helpman, and unlike Dixit and Stiglitz (1977) and Anas and Xiong (1999), the market allocations under the two market regimes are constrained efficient, that is, given the equilibrium population partition, utility is maximized in spite of the markup. However, the population partition between the cities itself may be distorted, both marginally and globally. Marginally, the distortion is the outcome of the rent-sharing externality and markup pricing. Globally, the potential source of misallocation is the multiple equilibria such that inefficient local optima may be sustainable, disallowing the convergence of the economy to the global optimum.

Section 7 discusses the role of a social planner in improving resource allocation. It is shown that, in some cases, when only the information directly disclosed in the market is available to the planner, following the marginal policy criteria may be globally inefficient by unduly prolonging the stability of inefficient local optima. Whether using the marginal criteria promotes or impairs efficiency depends crucially on the stage of population growth when the policy is introduced. In this respect, history matters.

Section 8 summarizes the paper's findings and provides concluding comments.

2 The Setup

The following assumptions and definitions are common to the three allocation regimes discussed in the paper:

1. The aggregate population, N, is partitioned between two cities i $(= 1, 2)$ such that

$$\sum_{i}^{2} N_i = N. \tag{1}$$

   We use the following definitions for the alternative population partitions: "full concentration" when either $N_1 = N$ or $N_2 = N$, "full dispersion" when $N_1 = N_2 = N/2$, and asymmetric partition when $N_1, N_2 > 0$ and $N_1 \neq N_2$. An asymmetric partition $\left(\tilde{N}_i, N - \tilde{N}_i; \tilde{N}_i > N - \tilde{N}_i\right)$ is said to be "more concentrated" ("less dispersed") from an asymmetric partition $\left(\hat{N}_i, N - \hat{N}_i; \hat{N}_i > N - \hat{N}_i\right)$ when $\tilde{N}_i / \left(N - \tilde{N}_i\right) > \hat{N}_i / \left(N - \hat{N}_i\right)$. Full concentration is an urban analogue of the regional "core-periphery" of Fujita, Krugman, and Venables (1999). However, in their specification, each location is always populated, whereas in our case, a potential site for a city may be unpopulated, thus generating zero demands.

2. Migration is costless and individuals, being fully informed, move to the city which offers them the higher utility.

3. The commodities are land, labor, housing, and manufactured products, where the output of each manufacturing firm is perceived by consumers as a unique brand of differentiated products.

4. Labor and housing are nontradeable: labor is used and housing is consumed only in the city where they are supplied. The differentiated products are tradeable but because their inter-city transport is costly–in the form of "melting iceberg"– $\tau(>1)$ units of a brand must be exported from the city of origin in order to import one unit to the city of destination. That is, exporting one unit of a brand from city i to city $-i$, where $-i$ denotes "not i", costs a fraction $1 - 1/\tau$ of it.

5. Individuals have identical preferences. Specifically, the utility of a representative individual living in city i, u^{i}, depends on a quasi-concave function for housing, h_{i} and a quantity index of the differentiated products, D_{i}, according to

$$u^{i} = u(h_{i}, D_{i})$$

$$D_{i} = \left[\int_{0}^{n} z_{i}\left(n'\right)^{\frac{\sigma-1}{\sigma}} dn' \right]^{\frac{\sigma}{\sigma-1}}, \tag{2}$$

where, n is the number (measure) of firms in the economy, and $z_{i}\left(n'\right)$ is the quantity (density) of brand n' consumed by an individual in city i.

6. Each individual supplies one unit of labor. Accordingly, the aggregate supply of labor in city i is equal to its population size, N_i.

7. Housing is represented by land whose supply is infinitely inelastic. Without loss of generality, this supply is assumed to be one unit.

8. The differentiated products are produced by labor only. Specifically, it takes $a+x$ units of labor to produce x units of a brand by any (existing or potential) manufacturing firm.

9. According to each allocation considered in this paper, individuals are identical and brands are treated symmetrically in the utility. Hence, the bundle of brands consumed by all individuals living in city i is the same. Furthermore, since the technology of the firms is also identical, each city's brands are treated symmetrically. Thus, every individual consumes the same quantity of each brand produced in his own city of residence, $z_{i,i}$, and the same quantity of each imported brand produced in the other city, $z_{i,-i}$. In consequence, the quantity index of the differentiated product, (2), simplifies to:

$$D_i = \left(n_i z_{i,i}^{\frac{\sigma-1}{\sigma}} + n_{-i} z_{i,-i}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \tag{3}$$

where n_i is the number of firms (brands) produced in city i.

10. For convenience, we define new variables $Z_{i,j} = n_j z_{i,j}$ $(j = i, -i)$, that is $Z_{i,j}$ is aggregate consumption in city i of all brands produced in city j. It follows that the quantity

index of the differentiated products, D_i, becomes

$$D_i = \left(n_i^{\frac{1}{\sigma}} Z_{i,i}^{\frac{\sigma-1}{\sigma}} + n_{-i}^{\frac{1}{\sigma}} Z_{i,-i}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}. \tag{4}$$

Accordingly to this formulation, individuals in city i consume two private products, $Z_{i,i}$ and $Z_{i,-i}$, and two "semi-local public goods" (SLPGs, hereinafter), n_i and n_{-i}. A SLPG is a (pure, in the present case) public good supplied in one city and consumed in both cities, where the consumption of the other city's SLPG is costly.

11. The material balance of each differentiated product and its non-satiation requires:

$$N_i Z_{i,i} + N_{-i} Z_{-i,i} \tau = n_i x_i, \tag{5}$$

where x_i is a brand produced by a representative firm in city i. Observe that consuming $Z_{-i,i}$ units of differentiated product produced in city i by a resident of city $-i$ requires the production of $\tau Z_{-i,i}$ units of the differentiated product in city i.

12. The material balance of labor in city i and non-satiation of the quantity and the diversity of the differentiated products imply

$$n_i (a + x_i) = N_i. \tag{6}$$

13. The material balance of housing in city i and its non-satiation imply

$$N_i h_i = 1. \tag{7}$$

3 Laissez-faire Allocations (Regimes I and II)

In this section, we assume that the markets for labor, land, and housing are perfectly competitive whereas the markets for the differentiated products exhibit monopolistic competition. We distinguish, however, between two alternative market regimes, denoted by I and II, differentiated by land ownership and, correspondingly, by the way land rent is allocated to individuals.

3.1 The Price System and the Demands for Housing and Brands

Let the price of housing in city i be R_{i} and the mill price of a representative brand produced in city i be p_{i}. Hence, due to the "melting iceberg" transport cost, the delivery price of a unit imported to city i from city $-i$ is $\tau p_{-\mathsf{i}}$.[11] Using the above definitions, the utility-maximizing consumption bundle satisfies an equality of MRS with the respective relative prices and the budget constraint. Thus, the utility maximizing choice between the locally produced brand and housing implies

$$MRS_{\mathsf{z}_{i,i},\mathsf{h}_i} \;=\; \frac{u^{\mathsf{i}}_{\mathsf{h}_i}}{u^{\mathsf{i}}_{\mathsf{z}_{i,i}}} \;=\; \frac{R_{\mathsf{i}}}{p_{\mathsf{i}}}; \tag{8}$$

Likewise, the utility maximizing choice between the locally produced and the imported brands implies

$$MRS_{\mathsf{z}_{i,i},\mathsf{z}_{i,-i}} \;=\; \frac{u^{\mathsf{i}}_{\mathsf{z}_{i,-i}}}{u^{\mathsf{i}}_{\mathsf{z}_{i,i}}} = \left(\frac{n_{-\mathsf{i}}}{n_{\mathsf{i}}}\frac{Z_{\mathsf{i},\mathsf{i}}}{Z_{\mathsf{i},-\mathsf{i}}}\right)^{\dfrac{1}{\sigma}} \;=\; \frac{\tau p_{-\mathsf{i}}}{p_{\mathsf{i}}}, \tag{9}$$

[11] Due to the "melting iceberg" transport cost and CES subutility, the own-price elasticities of local and foreign demands are the same, σ. Hence, there is no point in price discrimination: uniform mill pricing is profit maximizing.

The budget constraint is

$$h_i R_i + Z_{i,i} p_i + Z_{i,-i} \tau p_{-i} = I_i, \tag{10}$$

where I_i is the income of an individual living in city i.

(8)-(10) determine the ordinary demands for the consumption bundle

$$\begin{aligned} h_i &= \tilde{h}_i \left(R_i, p_i, \tau p_{-i}, n_i, n_{-i}, I_i\right); \\ Z_{i,i} &= \tilde{Z}_{i,i} \left(R_i, p_i, \tau p_{-i}, n_i, n_{-i}, I_i\right); \\ Z_{i,-i} &= \tilde{Z}_{i,-i} \left(R_i, p_i, \tau p_{-i}, n_i, n_{-i}, I_i\right). \end{aligned} \tag{11}$$

3.2 Supply of Differentiated Products

Each brand is produced by a monopolistic competitive firm which, in maximizing its profits, equates marginal revenue to marginal cost. Since the own-price demand elasticity is σ, the marginal revenue of a brand in city i is $p_i (\sigma - 1) / \sigma$.[12] The marginal product of labor is 1 and, therefore, the marginal cost of a brand is the local wage rate, w_i. Hence, profits maximizing requires

$$w_i = \frac{\sigma - 1}{\sigma} p_i \Longrightarrow p_i = \frac{\sigma}{\sigma - 1} w_i. \tag{12}$$

Free entry of profit-seeking firms implies

$$\begin{aligned} w_i (a + x_i) &= x_i p_i \overset{(12)}{=} x_i \frac{\sigma}{\sigma - 1} w_i \\ &\Longrightarrow x_i = a (\sigma - 1). \end{aligned} \tag{13}$$

[12] See the preceding footnote.

