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International migration in the presence of public goods

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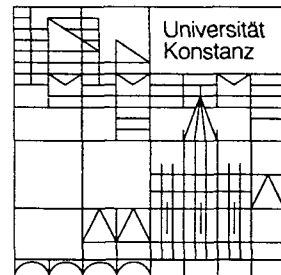
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in the Presence of Public Goods

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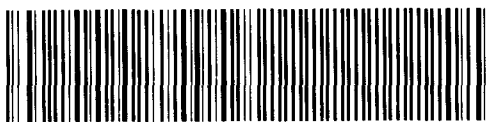
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**International Migration in the Presence of
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International Migration in the Presence of Public Goods

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Abstract

The paper analyses the effects of international migration on national welfare and on the structure of private production in a two-country trade model with public goods. Implications for migration policy and the role and design of entrance fees are discussed. It is further demonstrated that a migration-induced adjustment in public good supply affects a country's trade structure: in a Heckscher-Ohlin framework an immigration (emigration) of labourers can be connected to a decrease (increase) in the production of the labour intensive private good.

Keywords: migration, public goods, international trade

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1 Introduction

In the last few years, there have been huge migration flows to the western part of Europe. Especially in Germany, which has taken in large numbers of foreign people, tensions are running high. Apart from the fear of increasing unemployment, concern is rising with respect to the usage of publicly provided goods by immigrants. As several authors suggest (e.g. Gieseck et al. 1992, Koll 1993, or Borjas 1994 and Simon 1989 for the U.S.), immigration increases the congestion associated with some parts of the infrastructure. As a result, an adjustment in the supply of publicly provided goods might become necessary (e.g. Franz 1994:139, Kronberger Kreis 1994:27). This seems to be equally important for Israel, which is the target of dramatic immigration from Russia. Whether immigration actually improves or worsens the non-immigrants' position under the conditions described is not obvious and also depends clearly on the additional tax revenue raised from immigrants. In the emigration country, tax revenue, crowding and possibly public good supply decrease. Moreover, in the destination countries entrance fees are discussed as a compensation of the immigrants' use of a given public capital stock (e.g. Weber & Straubhaar 1994). Another aspect is that a migration-induced adjustment in the production of public goods can affect the countries' trade structures and terms-of-trade. This is why a thorough analysis of international migration in the presence of publicly provided goods needs a trade theoretic framework.

The analysis of the precise question of how non-migrants are affected by an international migratory movement in the presence of public goods has largely gone without a suitable theoretical ground. Problems connected with this question have partly been dealt with in the literature on the Brain Drain (e.g. Bhagwati 1976), which however does not model the public sector explicitly. The latter will receive central attention here. In the local public finance literature, on the other hand, problems concerning the interaction between interregional migration and publicly provided goods have been dealt with extensively (e.g. Tiebout 1956; for a survey see Rubinfeld 1987 and Wildasin 1987). However, as this literature mostly concentrates on efficiency aspects of public provision in the presence of free labour mobility, the production structure is often modelled quite simply, not seldom assuming the existence of only one private good. Some authors have extended this framework in order to incorporate trade in goods with exogenous

terms-of-trade (e.g. Berglas 1976, Wilson 1990). These publications seem to be promising steps towards a stronger integration of aspects of international trade and public finance. In the trade literature migration is also an important subject. There, distributional aspects and influences on a country's terms-of-trade are considered (e.g. Dixit & Norman 1980, Woodland 1982, Leiner & Meckl 1995). Finally, the influence of public goods on trade is a developing subject of research. An important feature of public goods that is often assumed—non-tradability—has its place in trade theory already.

The present paper integrates aspects of both areas of research by analysing the effects of international migration in the presence of public goods in a trade-theoretic framework. As the underlying model is quite complex, the comparative static effects derived in the presence of endogenous goods and factor prices are often ambiguous. It would therefore be helpful to analyse the theoretic framework in a computable general equilibrium context. The present discussion of various effects is to be seen as a first step towards such an analysis.

The paper proceeds as follows: section 2 presents a two-country-trade model with public goods. Comparative-static welfare effects of international migration are considered in section 3. Here, the effects of changes in the size of the public goods sector on a country's production and trade structure are also considered; additionally, terms-of-trade effects are derived. Section 4 gives devices for possible immigration policies and considers the role of entrance fees. Section 5 concludes. Details of the comparative-statics are given in an appendix.

2 The model

We consider a two-country model with \bar{r} goods, \bar{s} factors and a public good g in each country. Because of Walras' law we choose one private good as a numeraire good and set its price equal to one such that \mathbf{p} denotes the price vector of the non-numeraire private goods. In the following subsections, the behaviour of consumers, private producers and the government is described.

2.1 Consumer behaviour

The demand side of the model can be formulated with the help of the expenditure function $e(\mathbf{p}, g, l, u)$ that defines the minimum expenditure for a private

consumption vector \mathbf{c} , which is necessary in order to reach a predetermined utility level u , given the price vector for private goods \mathbf{p} , the supply of the publicly provided good g and a total population l consuming the public good. The public good in each country is assumed to be a national public good which does not create international spillovers. The relationship between the supplied capacity of g and the total number of users l specifies a level of (quality-adjusted) collective good consumption \tilde{g} :¹

$$\tilde{g} = f(g, l); \quad \frac{\partial f}{\partial g} > 0; \quad \frac{\partial f}{\partial l} \leq 0 \quad (1)$$

That is, the actual level of (quality-adjusted) public good consumption increases as the supply of g increases. In the case of pure public goods, a change in the number of users has no influence on the level of (quality-adjusted) consumption. Crowding, however, is modelled by assuming \tilde{g} to be decreasing in l .² The expenditure function can now be defined as:

$$\tilde{e}(\mathbf{p}, g, l, u) := \min_{\mathbf{c}} \{ \mathbf{p}^T \mathbf{c} : h(\mathbf{c}, \tilde{g}) \geq u, f(g, l) = \tilde{g}, c \geq 0 \} \quad (2)$$

where h denotes a quasi-concave utility function. The expenditure function is concave in \mathbf{p} and convex in g and l .³ The partial derivative of the expenditure function with respect to g , $D_g \tilde{e}(\cdot) < 0$, is equal to the (negative) demand shadow price of the publicly provided good, i.e. the value of private expenditure that the consumer is willing to give up for an additional unit of the publicly provided good, which at constant l leads to a utility increasing rise in \tilde{g} . Moreover, the partial derivative with respect to l , $D_l \tilde{e}(\cdot) > 0$, can be interpreted as crowding costs incurred by consumers. These costs are defined as the compensating value of minimum expenditure necessary to reach a constant predetermined utility level as the total population consuming the publicly provided good increases. Crowding costs are zero if the public good is of the pure type; otherwise they are positive.

¹As an example, g could be interpreted as a highway, whereas \tilde{g} gives the resulting level of consumption additionally dependent on the number of drivers using g . See Hillman (1978) and Arad & Hillman (1979).

²Note that $\partial f / \partial l > 0$ may be plausible for some public goods as for example positive human capital or cultural externalities induced by immigration.

³For the properties of the expenditure function with pure public goods see Schweinberger (1994:4). Congestion in a duality framework is modelled in Wilson (1990).

In the following we assume identical homothetic preferences in both countries. The expenditure function can then be written as

$$\tilde{e}(\mathbf{p}, g, l, u) = e(\mathbf{p}, g, l) \cdot u$$

2.2 Firm behaviour

The supply side is described by the social product function $y(\mathbf{p}, g, \mathbf{v}, l)$, which describes the maximum value of *private* production produced with a constant returns to scale technology at a given price vector \mathbf{p} , a given supply of g , a given supply of factors of production \mathbf{v} and the number of residents l :⁴

$$y(\mathbf{p}, g, \mathbf{v}, l) := \max_{\mathbf{v}^j, \mathbf{v}^g, l_j, l_g} \left\{ \sum_{j=1}^{\bar{r}} p_j \cdot f_j(\mathbf{v}^j, l_j) : f_g(\mathbf{v}^g, l_g) \geq g; l_j, l_g \geq 0; \right. \\ \left. \mathbf{v}^g + \sum_{j=1}^{\bar{s}} \mathbf{v}^j \leq \mathbf{v}; \sum_{j=1}^{\bar{s}} \mathbf{v}^j = \mathbf{v}^p; \mathbf{v}^g, \mathbf{v}^j, \mathbf{v}^p \geq 0; \sum l_j + l_g \leq l \right\} \quad (3)$$

Here, $\mathbf{v}^p(\mathbf{v}^g)$ denotes the vector of factors of production in the private (public) sector. The social product function is convex in \mathbf{p} and concave in g . Its partial derivative with respect to the public good, $D_g y(\cdot) < 0$, defines the (negative) supply shadow price of the public good, i.e. the value of private production that has to be given up in order to produce an additional unit of the publicly provided good.⁵ The social product function is concave in \mathbf{v} and its partial derivative with respect to factor endowments determines the vector of factor prices \mathbf{w} :

$$\mathbf{w}(\mathbf{p}, g, \mathbf{v}, l) = D_{\mathbf{v}} y(\mathbf{p}, g, \mathbf{v}, l) \quad (4)$$