It follows that the supply of a brand by its representative firm is independent of its demand (see Dixit and Stiglitz (1977)).

(6) and (13) determine the number of firms in each city

$$n_{\mathsf{i}} = \frac{N_{\mathsf{i}}}{\sigma a}. \tag{14}$$

3.3 Rent Disposal under Two Alternative Market Regimes

The urban economics literature includes different assumptions regarding the disposal of the land rent. One of them is that the rent revenue accrues to absentee landlords. Consistency with our assumptions in Section 2, however, excludes this possibility. One reason is that such an assumption implies two classes – workers and landlords. This complicates the normative analysis because we have to adopt some arbitrary social welfare function, which, in this paper, we do not want. The other is that such an assumption leaves some loose end in the specification of the economy. Specifically, it is not clear where the absentee landlords spend their income in the context of an urban version of the new economic geography. Without such specification, the absentee landlords' assumption implies some leakage of resources out of the economy.[13] Due to the above reasons, we define two alternative assumptions which do not allow unaccounted leakage of resources.

[13] The absentee landlords' assumption prevails in the urban economic literture in spite of its problematic implications. For example, in his short normative discussion, Tabuchi (1998), who adopts the absentee landlords' assumption, concentrates on the welfare of the workers only. As a result, the alleged inefficiency of some allocations may reflect change in income distribution rather than a true market failure (see Solow (1973) for discussion of this issue).

3.3.1 Regime I (Laissez Faire with Local Rent Distribution)

Under this regime, the rent derived in each city belongs exclusively to the local population (equivalent to a 100 % land-rent tax, collected by the local jurisdiction and redistributed to the local population as a lump-sum transfer). Accordingly[14],

$$I_i = w_i + \frac{R_i}{N_i}. \tag{15}$$

3.3.2 Regime II (Laissez Faire with Global Rent Distribution)

Under this regime, there is no local jurisdiction and individuals are ex ante identical in terms of initial holdings, implying that every individual owns an equal share of the land in both cities. Accordingly, each individual is entitled to an equal share in the aggregate land rent paid in each city.[15]

$$I_i = w_i + \frac{R_i + R_{-i}}{N}. \tag{16}$$

[14] See, e.g., Anas (1982).

[15] See, e.g., Helpman (1998), Papageorgiou and Pines (1999), and Hadar (2001).

3.4 Laissez-faire (Stable) Equilibria and their Properties

3.4.1 Equilibrium for a Given population Partition (Short-Run Equilibrium)

Substituting into (11) either (15) or (16), according to the relevant regime, for I_{i} and (14) for n_{i}, and using (1), the demands reduce to functions of $w_{\mathsf{i}}, R_{\mathsf{i}}, R_{-\mathsf{i}}$, and N_{i}, that is,

$$\begin{aligned} h_{\mathsf{i}} &= h_{\mathsf{i}}\left(w_{\mathsf{i}}, R_{\mathsf{i}}, R_{-\mathsf{i}}, N_{\mathsf{i}}\right); \\ Z_{\mathsf{i},\mathsf{i}} &= Z_{\mathsf{i},\mathsf{i}}\left(w_{\mathsf{i}}, R_{\mathsf{i}}, R_{-\mathsf{i}}, N_{\mathsf{i}}\right); \\ Z_{\mathsf{i},-\mathsf{i}} &= Z_{\mathsf{i},-\mathsf{i}}\left(w_{\mathsf{i}}, R_{\mathsf{i}}, R_{-\mathsf{i}}, N_{\mathsf{i}}\right). \end{aligned} \tag{17}$$

Substituting (13), (14), and (17), into (5) and (17) into (7), the market clearing conditions become, respectively

$$\begin{aligned} N_{\mathsf{i}} Z_{\mathsf{i},\mathsf{i}}\left(w_{\mathsf{i}}, R_{\mathsf{i}}, R_{-\mathsf{i}}, N_{\mathsf{i}}\right) + N_{-\mathsf{i}} Z_{-\mathsf{i},\mathsf{i}}\left(w_{\mathsf{i}}, R_{\mathsf{i}}, R_{-\mathsf{i}}, N_{\mathsf{i}}\right)\tau &= (\sigma - 1) N_{\mathsf{i}}/\sigma; \\ N_{\mathsf{i}} h_{\mathsf{i}}\left(w_{\mathsf{i}}, R_{\mathsf{i}}, R_{-\mathsf{i}}, N_{\mathsf{i}}\right) &= 1. \end{aligned} \tag{18}$$

Given N_{i}, three out of the four equations of (18) are independent and can solve for the relative price system (short-run equilibrium). For example, using w_1 as the numeraire, the market clearing conditions of the differentiated products in the two cities and the market clearing condition of the housing market in city 1 can be used for solving w_2, R_1, and R_2. These variables can, then, be used to determine in a closed form the allocation and the remaining components of the price system, that is, $(Z_{\mathsf{i},\mathsf{i}}, Z_{\mathsf{i},-\mathsf{i}}, h_{\mathsf{i}}, x_{\mathsf{i}}, n_{\mathsf{i}}, w_2, p_1, p_2)$.

Calculating $u^{\mathsf{i}}_{\mathsf{n}_i}/u^{\mathsf{i}}_{\mathsf{Z}_{i,i}}$ from (4), use the definition of Z_{ij}, and (14), the first equation of (18) can be written as

$$N_{\mathsf{i}} \frac{u^{\mathsf{i}}_{\mathsf{n}_i}}{u^{\mathsf{i}}_{\mathsf{Z}_{i,i}}} + N_{-\mathsf{i}} \frac{u^{-\mathsf{i}}_{\mathsf{n}_i}}{u^{-\mathsf{i}}_{\mathsf{Z}_{-i,i}}}\tau = a. \tag{19}$$

The first term on the left-hand side (hereinafter LHS) of (19) is the marginal benefit to all the individuals living in city i by the locally provided SLPG (in terms of the locally supplied private good). A unit imported to city $-i$ from city i costs τ units in city i, therefore, the second term on the LHS is the marginal social benefit of the SLPG provided in city i to all the individuals living in city $-i$ (in terms of the private goods produced and consumed in city i).[16] The right-hand side (hereinafter RHS) of (19) is the marginal social cost of providing the SLPG in city i, in terms of the private goods produced and consumed in city i. Hence, (19) is the standard Samuelson condition for providing an SLPG.

Equations (9) imply

$$\frac{u^{\mathsf{i}}_{\mathsf{Z}_{i,-i}}}{u^{\mathsf{i}}_{\mathsf{Z}_{i,i}}}/\tau = \frac{u^{-\mathsf{i}}_{\mathsf{Z}_{-i,-i}}}{u^{-\mathsf{i}}_{\mathsf{Z}_{-i,i}}}\tau. \tag{20}$$

The LHS represents the quantity of $Z_{\mathsf{i,i}}$ a consumer in city i can offer a consumer in city $-i$ in exchange for the marginal unit of differentiated products imported to city i; the RHS represents the quantity of import from city i a consumer in city $-i$ needs to compensate herself for exporting the τ units of local output required for one unit to be imported to city i. If the two magnitudes – LHS and RHS – are unequal, reallocation of outputs can leave both consumers better off.

3.4.2 Equilibrium (Long-Run Equilibrium) and Stability of Partitions

An equilibrium population partition between the cities (long-run equilibrium) is a short-run equilibrium which does not motivate migration. Formally, denote

- $e = N_1/N$, that is, the proportion of aggregate population residing in city i,

[16] Aanas and Xiong (1999) define the first term as "intra-city pecuniary externality" and the second term as "inter-city pecuniary externality".

- $u^i(e)$ = achievable utility in city i under short-run equilibrium, given e,

- $v(e) = u^1(e)/u^2(e)$.

With costless migration, a partition e^* is:

1. An internal equilibrium if $0 < e^* < 1$ and $v(e^*) = 1$.

2. A boundary equilibrium if $e^* \in \{0, 1\} : v(1) \geq 1$.

We are, in fact, interested in stable equilibria, which require that,

1. For an internal equilibrium: $v'(e) < 0$ and

2. For boundary equilibrium: either $v(1) > 1$ or $v(1) = 1$ and $v'(1) < 1$.

These conditions guarantee that any marginal deviation from equilibrium generates a corrective force which restores the initial equilibrium partition.

4 Optimal Equal Treatment Allocations (Regime III)

We distinguish between two aspects of optimal allocations:

- Constrained efficient allocations, that is, efficient allocations, each for a given population partition and

- Efficient population partition.

4.1 Constrained Efficient Allocation

We define a constrained efficient allocation as an allocation which maximizes the utility of a representative individual, given a specific population partition, represented by N_{i}. Accordingly, a constrained efficient allocation solves the following problem

$$\underset{\mathsf{n}_i,\mathsf{n}_{-i},\mathsf{h}_i,\mathsf{h}_{-i},\mathsf{Z}_{i,i},\mathsf{Z}_{i,-i},\mathsf{Z}_{-i,i},\mathsf{Z}_{-i,-i},}{Max} \quad U$$

$$\begin{array}{lcrl} & \text{Subject to:} & & \\ \lambda_{\mathsf{i}} & U - u^{\mathsf{i}}\left(h_{\mathsf{i}}, D_{\mathsf{i}}\right) & = & 0; \\ \Omega_{\mathsf{i}} & N_{\mathsf{i}} Z_{\mathsf{i},\mathsf{i}} + \left(N - N_{\mathsf{i}}\right) Z_{-\mathsf{i},\mathsf{i}}\tau + a n_{\mathsf{i}} - N_{\mathsf{i}} & = & 0; \\ \rho_{\mathsf{i}} & N_{\mathsf{i}} h_{\mathsf{i}} - 1 & = & 0; \end{array} \tag{21}$$

where D_{i} is defined in (4) and $\lambda_{\mathsf{i}}, \Omega_{\mathsf{i}}$, ρ_{i}, and μ are the Lagrange Multipliers of the respective constraints.

Our present maximization problem thus reduces to a more familiar one arising in the context of urban economics and local public goods theories: The determination of optimum allocation with four private goods, each produced under constant returns to scale, and two SLPGs.

The first-order conditions for a constrained efficient allocation are

$$n_{\mathsf{i}} : \lambda_{\mathsf{i}} u^{\mathsf{i}}_{\mathsf{n}_i} + \lambda_{-\mathsf{i}} u^{-\mathsf{i}}_{\mathsf{n}_i} - a\Omega_{\mathsf{i}} = 0, \tag{22}$$

$$h_{\mathsf{i}} : \lambda_{\mathsf{i}} u^{\mathsf{i}}_{\mathsf{h}_i} - \rho_{\mathsf{i}} N_{\mathsf{i}} = 0, \tag{23}$$

$$Z_{i,i} : \lambda_i u^i_{Z_{ii}} - \Omega_i N_i = 0, \tag{24}$$

$$Z_{i,-i} : \lambda u^i_{Z_{i,-i}} - \Omega_{-i} N_i \tau = 0, \tag{25}$$

where u^i_k is the partial derivative $u(h_i, D_i)$ with respect to k, where $k \in (h_i, Z_{i,i}, Z_{i,-i}, n_i, n_{-i})$.

(21), (22), (24), and (25) yield (13), (14), (19), and (20) which are satisfied under both regimes of laissez faire. Stating it differently *laissez-faire allocation is constrained efficient: It allocates the labor between the public and the private dimensions of the differentiated goods (diversity versus quantity of the differentiated product) efficiently and it allocates the manufactured output between local consumption and export (allocates consumption between locally-produced and imported brands) efficiently.*

The above observation deviates from that of Dixit and Stiglitz (1977) because, in our case, the two sectors, manufacturing and housing, do not compete on the same input: The manufacturing sector uses only labor and the housing sector uses only land. Hence, in our case, the competitive sector (housing) does not attract resources from the monopolistic competitive one (manufacturing) as it does in Dixit and Stiglitz (1977) (see Pines and Thisse (2001)).

4.2 Efficient Population Partition

Using the envelope theorem to determine the optimal partition, we differentiate the Lagrangian of (21) with respect to N_i and equate the result to zero. We obtain

$$S_i - S_{-i} = E_i - \Omega_i - (E_{-i} - \Omega_{-i}) = 0, \tag{26}$$

where

$$E_i \equiv h_i\rho_i + Z_{i,i}\Omega_i + Z_{i,-i}\Omega_{-i}\tau$$

$$E_{-i} \equiv h_{-i}\rho_{-i} + Z_{-i,-i}\Omega_{-i} + Z_{-i,i}\Omega_i\tau$$

The interpretations of E_i and E_{-i} are the shadow values of the individual expenditure and that of Ω_i and Ω_{-i} are the shadow wages in city i and $-i$, respectively. Hence, (26) states that the marginal surplus of allocating individuals to the two cities should be equated, where the marginal surpluses of cities i and $-i$, S_i and$-S_{-i}$, are the shadow wage (marginal labor productivity) minus the shadow value of the consumption bundle. Equivalently, (26) states that the shadow non-wage income of individuals in the two cities should be equated.

Further manipulations allow for solving the non-wage income explicitly:[17]

$$E_{\mathsf{i}} - \Omega_{\mathsf{i}} = E_{-\mathsf{i}} - \Omega_{-\mathsf{i}} = \frac{\left[\rho_{\mathsf{i}} + \rho_{-\mathsf{i}}\right] - \left[a\left(n_{\mathsf{i}}\Omega_{\mathsf{i}} + n_{-\mathsf{i}}\Omega_{-\mathsf{i}}\right)\right]}{N}. \tag{27}$$

The first pair of brackets on the denominator of (27) can be interpreted as the aggregate shadow land rent and the second as aggregate shadow value of the SLPG. Hence, the interpretation of (27) is that the shadow non-wage income is equal to aggregate shadow land rent minus aggregate shadow cost of the SLPG divided by the aggregate population size. It can be shown that there exists N^* such that

$$\mu \underset{>}{\overset{<}{=}} 0 \iff N \underset{>}{\overset{<}{=}} N^*. \tag{28}$$

which is the Henry George rule (see Berglas and Pines (1981)).

(26) and (27) represent three closely related requirements for efficiency with equal utility:

1. Marginal cost pricing: In (26) the shadow prices used for evaluating the consumption bundle are the marginal cost for differentiated products and the marginal subjective valuation of housing in terms of local differentiated product, $MRS_{\mathsf{z}_{i,i},\mathsf{h}}$.

2. Optimal disposal of unearned profits: (27) states that unearned profits should be dis-

[17] Multiply each of the second set of constraints in (21) by the respective shadow price and add the resulting expresssions to get

$$I. \qquad N_i\left(E_i - \Omega_i\right) + N_{-i}\left(E_{-i} - \Omega_{-i}\right) = \rho_i + \rho_{-i} - \left(an_i + an_{-i}\right).$$

Multiply (26) by N_{-i} to get

$$II. \qquad N_{-i}\left(E_i - \Omega_i\right) - N_{-i}(E_{-i} - \Omega_{-i}) = 0.$$

Add II to I and use (1) to obtain the result in the text.

posed of equally, independently of residential location. Violation of lump-sum disposal of unearned profits is referred to in the literature as a rent-sharing externality (see Boadway and Flatters (1982) and Boadway and Wildasin (1984))

3. Like rent disposal, the burden of financing the SLPGs should be borne equally, independently of residential location. Violation of the lump-sum collection of the SLPGs' burden is referred to in the literature as a fiscal externality (see Flatters, Henderson, and Mieszkowski (1974) for a discussion of this externality in a broader context than can be discussed here).

In fact, the three requirements are closely related to the basic principle of marginal cost and benefit pricing. The third requirement stems from the purity of the SLPG in the sense that enjoying its benefit does not require either more resources (positive marginal cost) or infringement on the other's benefits (social cost). Likewise, income variation should reflect variation in marginal productivity. The effect of migration on productivity is fully reflected in the (shadow) wage differentials and, therefore, the unearned income should not be directly affected by migration.

It turns out that, in the present context, the fiscal externality does not contribute to distortion in the population partition. A further discussion of this puzzle is postponed until Section 6.

5 Urban Population Growth and Bifurcation under the Alternative Allocation Regimes

Defining the three allocation regimes, we now turn to characterize the pattern of population partition evolution generated by each regime when the aggregate urban population grows.

We discuss both the common and the distinct features of these patterns.

5.1 The Common Pattern of the Partition Evolution under the Three Regimes and its Determinants

The overall pattern of population partition between the cities under the three regimes depends on the population size and the elasticity of substitution between housing and the differentiated products. In exploring the effect of the population size and the elasticity of substitution on the resulting partition under the three allocation regimes, we assume that the utility function exhibits constant elasticity of substitution (CES) between housing and the quantity index of differentiated products:

$$\begin{aligned} u^{\mathsf{i}} &= (\beta h_{\mathsf{i}}^{\frac{\varepsilon-1}{\varepsilon}} + (1-\beta) D_{\mathsf{i}}^{\frac{\varepsilon-1}{\varepsilon}})^{\frac{\varepsilon}{\varepsilon-1}} \\ &= D_{\mathsf{i}} \left[\beta \left(\frac{h_{\mathsf{i}}}{D_{\mathsf{i}}} \right)^{\frac{\varepsilon-1}{\varepsilon}} + (1-\beta) \right]^{\frac{\varepsilon}{\varepsilon-1}} \qquad (29) \\ &= h_{\mathsf{i}} \left[\beta + (1-\beta) \left(\frac{D_{\mathsf{i}}}{h_{\mathsf{i}}} \right)^{\frac{\varepsilon-1}{\varepsilon}} \right]^{\frac{\varepsilon}{\varepsilon-1}} \end{aligned}$$

First, consider the case where housing and the differentiated products are complements, that is, $\varepsilon < 1$. Suppose that aggregate population size is very small, such that $h_{\mathsf{i}} = 1/N_{\mathsf{i}}$ tends to infinity and D_{i} to zero, irrespective of the population partition. In this case, the brackets of the second expression tend to $(1-\beta)$ and the expression itself tends to $(1-\beta)^{\frac{\varepsilon}{\varepsilon-1}} D_i$. Hence, the utility in the city with the larger D_i is higher. Now, under the three regimes, if city i is larger than city $-i$, D_i is larger than D_{-i}. This implies that full concentration is not only stable under each of the market regimes but also dominates all other partitions. Equation (29) also implies that full dispersion is unstable under the three allocation processes. For, starting from full dispersion, if city i becomes larger than city $-i$, D_i becomes larger than D_{-i} and so does the utility in city i vis-à-vis city $-i$. It follows that full dispersion is unstable. Similarly, the utility under full dispersion is Pareto dominated by any asymmetric partition and a fortiori by full concentration.