The determination of factor prices in the presence of an exogenously supplied and internationally non-tradable public good has to be analysed in more detail. If the country under consideration produces at least as many private goods as factors of production exist, that is $\bar{r} \geq \bar{s}$, and if we additionally assume that a detraction of factors from the private industries towards the public sector does not lead to specialisation, then $D_{\mathbf{v}} \mathbf{w} = D_g \mathbf{w} = 0$, such that a change in the endowment of factors in the private industries has no influence on factor prices. If, on the other

⁴ l is used as a separate variable for reasons of clarity. Its composition is described in more detail below.

⁵See Schweinberger (1994:6).

hand, the country is specialized in production, factor prices can change and $D_g w$ depends on the factor intensity of g .

All private goods and the public good differ in their factor intensities of production, with the internationally available technologies being identical, though. This is an assumption that matters quite a lot in trade theory but not in the local public finance literature where the private good is often used as the single input in the production of the publicly provided good.

2.3 Government behaviour

The government sector supplies the public good, whose quantity consumers and producers take as given. The decision on the amount of public good to be supplied to residents can be based on several aims of which we will consider two in more detail.

1. The government's public good supply could be led by an optimization calculus. This can aim at maximizing the residents' welfare or instead world welfare as a whole.
2. In the more simpler case, the government could wish to bring about a constant and exogenously given level of public good consumption \tilde{g} . The choice of a constant \tilde{g} is usually not welfare maximizing because opportunity costs of public good provision are ignored.

An international migratory movement could now counteract these aims such that public good supply would need to be adjusted. The resident population is therefore concerned about the usage of publicly provided goods by immigrants, or to put it more precisely, concerned whether immigrants really "pay their way" for publicly provided goods. Hence, it is necessary to ascribe the costs actually incurred by residents through the usage of public goods by immigrants. For these purposes, production costs of g and the methods of how these are financed have to be specified. The following two possibilities of how the public good is financed are considered:

- first, costs of the capacity could already have been completely financed by the resident population and

- second, the costs of a public good could be financed with current tax revenue.

Production costs are minimized, as expressed by the linear homogeneous cost function of g :

$$C_g(\mathbf{w}) := \min_{a_{ig}} \left\{ \sum_{i=1}^{\bar{s}} a_{ig} \cdot w_i : f(\mathbf{a}^g) \geq 1 \right\} \quad (5)$$

with a_{ig} as input coefficient of factor i in the production of g .⁶

The government levies a proportional income tax for financing the public good. The income tax is one of the most important sources of tax revenue countries raise for financing the provision of public services. With the total income for the domestic and the foreign country (foreign variables with capital letters) respectively being defined as

$$y^*(\mathbf{p}, g, \mathbf{v}, l) \equiv y(\mathbf{p}, g, \mathbf{v}, l) + C_g(\mathbf{w}) \cdot g \quad (6)$$

$$Y^*(\mathbf{p}, G, \mathbf{V}, L) \equiv Y(\mathbf{p}, G, \mathbf{V}, L) + C_G(\mathbf{W}) \cdot G, \quad (7)$$

the governmental budget constraint stating that tax revenues have to equal public provision costs can be written as

$$t \cdot y^*(\mathbf{p}, g, \mathbf{v}, l) = C_g(\mathbf{w}) \cdot g \equiv \theta(\mathbf{w}, g) \quad (8)$$

$$T \cdot Y^*(\mathbf{p}, G, \mathbf{V}, L) = C_G(\mathbf{W}) \cdot G \equiv \Theta(\mathbf{W}, G). \quad (9)$$

Income tax rates for the domestic and foreign country can then be easily derived as:

$$t = \frac{C_g(\mathbf{w}) \cdot g}{y(\mathbf{p}, g, \mathbf{v}, l) + C_g(\mathbf{w}) \cdot g} = \frac{\theta(\mathbf{w}, g)}{y(\mathbf{p}, g, \mathbf{v}, l) + \theta(\mathbf{w}, g)} \quad (10)$$

$$T = \frac{C_G(\mathbf{W}) \cdot G}{Y(\mathbf{p}, G, \mathbf{V}, L) + C_G(\mathbf{W}) \cdot G} = \frac{\Theta(\mathbf{W}, G)}{Y(\mathbf{p}, G, \mathbf{V}, L) + \Theta(\mathbf{W}, G)} \quad (11)$$

Hence, the government adjusts tax rates such that the budget is always balanced. Note that a situation with free trade is assumed, such that $\mathbf{p} = \mathbf{P}$. Furthermore, labour is in inelastic supply such that the consumption–leisure decision is not distorted by the income tax system.