Next, consider the case of a sufficiently large population so that whatever the regime or the partition, D_i is abundant. When N tends to infinity and the population is fully dispersed or, at the minimum, the population of the smaller city in an asymmetric partition is not negligible, h_i tends to zero in both cities. Then, the brackets of the last expression in (29) tends to β and the expression as a whole tends to $\beta^{\frac{\varepsilon}{\varepsilon-1}} h_i$, that is, the city with the smaller population (larger h_i) provides higher utility. Using arguments similar to those in the preceding paragraph, it follows that full dispersion is stable and full concentration is disequilibrium (the quantity of housing in a city with negligible population is sufficiently large to compensate for inaccessibility to the differentiated products).

Now, suppose that housing and differentiated products are substitutes, that is $\varepsilon > 1$. First, consider the case when aggregate population is sufficiently small. Whatever the partition between the cities, housing is abundant and diversity of differentiated products is negligible. Then, once again, use the last expression of (29) to verify that utility is an increasing function of h_i and, therefore, decreasing in N_i. This implies that full dispersion is stable equilibrium and full concentration is disequilibrium.

Finally, when housing and the differentiated products are again substitutes, yet aggregate population is very large, the brackets in the second expression of (29) tends to $(1-\beta)$ and the expression itself tends to $(1-\beta)\frac{\varepsilon}{\varepsilon-1}D_i$ for any partition that is not radically asymmetric. Hence, starting from full dispersion, migration of any individual from one city to the other generates advantages for the larger city over the smaller one, implying instability of full dispersion. Full concentration cannot be an equilibrium because, even with the overall scarcity of housing under full concentration, land, which is still abundant in the vacant city, can easily compensate the individual for inaccessibility to differentiated products. Hence, $\varepsilon > 1$ and sufficiently large population imply the existence of stable asymmetric partitions.

The above results are summarized in Figure 1.

Figure 1 here

Figure 1 is based on the CES (constant elasticity of substitution) utility functions of h and D. We *conjecture* that it can also be derived from homogenous utility functions which either imply that h and D are globally complements, that is, for all h and D, the elasticity of substitution, $\varepsilon(h, D)$, is larger than 1, or globally substitutes, that is, for all h and D, the elasticity of substitution, $\varepsilon(h, D)$, is smaller than 1.[18] Thus, if $\varepsilon(h, D) > 1$ ($\varepsilon(h, D) < 1$) and the population grows from negligible size to sufficiently large size, the partition transforms from full dispersion to asymmetric distribution (from full concentration to full dispersion).

5.2 The Distinct Patterns of the Partition Evolution under the Three Regimes

In this section, we discuss the bifurcation process when housing and differentiated products are complements, that is $\varepsilon < 1$. In particular, we examine whether discontinuous bifurcation

[18] Formally: $\varepsilon(h, D) \equiv d\ln(h/D)/d\ln(u_D(h, D)/u_h(h, D))$.

is, indeed, inherent in such a process. Figure 2, which represents results of simulations, portrays the stable equilibria associated with each allocation regime as a function of population size.[19] Panel (a) portrays the process of bifurcation under regimes II (global rent redistribution) and III (optimum); panel (b) portrays this process under regimes I (local rent redistribution) and III (optimum). In both panels, the solid loci represent the stable equilibria of the respective market regimes; the dashed loci represent the partition under Regime III (optimum) where it deviates from the stable equilibria of the market regime.

Figure 2 illustrates the result derived analytically in the preceding section for the case where h and D are complements: When N is sufficiently small ($N < G_1$), full concentration is the unique stable equilibrium under each of the three regimes. Likewise, when N is sufficiently large ($N > L_2$), full dispersion is the unique stable equilibrium in each of the three regimes.

The regimes, however, differ from one another with respect to the timing and pattern of the bifurcation process. Specifically, Under Regime I, full dispersion becomes stable once the population reaches size L_1. However, at that stage, full concentration is still sustainable and remains so until the population size exceeds L_2. Only then, full concentration becomes unsustainable being transformed into full dispersion through a discontinuous bifurcation. In contrast to Regime I, under Regime II, the bifurcation is continuous, beginning when the population reaches a size of G_1 and ending when it reaches a size of G_2. Furthermore, in contrast to Regime I, under Regime II, the stable equilibrium is unique for any given population size.

It turns out that, both under regimes I and II, the market fails within certain intervals of population size (different for each regime), being dominated by regime III. Within the

[19] In these simulation, we use the CES function defined in (29) with the following parameters: $\sigma = 2, \varepsilon = .3$, $\beta = .4, a = 1, \tau = 6$. The simulations yield: $G_1 = 2.74, O = 2.79, G_2 = 2.89, L_1 = 3.87$, and $L_2 = 7.8$. Different scales were used to draw the upper and the lower panels of Figure 2.

interval (G_1, O), Regime I is optimal whereas the market under Regime II fails. This should not be surprising although Regime II is free of rent-sharing externality whereas Regime I is infected by it. The reason is that in the interval G_1O the distortive effect of the markup is stronger under Regime II than under Regime I and this advantage of Regime I more than offsets its disadvantage resulting from the rent-sharing externality.[20] However, when the population size exceeds O, Regime II starts dominating Regime I[21]. The explanation is that for population larger than O, the rent is sufficiently high such that the adverse effect of the rent-sharing externality, which is inherent in Regime I, dominates the markup effect.

In summation, the robust results that we may infer from the simulations themselves are that the discontinuous bifurcation is not inherent in a market allocation, the direction of the market bias may change, depending on the stage of urban population growth, as does the relative inefficiency of the market allocations under alternative rent disposal regimes.

The following sections are concerned with the causes of this market failures and their policy implications.

<u>Figure 2 here</u>

[20] As will be shown, in the next section, the marginal effect of the markup in distorting the population partition is reflected by the higher wage in the larger city vis à vis that of the smaller city.

[21] For the interval (O, G_2), this property can only be inferred from the underlying calculations and is not directly observed in Figure 2 itself; only for population size larger than G_2 it is reflected in the figure itself.

6 Reasons for the Market Failure in Distributing the Population between Cities and the Direction of the Bias

We have shown in Section 4.1 that the two market regimes are constrained efficient, that is, for each of the regimes, given any equilibrium partition, no Pareto improvement is possible. However, Figure 2 illustrates that, for some specific population range, each of the two market regimes fails to induce an efficient population partition and that the market bias depends on the regime, the functional specification, and the parameters, including the population size. In this section we analyze the reason for these market failures and the direction of the bias.

We say that a laissez-faire partition is "*marginally biased against concentration (dispersion)*" if a sufficiently small increase (decrease) in $e(\equiv N_1/N)$ increases the utility achievable under constrained efficiency. We say that a laissez-faire partition is "*globally biased against concentration (dispersion)*" if the optimal $e(\equiv N_1/N)$ is larger (smaller) than its level under the laissez-faire allocation. Of course, a laissez-faire allocation can be marginally biased only if it implies asymmetric equilibrium. In addition, any laissez-faire allocation which is marginally biased is also globally biased. However, the direction of a marginal bias may be different from that of the global bias.

6.1 Marginal Bias

Substitute the population constraint, (1) , into the labor constraint of city $-i$ in (21) to eliminate N_{-i}. Then, since the laissez-faire allocation is constrained efficient, apply the envelope theorem to (21) and use the first-order conditions, including the constraints, to evaluate the effect of N_i on the attainable U:

$$
\begin{aligned}
\frac{dU}{dN_i} &= \left(\Omega_i - \left(\frac{1}{N_i}\rho_i + Z_{i,i}\Omega_i + Z_{i,-i}\Omega_{-i}\tau\right)\right) \\
&- \left(\Omega_{-i} - \left(\frac{1}{N_{-i}}\rho_{-i} + Z_{-i,-i}\Omega_{-i} + Z_{-i,i}\Omega_i\tau\right)\right) \\
&= \Omega_i \left[\left(1 - \frac{\Omega_{-i}}{\Omega_i}\right)\right. \\
&+ \left.\left(\frac{1}{N_i}\frac{\rho_i}{\Omega_i} + Z_{i,i} + Z_{i,-i}\frac{\Omega_{-i}}{\Omega_i}\tau\right) - \left(\frac{1}{N_{-i}}\frac{\rho_{-i}}{\Omega_i}Z_{-i,-i}\frac{\Omega_{-i}}{\Omega_i}Z_{-i,i}\tau\right)\right]
\end{aligned} \tag{30}
$$

Calculating Ω_{-i}/Ω_i from (24) and (25) , on the one hand, and calculating w_{-i}/w_i from (9) and (12) , it follows $w_{-i}/w_i = \Omega_{-i}/\Omega_i = p_{-i}/p_i$ because the laissez-faire and the optimal values of $(n_i, n_{-i}, z_{i,i}, z_{i,-i}, z_{-i,i}, z_{-i,-i})$ are the same. Likewise, it follows from (8) , (23) , and (24) that the laissez faire rent is identical to the shadow rent, both in terms of the local differentiated product, that is, $\rho_i/\Omega_i = R_i/p_i = R_i(\sigma-1)/\sigma w_i$. Hence, (30) can be rewritten:

$$
\begin{aligned}
\frac{dU}{dN_i} &= \frac{\Omega_i}{w_i}\left(\left(w_i - \frac{1}{N_i}\frac{\sigma-1}{\sigma}R_i - Z_{i,i}w_i - Z_{i,-i}w_{-i}\tau\right)\right. \\
&- \left.\left(w_{-i} - \frac{1}{N_{-i}}\frac{\sigma-1}{\sigma}R_{-i} - Z_{-i,-i}w_{-i} - Z_{-i,i}w_i\tau\right)\right) \\
&= \frac{\Omega_i}{w_i}\left([w_i - w_{-i}] + \frac{\sigma-1}{\sigma}\left[\frac{1}{N_{-i}}R_{-i} - \frac{1}{N_i}R_i\right]\right. \\
&+ \left.[(Z_{-i,-i}w_{-i} + Z_{-i,i}w_i\tau) - (Z_{i,i}w_i + Z_{i,-i}w_{-i}\tau)]\right).
\end{aligned} \tag{31}
$$

Let, $N_1 \geq N_2$. Then, equation (31) can be used to evaluate the effect of increased concentration on the maximum utility, dU/dN_1, under each of the market regimes, I and II.