⁶With no loss of generality one can assume that the public good is privately produced but publicly supplied.

2.4 Income distribution

In the following, we assume that the total population $l(L)$ in the two countries considered consists of two income classes, with $n(N)$ being the high and $m(M)$ being the low income group, i.e. $l(L) = m + n(M + N)$. One can imagine that the first group (called capitalists) possesses one unit of labour and additionally all the other factors of production, whereas the other group (called labourers) only possesses labour. Under the assumption of identical homothetical preferences it follows that capitalists receive higher factor incomes than workers such that $u_n > u_m$. Following this distribution of production factors among the two income classes considered it is possible to argue that low income group members are unskilled workers and high income group members are skilled workers with one production factor other than labour being human capital. We can now specify the vector of factors of production $\mathbf{v}(\mathbf{V})$ such that $v_1(V_1)$ describes the amount of labour available in the economy, which is equal to the total number of resident population $l(L)$. The vector of factor prices has to be standardized such that $w_1(W_1)$ describes the domestic (foreign) wage rate. The budget restrictions of the different income classes can then be written as:

$$m \cdot e(\mathbf{p}, g, l) \cdot u_m = m \cdot (1 - t) \cdot w_1(\mathbf{p}, g, \mathbf{v}, l) \quad (12)$$

$$n \cdot e(\mathbf{p}, g, l) \cdot u_n = y(\mathbf{p}, g, \mathbf{v}, l) - m \cdot (1 - t) \cdot w_1(\mathbf{p}, g, \mathbf{v}, l) \quad (13)$$

$$M \cdot e(\mathbf{p}, G, L) \cdot U_M = M \cdot (1 - T) \cdot W_1(\mathbf{p}, G, \mathbf{V}, L) \quad (14)$$

$$N \cdot e(\mathbf{p}, G, L) \cdot U_N = Y(\mathbf{p}, G, \mathbf{V}, L) - M \cdot (1 - T) \cdot W_1(\mathbf{p}, G, \mathbf{V}, L) \quad (15)$$

where equal expenditure functions in both countries arise from identical preferences. From (12) and (13) or (14) and (15), respectively, follows the national budget restriction:

$$(m \cdot u_m + n \cdot u_n) \cdot e(\mathbf{p}, g, l) = y(\mathbf{p}, g, \mathbf{v}, l) \quad (16)$$

$$(M \cdot U_M + N \cdot U_N) \cdot e(\mathbf{p}, G, L) = Y(\mathbf{p}, G, \mathbf{V}, L), \quad (17)$$

In the following, we analyse the effects of an international migration of low income group members, i.e. unskilled workers, and assume the high-income group to be internationally immobile. At present, this is a very typical form of international migration to be observed. In Germany, for example, the former guest worker programmes and the present working contracts with workers from Central and

Eastern Europe have traditionally targeted low skilled people. For the U.S., Borjas (1991) warns that as a consequence of changes in the immigration policy the more recent immigration waves consist of a significant increased number of unskilled workers than earlier ones.

Furthermore, we need the condition for the clearing of the world private goods' markets:

$$\mathbf{x}(\mathbf{p}, g, \mathbf{v}, l) + \mathbf{X}(\mathbf{p}, G, \mathbf{V}, L) = 0 \quad (18)$$

with

$$\mathbf{x}(\mathbf{p}, g, \mathbf{v}, l) = D_{\mathbf{p}}y(\mathbf{p}, g, \mathbf{v}, l) - \frac{D_{\mathbf{p}}e(\mathbf{p}, g, l)}{e(\mathbf{p}, g, l)} \cdot y(\mathbf{p}, g, \mathbf{v}, l)$$

denoting the vector of excess supply and $D_{\mathbf{p}}e/e$ stands for the marginal propensity to consume private goods.

With the help of (16), (17) and (18) the condition for an optimal public good supply can now be analytically formulated. The derivation is simplified by recognizing that $(u_m \cdot u_n \cdot n) = y/e$ as we see from (16). By totally differentiating and setting the changes in utility following a change in public good supply equal to zero we receive:

$$\frac{y(\mathbf{p}, g, \mathbf{v}, l)}{e(\mathbf{p}, g, l)} \cdot D_g e(\mathbf{p}, g, l) - D_g y(\mathbf{p}, g, \mathbf{v}, l) = \mathbf{x} \frac{d\mathbf{p}}{dg} \quad (19)$$

$$\frac{Y(\mathbf{p}, G, \mathbf{V}, l)}{e(\mathbf{p}, G, L)} \cdot D_G e(\mathbf{p}, G, L) - D_G Y(\mathbf{p}, G, \mathbf{V}, L) = -\mathbf{x} \frac{d\mathbf{p}}{dG} \quad (20)$$

At constant goods' prices, equations (19) and (20) give the Samuelson conditions, stating that the sum of the demand shadow prices for the public good have to equal its supply shadow price. For large open economies a deviation of public provision from allocative efficiency implied by the Samuelson condition can be rational. This is the case if a country wants to strategically influence its terms of trade. In the following, by assuming that public good supply is based on an optimization calculus instead of being exogenously provided, we consider the case in which governments abstract from this strategic behaviour. Consequently, governments choose the amount of national public provision such that the Samuelson condition holds in both countries:

$$\frac{y(\mathbf{p}, g, \mathbf{v}, l)}{e(\mathbf{p}, g, l)} \cdot D_g e(\mathbf{p}, g, l) = D_g y(\mathbf{p}, g, \mathbf{v}, l) \quad (21)$$

$$\frac{Y(\mathbf{p}, G, \mathbf{V}, l)}{e(\mathbf{p}, G, L)} \cdot D_G e(\mathbf{p}, G, L) = D_G Y(\mathbf{p}, G, \mathbf{V}, L). \quad (22)$$

Then, world welfare with respect to public good provision is maximized.

Summarizing, the model can be expressed through equations (10) and (11), (12)–(15), (21), (22) and (18). This determines $t, T, u_m, u_n, U_M, U_N, g, G$ and \mathbf{p} . In the following, distributional aspects between income groups within one country are not considered, i.e. only aggregate national utilitarian welfare, defined as $m \cdot u_m + n \cdot u_n$ and $M \cdot U_M + N \cdot U_N$, respectively, matters.⁷⁸ Migration incentives, the migration equilibrium and resulting welfare–changes for the migrants can now be considered.

2.5 Migration equilibrium

A free international migration of workers in the presence of public goods does not necessarily imply an equalization of the domestic and foreign wage rate. At given *identical* levels of collective good consumption in both countries, i.e. $\tilde{g} = \tilde{G}$ at $e(\mathbf{p}, g, l) = e(\mathbf{p}, G, L)$, following (12) and (14) workers' utility levels are equalized as their net incomes adjust internationally: $(1 - t) \cdot w_1(\mathbf{p}, g, \mathbf{v}, l) = (1 - T) \cdot W_1(\mathbf{p}, G, \mathbf{V}, L)$. This implies that a wage differential, which compensates differing tax prices for the public good, $t \cdot w_1$ and $T \cdot W_1$ respectively, persists in the migration equilibrium:

$$w_1(\mathbf{p}, g, \mathbf{v}, l) - W_1(\mathbf{p}, G, \mathbf{V}, L) = t \cdot w_1(\mathbf{p}, g, l) - T \cdot W_1(\mathbf{p}, G, L). \quad (23)$$

Given identical levels of collective good consumption, in the country with the higher (lower) wage rate in an equilibrium, workers have to pay higher (lower) tax prices for the public good (Flatters, Henderson & Mieszkowski 1974). In a situation where the domestic level of collective good consumption is larger (smaller) than in the foreign country, workers' income after taxes has to be lower (higher) in the domestic country and is therefore not equalized internationally. In a migration equilibrium a wage differential probably exists, implying that world output is *not* maximized.

⁷The choice of this simple social welfare function makes sense if it is assumed that each individual has exactly one vote in a hypothetical political process.

⁸For a detailed discussion of distributional aspects of international migration in a trade-theoretic context see Leiner & Meckl (1995).

3 Comparative–static effects of migration

This chapter is concerned with the welfare effects of international migration which result for the aggregate group of non–immigrants and non–emigrants, respectively, in the presence of public goods. Therefore, it will be abstracted from distributional consequences. The model outlined above is used to enable a clearcut valuation of the costs and benefits actually induced by an international migration. At the same time this will make a discussion of arguments held in the literature possible. For example, one aspect to be found in the literature refers to the fact that migrants automatically gain a share of the economy’s public good supply or social capital by entering the destination country just because of the public good’s property that nobody can be excluded from consumption. Does this hurt the resident population? Clarke & Ng (1993:261) point out:

[.] to the extent that current publicly available benefits (e.g. roads, libraries) are funded out of past community savings rather than current taxes, public expenditures themselves represent a redistribution from existing to new residents.