Regime I (Local Rent Distribution) Under Regime I, the budget constraints are

$$\begin{aligned} I_1 = w_1 + \frac{R_1}{N_1} &= \frac{R_1}{N_1} + \left(\frac{\sigma}{\sigma - 1} Z_{1,1} w_1 + \frac{\sigma}{\sigma - 1} Z_{1,2} w_2 \tau \right), \\ I_2 = w_2 + \frac{R_2}{N_2} &= \frac{R_2}{N_2} + \left(\frac{\sigma}{\sigma - 1} Z_{2,2} w_2 + \frac{\sigma}{\sigma - 1} Z_{2,1} w_1 \tau \right), \end{aligned} \tag{32}$$

implying

$$w_1 - w_2 = \frac{\sigma}{\sigma - 1} \left[(Z_{1,1} w_1 + Z_{1,2} w_2 \tau) - (Z_{2,2} w_2 + Z_{2,1} w_1 \tau) \right]. \tag{33}$$

Substituting (33) into (31), where $i = 1$ and $-i = 2$, yields

$$\frac{dU}{dN_1} |_{\text{Regime I}} = \frac{\Omega_1}{w_2} \left(\left[\frac{\sigma - 1}{\sigma} \left(\frac{1}{N_2} R_2 - \frac{1}{N_1} R_1 \right) \right] + \frac{1}{\sigma - 1} \left[w_1 - w_2 \right] \right). \tag{34}$$

The RHS of the first equality in (34) is comprised of two sets of brackets. The first set represents the effect of the rent-sharing externality associated with Regime I, that is, the difference in per capita rent income between the small and the large region. In our model, this difference is negative because the rent is higher in city 1 which is the larger city.

The second source of misallocation, represented by the second set of brackets, is the wage differentials across cities. It reflects the *variation across cities* of the gap between the marginal and the average labor productivity, generated by the price markup. To see that, observe that the marginal product of labor is 1 whereas the average product of labor is $x/(x+a) = (\sigma - 1)/\sigma$. Hence, the gap between the marginal and the average product is $1 - (\sigma - 1)/\sigma = 1/\sigma$ units of brand per worker . The value of this gap in city i, in terms of the numeraire, is $p_i/\sigma = (\sigma/(\sigma - 1)) w_i/\sigma = w_i/(\sigma - 1)$. Hence, the term inside the second brackets on the RHS of (34) equals precisely the *variation across cities of the gap between the marginal and the average labor productivity.* Further elaboration on this source of market failure is postponed to the next section.

It follows from (34) that in the case of Regime I, if an asymmetric partition is an equilibrium, information on rents and wages in each city is insufficient to determine whether the market is marginally biased against concentration or dispersion because information on σ is also needed.[22]

Regime II (Global Rent Distribution) Under Regime II, the budget constraints are

$$\begin{aligned} I_1 = w_1 + \frac{1}{N}\left[R_1 + R_2\right] &= \frac{1}{N_1}R_1 + \left(\frac{\sigma}{\sigma-1}Z_{1,1}w_1 + \frac{\sigma}{\sigma-1}Z_{1,2}w_2\tau\right), \\ I_2 = w_2 + \frac{1}{N}\left[R_1 + R_2\right] &= \frac{1}{N_2}R_2 + \left(\frac{\sigma}{\sigma-1}Z_{2,2}w_2 + \frac{\sigma}{\sigma-1}Z_{2,1}w_1\tau\right), \end{aligned} \tag{35}$$

implying

$$w_1 - w_2 = \left(\frac{1}{N_1}R_1 - \frac{1}{N_2}R_2\right) + \frac{\sigma}{\sigma-1}\left[\left(Z_{1,1}w_1 + Z_{1,2}w_2\tau\right) - \left(Z_{2,2}w_2 + Z_{2,1}w_1\tau\right)\right]. \tag{36}$$

Substituting (36) into (31), where $i = 1$ and $-i = 2$, yields

$$\frac{dU}{dN_1}\Big|_{\text{Regime II}} \overset{(36)}{=} \frac{\Omega_i}{w_i}\left(\frac{1}{\sigma-1}\left(w_1 - w_2\right)\right) \tag{37}$$

[22]Observe that although in our simulations, which are based on the CES utility function of h and D, we did not encounter asymmetric equilibria, the discussion about marginal bias in the case of market regime I is not vacuous. The reason is that our analysis is valid for more general specifications which can yield stable asymmetric partitions as well. Moreover, our methodology equally applies to the case of full concentration. Although in that case the wage in the empty city is not defined, one can use, instead, $w_2 = \lim_{N_2 \to 0} \frac{\sigma-1}{\sigma} p_2$. Such a limit exists.

Since Regime II is free from rent-sharing externality, the first set of brackets in (34), which is relevant only to Regime I, disappears in (37); the only remaining term is the wage differentials across cities which reflect the variation across cities of the gap between the marginal and the average labor productivity, generated by the price markup. Efficient partition requires equalization of such gaps (see discussion in Papageorgiou and Pines (1999 and 2000)).

Three comments are in order:

1. As mentioned at the end of Section 4.2, under both regimes, the fiscal externality is neutral; it does not affect the direction of the bias. The reason being that whereas the markup and the rent-sharing externality vary across cities the fiscal externality does not. Under both regimes, the individuals do not bear their shares in financing the SLPG. The *deviation* from the optimum financing is uniform across individuals. This is not the case in rent-sharing externality under Regime I, when the rent varies across cities. Then, the gap between the optimal share (aggregate rent divided by the population size) and the realized share under laissez faire varies across individuals according to residential location. Likewise, asymmetric equilibria under both regimes imply that the gap between the marginal and the average labor productivity varies across cities. This distinction between the very existence of an externality, which need not contribute to the bias, and the variation in the size of the externality across cities is elaborated upon in Papageorgiou and Pines (1999, 2000)).

2. In view of the analysis in this section, the isomorphism between the prototype model of Helpman (1998) which is based on Chipman (1970) and Henderson (1974), on the one hand, and the fully specified model which is based on Dixit and Stiglitz (1977), becomes apparent. In both of Helpman' (1988) specifications, the source of the market failure is the variation across cities of the gap between the marginal and the average

labor productivity. However, in the prototype model, the scale economies which generate the gap are external, whereas in the fully-specified model, the scale economies are internal to the firm. In both specifications, however, the gap between the marginal and the average productivity in the larger city exceeds that of the smaller one, implying that laissez faire with asymmetric equilibrium is biased against concentration. In the prototype model, this directly follows from the specification of the industry's production function; in the fully-specified model, it follows from the (endogenously determined) higher wage in the larger than in the smaller city when the utility is Cobb Douglas.[23]

3. In contrast to Regime I, under Regime II, the information on the bias is directly disclosed in the market through the wage differentials.

The above analysis is based on a general specification of the utility function, $u(h, D)$. In the rest of this section we use simulation to *illustrate* the findings regarding Regime II. Figures 3-5 are derived from simulations based on CES utility function and the same parameters with the exceptions of the aggregate population size, N, each figure represents. Panel (a) of each figure portrays the utility level in each city (the bold solid locus is the utility in city 1 and the bold dashed locus is the utility in city 2), as well as the utility under constrained efficiency (the thin solid locus) as a functions of $e \equiv N_1/N$. The property of laissez-faire equilibrium as constrained efficient is reflected in that the three loci intersect at the same partition.

The solid locus in panel (b) of Figures 3-5 represents $v(e) - 1 \equiv u^1/u^2 - 1$. A stable equilibrium partition is where $v(e) - 1 = 0$ and $v'(e) < 0$. The dashed locus is the wage differentials, $w_1 - w_2$. As can be verified in Figures 3 and 5, when the constrained efficient

[23] A proof is provided by Hadar (2001).

utility is increasing (decreasing), that is, $dU/de > 0$ ($dU/de < 0$) at an equilibrium e, $w_1 - w_2$ is positive (negative). Figure 4 is an intermediate case where the constrained efficient utility is stationary at an asymmetric equilibrium partition, that is, $dU/de = 0$ such that the loci $v(e) - 1$ and $w_1 - w_2$ intersect on the horizontal axis, implying that at the equilibrium, $w_1 - w_2 = 0$.