From this other authors derive the necessity of a compensation for the resident population. Weber & Straubhaar (1994:4) are quite precise:

[.] the immigrants’ financial responsibilities regarding the already existing capital stock (infrastructure) would have to be met through an equal entrance fee or a similar levy.

Another aspect is pointed out by Simon (1989:153):

[.] if all construction were paid for on current account, immigrants would underpay for the structures they use, because they would then be paying only a part [.] for the new construction necessary for them (causing increased expenditure by natives for the new construction), while not paying at all for the existing structures they would be using.

That is, he also mentions that immigrants do not pay for the existing public capital *stock* but additionally he argues that the non–migrant population suffers a loss if a migration–induced *enlargement* of public good supply becomes necessary: As additional costs are split among residents and immigrants the latter then only pay part of it, although expansion is exclusively due to them.

One aim of the following welfare analysis is to work out the possible migration-induced costs associated with a given capital stock and with additional public capital adjustments. We see that both aspects are closely related to how the public good is financed, i.e if it has already been completely financed or if it is paid for with the help of current tax revenue. Therefore, this point will have to be considered in more detail below.

The chapter proceeds as follows. At first, the welfare effects of immigration and emigration in the presence of public goods for the non-migrant population in both countries are analyzed. In the discussion that follows, the domestic country will also be referred to as the immigration country. That is, the analysis concentrates on the destination country but also tries to take effects concerning the country of emigration into account. Afterwards, the effects of a migration-induced change in the size of the public sector on the countries' trade structure and the terms-of-trade are analysed in some detail. Thus, this chapter lays the theoretical ground for a suitable discussion of migration policy implications.

3.1 Welfare effects of migration

The comparative static analysis proceeds from the initial equilibrium described in section 2. It is therefore clear that it only considers the residents' welfare in both countries and consequently excludes the migrants. This is because it is the group of non-immigrants that actually decides on the design of a suitable migration policy. The change in national welfare is derived under the assumption that $e(\mathbf{p}, g, l) = e(\mathbf{p}, G, L)$ such that the level of quality-adjusted public good consumption is identical in both countries. By total differentiation of (16) and (17) we get with $dv_1 = dm = -dM = dl = -dL$:

$$\psi = \mathbf{x} \cdot \frac{d\mathbf{p}}{dl} + \delta \cdot \frac{dg}{dl} - (m \cdot u_m + n \cdot u_n) \cdot D_l e + t \cdot w_1 \quad (24)$$

$$\Psi = -\mathbf{x} \cdot \frac{d\mathbf{p}}{dl} + \Delta \cdot \frac{dG}{dl} + (M \cdot U_M + N \cdot U_N) \cdot D_L e - T \cdot W_1 \quad (25)$$

where $\psi = (m \cdot du_m/dl + n \cdot du_n/dl) \cdot e(\mathbf{p}, g, l)$ describes the domestic, non-immigrants', and $\Psi = (M \cdot dU_M/dl + N \cdot dU_N/dl) \cdot e(\mathbf{p}, G, L)$ the foreign, non-emigrants', aggregate welfare change following an international migratory movement of workers. $\delta = D_g y - (m \cdot u_m + n \cdot u_n) \cdot D_g e$ and $\Delta = D_G Y - (M \cdot U_M + N \cdot$

$U_N) \cdot D_{Ge}$ describe the degree of optimality in public good supply (i.e. optimal-, over- or undersupply) in both countries. As (24) and (25) show, international migration affects the domestic as well as the foreign level of national welfare through a change in the terms-of-trade (dp), a change in public good supply (dg), a congestion cost effect (dl) and a change in tax revenue. As the government decides on changes in public good supply and simultaneously adjusts tax rates such that the budget is balanced, tax rate changes are not explicit. That is, the interactions between additional tax revenue, additional public good provision and possible tax rate changes are not visible.⁹ We now discuss the conditions under which the non-migrant population in each country wins or loses following an international migratory movement of workers. The procedure is as follows: at first, we will discuss all comparative static effects except for possible adjustments in public good supply. This will enable a valuation of migration-induced welfare-effects for the resident population connected with the migrants' use of a given public capital *stock*. Afterwards, the effect of a change in public good supply is introduced such that an analysis of the costs and benefits associated with migration-induced public capital *investments* are possible.

The terms-of-trade effect is irrelevant for aggregate world welfare, defined as $\psi + \Psi$. This is because the terms-of-trade effect can be seen as a mechanism of internationally redistributing income between countries via changes in prices for private products that one country imports and the other exports (see Leiner & Meckl 1995). An increase (decrease) in a country's terms-of-trade leads to an increase (decrease) in its national welfare if it is an exporter, i.e. $x > 0$ of the non-numeraire goods. Therefore, terms-of-trade effects influence the choice of migration policies at the national level, at which these policies usually are being implemented.

A further important policy relevant effects is the congestion cost effect. Congestion costs will be zero in the presence of pure public goods. If, on the other hand, the public goods are assumed to be of the non-pure type, congestion costs will be positive (negative) in the country of immigration (emigration) as the level of crowding changes following the migratory movement.

As far as the change in tax revenue is concerned, the mentioned distinction of public provision costs becomes crucial. If the public capital stock has already

⁹See the complete system of total differentials in the appendix for changes in tax rates.

been completely financed, no taxes are levied in the initial equilibrium. Then, tax rates in (24) and (25) and therefore the change in tax revenue following migration would be zero. If, on the other hand, public capital is financed with the help of current tax revenue, tax rates would be positive. Then, tax revenue increases in the destination country and decreases in the country of emigration.

We can now confront the argument by Weber & Straubhaar (1994). According to them, immigrants should pay entrance fees for the social capital in existence which they use without having helped finance these structures. The analysis of our model contradicts their speculations quite clearly. As we intend a consideration of a public capital stock already in existence, we first abstract from a potential change in public good supply such that dg/dl in (24) equals zero. Furthermore, the costs of the given stock of public goods must be assumed to be already completely financed such that $t = 0$. Equation (24) then shows that the mere existence of additional users has no effect on residents welfare unless congestion occurs and the terms of trade change. This is because the costs for public provision are sunk. Thus, the fact that migrants automatically gain a share of the public capital stock by entering the country does not affect residents if the good under consideration is of the pure type. Analogously, the non-emigrant population does not automatically gain from an emigration of nationals. Contrarily, in the case of impure public goods non-immigrants (non-emigrants) would incur a welfare loss (gain) equal to arising (decreasing) congestion costs.

Proposition 1: *Immigrants automatically gain a share of the immigration country's public capital stock. Although it can have been already completely financed, the resident population remains unaffected as these costs are sunk. The non-immigrants only incur a welfare loss, if*

1. *the public good under consideration is of the impure type such that congestion occurs or*
2. *the country's terms-of-trade worsen.*

By the same argument non-emigrants do not automatically gain by an emigration of nationals. Instead, their welfare is increased if congestion decreases or the terms-of-trade improve.

Clearly, if the public capital is financed with the help of current tax revenues, non-immigrants (non-emigrants) unambiguously win (lose) in the presence of pure

public goods, because for a given supply tax rates are decreased (increased) — at constant goods' and factor prices — following the simple cost sharing argument.

It is at this stage of analysis where the differences between our analysis and the literature on the Brain Drain come out most clearly. There, an emigration of high-skilled leaves those left behind worse off, whereas in our analysis the non-emigrants' welfare is increased. This is because the literature on the Brain Drain is concerned with a special public good, education, which creates positive human capital externalities. Instead, we are concerned with a public capital *stock* which can be subject to congestion. Additionally, Bhagwati (1976) assumes that the emigrants, because of their young age, have not paid for education received, whereas in our case it is assumed that the migrants have helped financing the public goods.

Now that we have considered problems connected with the public capital *stock* we shall look at its possible *changes* necessitated through migration, i.e. the effect dg/dl . Let us first analyse in detail the conditions under which a migration-induced adjustment of public good supply becomes necessary and how this affects national welfare. Let us first consider the case in which the government wishes to supply a constant level of quality adjusted public good consumption \tilde{g} to its residents. From $e(\mathbf{p}, g, l) = e(\mathbf{p}, \tilde{g})$ we get:

$$D_g e \cdot dg + D_l e \cdot dl = D_{\tilde{g}} e \cdot d\tilde{g} = 0.$$

It follows that:

$$\frac{dg}{dl} = -\frac{D_l e}{D_g e} > 0 \quad (26)$$

With pure public goods no congestion occurs such that no adjustment needs to be undertaken. Only in the presence of impure public goods does immigration automatically lead the government to enlarge public provision.