Figure 3 here

Figure 4 here

Figure 5 here

Summing up, an asymmetric partition under Regime II is likely to be inefficient, exhibiting, marginal bias at the least. Specifically, under a Regime II asymmetric equilibrium, redistributing the population in favor of the city with the higher wage always allows an increase in the common utility by an appropriate inter-city resource transfer. However, as explained below, this criterion may be misleading for non-marginal redistributions.

6.2 Global Bias

In order to identify the global bias, turn back to Figure 2. Accordingly, Regime I is globally biased against dispersion for aggregate population in the range of $N \in (O, L_2)$: Only at $L_1 (> O)$ does full dispersion becomes stable, and only at $L_2 (> L_1)$ does full concentration cease to be sustainable. Regime II is globally biased against concentration when $N \in (G_1, O)$; it is globally biased against dispersion when $N \in [O, G_2]$. However, in the case represented in Figure2, the marginal bias is in the same direction as the global bias. This need not be true under other parameter sets and a fortiori other functional specifications. For example, according to the parameters underlying Figure 6, the laissez-faire equilibrium under Regime II is marginally biased against concentration but globally biased against dispersion.

It follows, therefore, that one should be cautious in using the criterion of wage differentials for judging the direction of the global bias because the sign of the wage differentials indicates only the direction of the marginal bias.[24]

Figure 6 here

The issue at stake is multiple local optima and the difficulties involved in achieving efficiency. This issue is further elaborated in the next section.

7 Planning Instruments and their Effectiveness

Given that the social planner can use only information directly disclosed in the market and that her instruments are taxes and subsidies, two questions arise:

1. How to eliminate the distortive effect of the markup?

2. Will such internalization be welfare enhancing?

As to the first question, the optimal price system can be implemented by subsidizing the differentiated products at a rate of $1/(\sigma-1)$ such that the consumer pays w_i and the producer receives, as before, $w_i(1+1/(\sigma-1)) = w_i\sigma/(\sigma-1)$. The cost of the subsidy is to be financed by a tax on rent and, if the aggregate rent is insufficient, the rent revenue has to be supplemented by head tax.[25]

[24] Panel (c) is a magnification of panel (b) close to the equilibrium. It is required because the positive level of $w_1 - w_2$ at the equilibrium is not clearly visible in panel (b).

[25] The need for the subsidy to implement (26) stems from the assumed inability of the social planner to dictate marginal cost pricing. Without such a capacity, marginal cost pricing is unsustainable: The monopolistic producer, aware that the price elasticity of the demand for his specific brand is not infinitely elastic, will mark up the price.

We now turn to the second question which is trickier due to the multiple equilibria. Figure 7 illustrates the multiple stable equilibria that emerge when the effect of the markup is completely eliminated in Regime II as a result of subsidizing the differentiated products. It can be observed that when the population is within the interval $[2.7, 2.8]$, both full concentration and full dispersion are stable equilibria. Furthermore, there even exists an interval close to 2.8 where, in addition, an asymmetric partition is also a stable equilibrium.

<u>Figure 7 here</u>

Figure 8 corresponds to Figure 7 and allows us to identify which of the local maxima in Figure 7 is the global one ("maximum maximorum"). The bold solid locus in Figure 8 represents utility under stable full concentration, the bold dashed line represents utility under stable full dispersion, and the thin solid line represents utility under stable asymmetric partition. It follows from Figure 8 that full concentration is the global optimum when the aggregate population is smaller than 2.787 and full dispersion is the global optimum for larger population. Thus, the dashed line, which is drawn in Figure 7 at $N = 2.787$, indicates the population size at which the discontinuous bifurcation of the global optimum occurs.

Figures 7 and 8 show that, being a local optimum, full concentration remains sustainable until the population size increases to 2.805, even though it is dominated by full dispersion (and even by the asymmetric allocation for some interval) when population size reaches 2.787. [26]

<u>Figure 8 here</u>

[26] In the above discussion, we have assumed that the urban population is increasing. One can conceive of a reverse trend, which actually occurred (ancient Rome may be an example), where aggregate urban population shrinks. In this case, the optimal partition is transformed from full dispersion to full concentration. The transition in this reversed trend is also belated relative to the optimal timing, because full dispersion, being a local optimum, remains sustainable until the population declines to, roughly, 2.705 (see Figure 9).

In Figure 9, we introduce not only the achievable utility under equilibrium when the effects of the markup and the rent-sharing externalities are eliminated, but also the achievable utility under Regime II without intervention. The bold solid locus in Figure 9 is the utility under full agglomeration, the dashed locus is utility under full dispersion where, in both cases, the markup's effect is eliminated. The thin solid line is the utility under Regime II. It can be observed that when aggregate population lies in the interval between (approximately) 2.8 and 2.825, the unique stable equilibrium under Regime II (which is affected by the markup), yields a higher utility than the one achieved under full agglomeration, which is free of the markup's effect.[27]

Figure 9 here

What are the policy implications of the above observations? Our analysis implies that, with incomplete information, history matters: The stage of urban growth at which the distortive effect of the markup is eliminated determines whether such a policy enhances or impairs efficiency.

Of course, the social planner could adopt a much more effective policy if she were fully informed as to the global optimum partition. In that case, she could design a tax schedule that would induce the economy to converge to the optimal partition. This is certainly true if housing and the differentiated products are complements, that is, $\varepsilon < 1$. Suppose that in that case, the optimal partition is $e^* \equiv N_1^*/N$. Then, for partitions implying $e < e^*$, the tax schedule requires a transfer of mobile resources from city 2 (the smaller city) to city 1 (the larger city) in the amount which will push the achievable utility in city 2 below that of city 1. Symmetrically, for partitions implying $e > e^*$, the tax schedule requires a transfer of mobile resources from city 1 to city 2 in the amount which will push the achievable utility in

[27] Both allocations, however, are inferior to full dispersion.

city 1 below that of city 1. With $\varepsilon < 1$, such transfers exist and they induce the economy's convergence to a unique equilibrium at e^*.[28]

8 Summary and Concluding Comment

In this paper, we have investigated positive and normative aspects of urban population partition between cities and its evolution through time. We have shown that the characteristics of this evolution depends critically on the utility function and rent disposal specifications. If housing and the differentiated products are substitutes, the centrifugal dominates the centripetal force when the population is sufficiently small, and is dominated by the centripetal force when the population becomes sufficiently large; if housing and the differentiated products are complements, the centripetal dominates the centrifugal force when the population is sufficiently small and is dominated by the centrifugal force when the population becomes sufficiently large. There is, of course, empirical evidence for both cases as well as for an intermediate case where the size distribution remains stable when the population increases (see Eaton and Eckstein (1997)).

Our simulations indicate that whether the laissez-faire bifurcation is discontinuous or continuous depends on the rent disposal regime. Under local rent distribution (e.g., Anas 1992) the bifurcation is discontinuous; under universal rent distribution, the bifurcation is continuous.

On the normative level, our specification (as well as those of Krugman (1991) and Helpman (1998)) implies that any equilibrium partition is constrained efficient. However, the population partition between the cities is inefficient for some intervals of aggregate population

[28]If $\varepsilon > 1$, there may not exist sufficient transfers to guarantee the convergence of the economy to the optimal partition because housing is immobile.

size. Restricting our analysis to the case where housing and differentiated product are complements, our simulations imply:

- When the rent is redistributed locally as in Anas (1992), laissez-faire bifurcation is belated, relative to its optimal timing.
- When the rent is redistributed globally, the beginning of the laissez-faire (continuous) bifurcation generated by population increase is earlier than its optimal timing, yet its ending is belated. Hence, there exists an interval $\left[\underline{N}, \overline{N}\right]$ and a critical population size, say $\hat{N} \in \left(\underline{N}, \overline{N}\right)$, such that for $\underline{N} \leq N < \hat{N}$, the laissez-faire population partition is biased against concentration and for $\hat{N} < N \leq \overline{N}$, the laissez-faire population partition is biased against dispersion.

There are three sources for the market failure that prevents the economy from converging to the optimal pattern:

- Price markup and the resulting undervaluation of marginal labor productivity,
- Rent-sharing externality, and
- Multiple local equilibria.

When the rent-sharing externality is internalized and the effect of the markup is eliminated, we still remain with the issue of multiple local optima. There are some intervals of population partitions where full concentration, full dispersion, and asymmetric partitions are simultaneously stable equilibria, such that each equilibrium is a local optimum. In some intervals, full concentration remains sustainable though already dominated by full dispersion and, in some intervals, even by asymmetric partitions. Thus, the global optimal allocation cannot be achieved simply by internalizing the rent-sharing externality and eliminating the effect of the markup pricing. Furthermore, there exists an interval of population size where the sustainable full concentration is inferior even to the laissez faire with markup pricing. In this case, doing nothing (under common land ownership) or taxing land rent and redistributing the rent equally to every one, independently of residential location, while leaving the markup pricing untouched is the preferable policy (relative to eliminating its effect by an appropriate subsidy–see Figure 9).

Two lessons can be drawn from these observations. The first is that the stage of aggregate population growth may affect the usefulness of eliminating the effect of the markup pricing (history matters). The second is that the social planner needs to know the partition representing the global optimum in order to design a tax schedule which can induce the economy's convergence to that allocation. Even in that case, she may be constrained by the infeasibility of such a schedule due to easy substitution between housing and the differentiated products, on the one hand, and immobility of housing, on the other.

Finally, one of the interesting results reported in Helpman (1998) is that the population partition pattern is the outcome of the reduced form interplay of scale economies and diseconomies associated with city size, whatever the primitives generating these economies and diseconomies. Thus, using a prototype model, Helpman (1998) illustrates that external scale economies à la Chipman (1970) and Henderson (1974) yields qualitatively the same results as does Dixit and Stiglitz (1977)' monopolistic competition specification. In this respect, the new economic geography should be considered as providing new interesting primitives for old concepts of scale economies which have been used since the ancient world to explain the emergence of population concentration in cities and its limits.[29],[30]

[29] See Papageorgiou and Pines (2000).

[30] See the derivation of some of these results in Pines (2000, unpublished manuscript).

References

[1] A. Anas, 1992, "On the Birth and Growth of Cities," *Regional Science and Urban Economics*, 22, 243-258.

[2] A. Anas, R. Arnott, and K. A. Small, 1998, "Urban Spatial Structure." *Journal of Economic Literature*, 36, 1426-1464.

[3] A. Anas and Xiong, 1999, *The Formation and Growth of Specialized Cities: Laissez-faire and Planning Compared.*" Unpublished Manuscript.

[4] A. Anas, 2002, "Vanishing Cities: What Does the New Economic Geography Imply about the Efficiency of Urbanization?." Unpublished Manuscript.

[5] E. Berglas, and D. Pines, 1981, "Clubs, Local Public Goods, and Transportation Models: A Synthesis." *Journal of Public Economics*, 15, 141-162.

[6] R. W. Boadway and F. Flatters, 1982, "Efficiency and Equalization Payments in a Federal System of Government: A Synthesis and Extension of Recent Results." *The Canadian Journal of Economics*, 15, 613-633.

[7] J. S. Chipman, 1970, "External Economies of Scale and Competitive Equilibrium." *Quarterly Journal of Economics*, 84, 347-385.

[8] A. K. Dixit and J. E. Stiglitz, 1977, "Monopolistic Competition and Optimum Product Diversity." *American Economic Review*, 67, 297–308.

[9] J. Eaton and Z. Eckstein, 1997, "Cities and Growth: Theory and Evidence." *Regional Science and Urban Economics*, 27, 443-474.

[10] F. Flatters, V. Henderson, and P. Mieszkowski, 1974, "Public Good, Efficiency, and Regional Fiscal Equalization." *Journal of Public Economics*," 3, 99-112.

[11] M. Fujita, P. Krugman, and A. J. Venables, 1999, *The Spatial Economy*. The MIT Press, Cambridge, Massachusetts.

[12] Y. Hadar, 2001, "Topics in City Formations." Unpublished Ph.D. Dissertation.

[13] E. Helpman, 1998, "The Size of Regions." In D. Pines, E. Sadka, and I. Zilcha. (eds.) *Topics in Public Economics*. Cambridge University Press, Cambridge, 33-54.

[14] J. V. Henderson, 1974, "The Sizes and Types of Cities." *American Economic Review*, 64, 640-656.

[15] J. V. Henderson and Y, Ioannides, 1981, "Aspects of growth in a System of Cities", The Sizes and Types of Cities." *Journal of Urban Economics,* 10, 117-139.

[16] J. V. Henderson, 1985, *Economic Theory and the Cities*. Academic Press, New York (Second Edition).

[17] J. V. Henderson, 1986, "The Timing of Regional Development." *Journal of Development Economics*, 23, 275-292.

[18] J. V. Henderson, 1987, "General Equilibrium Modeling of Systems of Cities." In E. S. Mills (ed.) *Handbook of Regional and Urban Economics* II: *Urban Economics*. North Holland, Amsterdam, 927-956.

[19] P. Krugman, 1991, "Increasing Returns and Economic Geography." *Journal of Political Economy,* 99, 483-499.

[20] E. S. Mills and B. W. Hamilton, 1989, *Urban Economics*. Harper Collins Publishers, New York (Fourth Edition).

[21] T. Miyao, 1987, "Dynamic Urban Models." In E. S. Mills (ed.) *Handbook of Regional and Urban Economics* II: *Urban Economics*, North Holland, Amsterdam, 877–925.

[22] G. Ottaviano, T. Tabuchi, and J-F. Thisse, 2002, "Agglomeration and Trade Revisited", *International Economic Review, 43, 409-436.*

[23] Y. Papageorgiou and D. Pines, 1999, *An Essay on Urban Economic Theory.* Kluwer Academic Publishers, Boston.

[24] Y. Papageorgiou and D. Pines, 2000, "Externalities, Indivisibility, Nonreplicability, and Agglomeration." *Journal of Urban Economics,* 48, 509-535.

[25] D. Pines (2000), *On Alternative Urban Growth Patterns*, unpublished manuscript.

[26] D. Pines, (2001), "'New Economic Geography': Revolution or Counter Revolution." *Journal of Economic Geography*, 1, 139-146.

[27] D. Pines and J-F. Thisse, 2001, "Urban System: Market and Efficiency." *Journal of Public Economic Theory*, 3, 2001, 7-14.

[28] T. Tabuchi, 1988, "Urban Agglomeration and Dispersion: A Synthesis of Alonso and Krugman", *Journal of Urban Economics,* 44, 333–351.

[29] R. M. Solow, 1973, "Congestion Cost and the Use of Land for Streets." Bell Journal of Economics and Management Science, 4, 602-618.

[30] G. Tolley and J. Crihfield, 1987, "City Size and Place as Policy Issues." In E. S. Mills (ed.) *Handbook of Regional and Urban Economics* II: *Urban Economics*. North Holland, Amsterdam, 1285–1311.

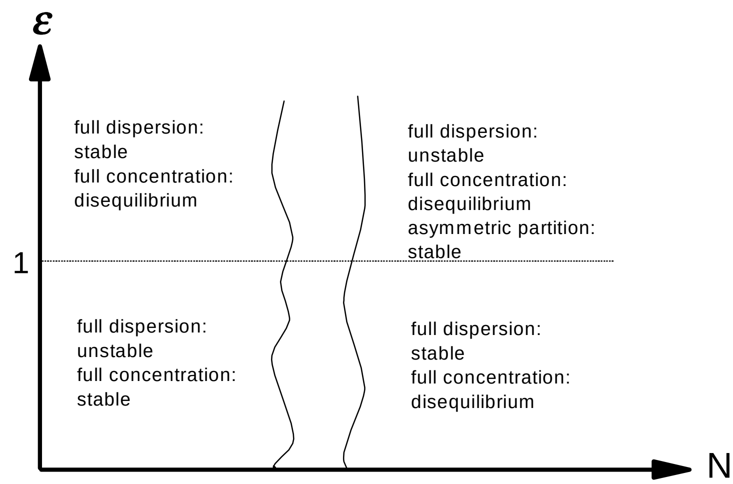
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Figure 1

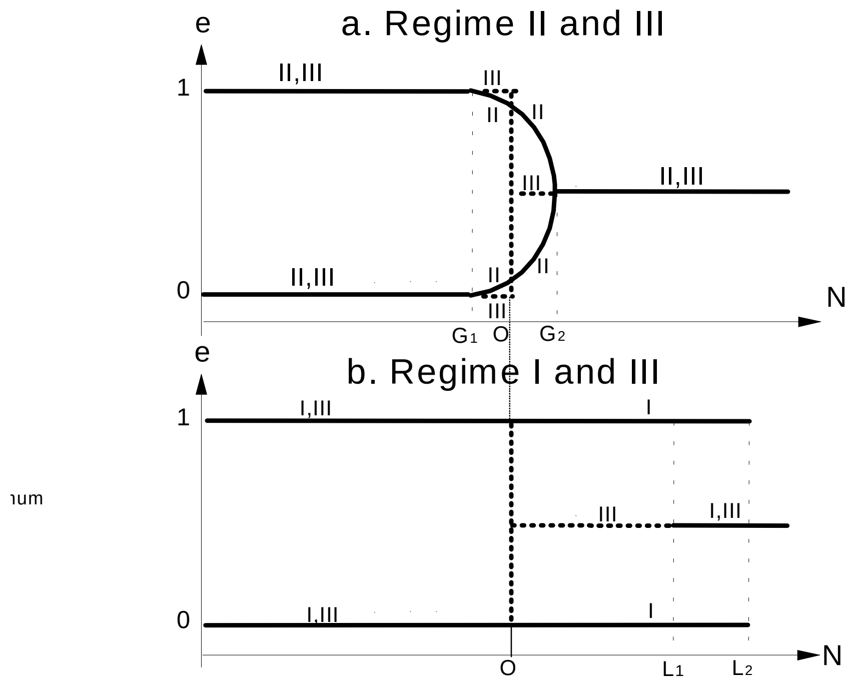


Figure 2: Stable equilibria of Regime I, Regime II, and Regime III (optimum) as functions of population Size

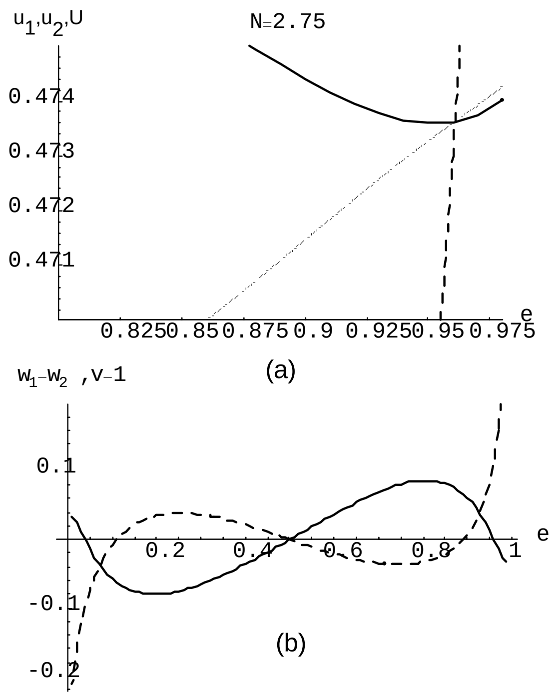


Figure 3: $U'(e) > 0$ for equilibrium e.

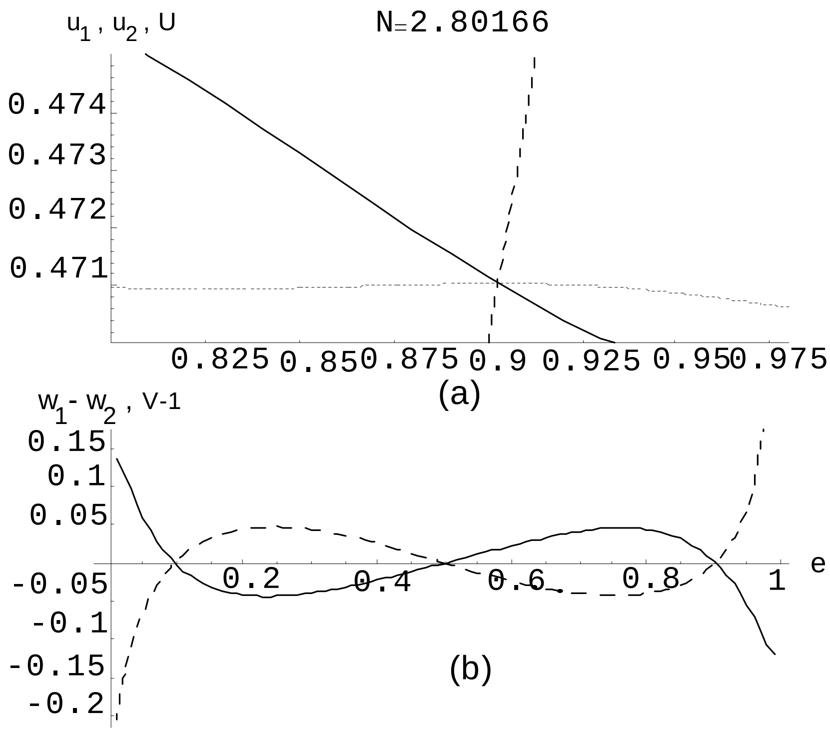
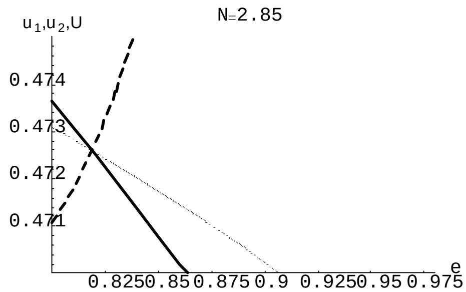


Figure 4: $U'(e) = 0$ for equilibrium e



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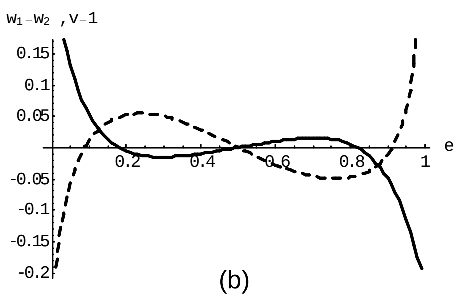

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Figure 5: $U'(e) < 0$ for equilibrium e

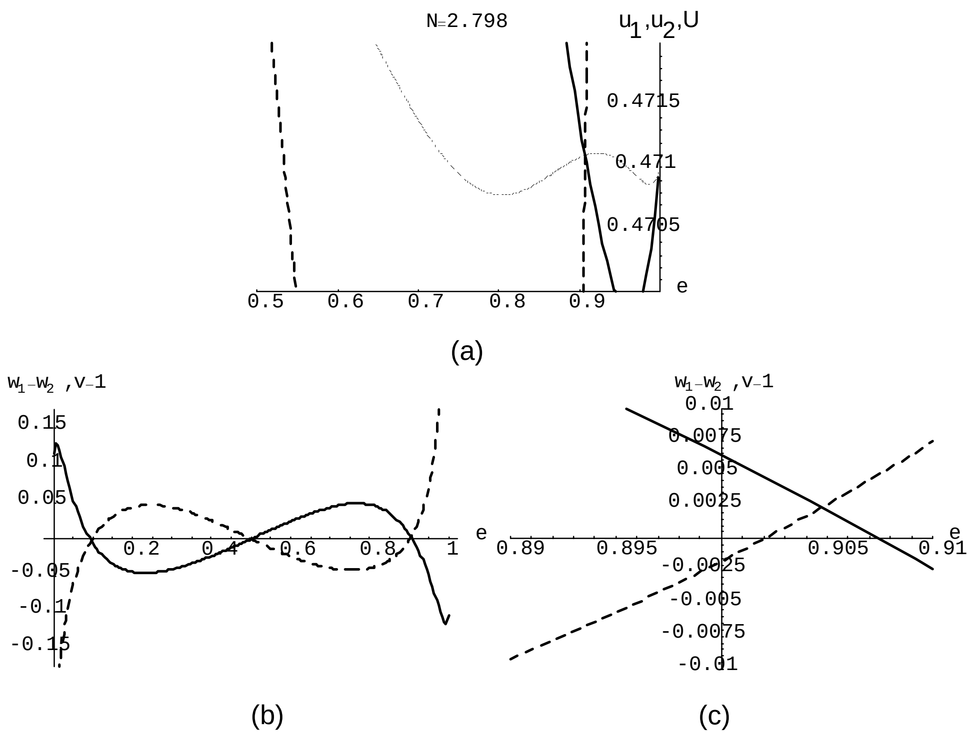

Figure 6: Local vs global bias

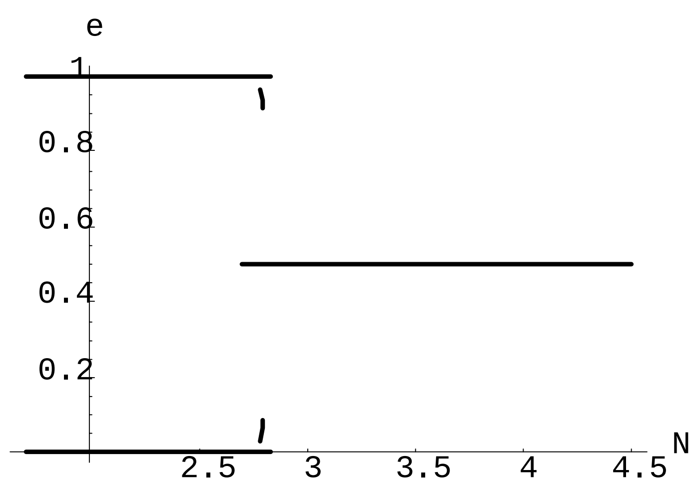

Figure 7: Muliple equilibria generated by eliminating the effect of the markup and the rent-sharing externality

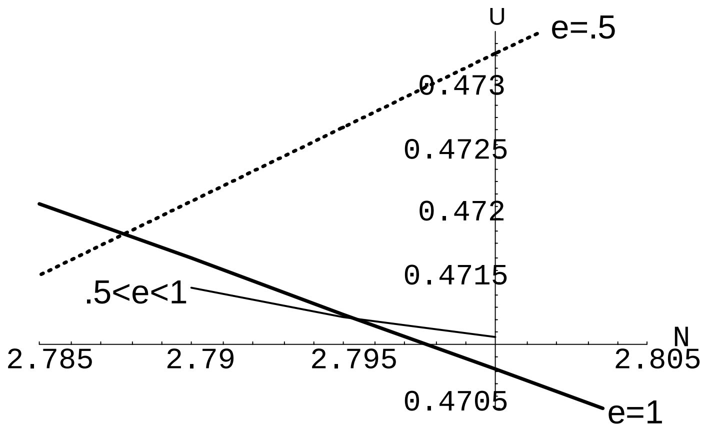

Figure 8: The achievable utility under alternative stable equilibria generated by eliminating the effect of the markup and the rent-sharing externality

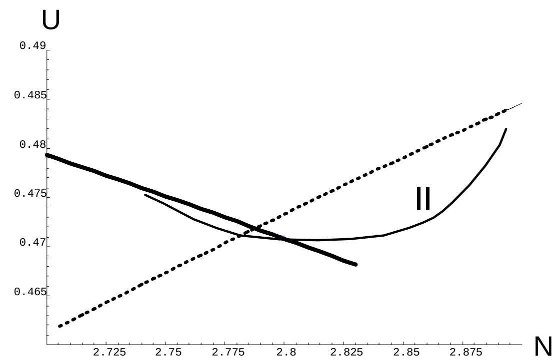

Figure 9: The achievable utility under full agglomeration and full dispersion generated by eliminating the markup effect and the rent-sharing externality and under Regime II

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