If the government instead follows an optimization calculus aiming at maximizing national welfare without strategically influencing the terms-of-trade, then total differentiation of (21) shows how a migration-induced adjustment of public good supply then proceeds. For the domestic country we yield:

$$\begin{aligned}
\frac{dg}{dl} &= \underbrace{\frac{1}{a}}_{(-)} \cdot \left[\frac{D_g e}{e} \cdot \mathbf{x} - D_{gp}y + (m \cdot u_m + n \cdot u_n) \cdot D_{gp}e \right] \cdot \frac{d\mathbf{p}}{dl} \\
&+ \underbrace{\frac{1}{a}}_{(-)} \cdot [-D_{gl}y + (m \cdot u_m + n \cdot u_n) \cdot D_{gl}e] \\
&+ \underbrace{\frac{D_g e}{e \cdot a}}_{(+)} \cdot [w_1 - (m \cdot u_m + n \cdot u_n) \cdot D_l e]
\end{aligned} \tag{27}$$

with $a = D_{gg}y - (m \cdot u_m + n \cdot u_n) \cdot D_{gg}e < 0$. The last term in (27) describes the migrant's welfare change.¹⁰ $D_g e/e$ is the marginal propensity to consume the public good. If migrants were to be included, their additional income (w_1) would automatically lead to a higher demand for the public good. In the following, we only consider the resident population. The last line in (27) is consequently set equal to zero. The first line in (27) describes how a change in private goods prices affects the demand and supply shadow prices of the public good. A positive (negative) change in the value of a country's exports is directly translated into an increased (decreased) demand for public good supply. The second line describes how a change in public provision costs, and possible congestion, affects the necessary adjustment of g . An increase in public provision costs, following a change in factor prices, implies $D_{gl}y < 0$ as more private production has to be given up. Consequently, the effect on dg/dl is negative. Furthermore, a rise in congestion implies that residents intend to give up less private consumption for an additional unit of g such that $D_{gl}e > 0$ which leads to a negative influence on dg/dl . In the presence of pure public goods this effect is equal to zero.

At this stage of analysis we can work out which public provision *adjustment* costs are actually welfare deteriorating. Therefore, we analyse how the degree of optimality in public good provision in the initial equilibrium, combined with a migration-induced change, affects residents' welfare. Thus, we first analyse the combined effect $\delta \cdot dg/dl$ in (24) for the destination country. An optimal provision of public good supply, i.e. $\delta = 0$, means that the individuals' marginal willingness

¹⁰As the national welfare measure $(m \cdot u_m + n \cdot u_n)$ equals y/e we see that a change in the number of persons over which the welfare change has to be analyzed leads to $e \cdot u_m \cdot dl = [w_1 - (m \cdot u_m + n \cdot u_n) \cdot D_l e] \cdot dl$ which is exactly the term in brackets.

to pay for the public good equals its marginal costs. Instead, an underprovision (overprovision) of the public good, $\delta > 0$ ($\delta < 0$), implies that the individuals' marginal willingness to pay for the public good is larger (smaller) than marginal costs, such that the level of public good supply is actually too low (high). As soon as the government has full information about tastes and costs, a welfare maximizing amount of g can always be supplied. Then, if the public good is optimally supplied in the initial equilibrium $\delta \cdot dg/dl = 0$. Consequently, an optimal adjustment in its provision leaves the resident population unaffected — additional costs are just internalized through their demand shadow prices. On the other hand, if an under- or an oversupply exists in the initial equilibrium due to unobservable preferences, a welfare maximizing adjustment in public provision following (21) is impossible. In that case, government behaviour is assumed to be led by the simple aim of maintaining the initial equilibrium's quality adjusted level of public provision \tilde{g} . Such an adjustment is then undertaken without recognition of a possible non-optimal supply in the initial equilibrium. An underprovision of public good supply in the initial equilibrium then implies $\delta \cdot dg/dl > 0$, such that a marginal increase in public good supply improves the non-immigrants welfare as their marginal willingness to pay for the additional unit is larger than marginal costs. But if g is initially oversupplied, a marginal enlargement of public provision leaves the resident population worse off as their willingness to pay for an additional unit is smaller than marginal production costs, i.e. $\delta \cdot dg/dl < 0$. They would prefer a shrinkage in public good supply.

Proposition 2: *If the public good is optimally supplied in the initial equilibrium, a welfare maximizing adjustment leaves the residents' welfare unaffected. If, instead, g is initially undersupplied (oversupplied) a marginal enlargement aiming at a constant \tilde{g} improves (worsens) the residents welfare.*

Let us now follow the argument proposed by Simon (1989) who argues that immigrants only pay a part of the migration induced public provision costs as these additional costs are also split among residents. It is not made clear by the author that considerations like these only make sense if no taxes are levied in the initial equilibrium, i.e. if public capital costs are already completely financed. In the more realistic case in which the maintenance of public capital stocks is financed with current tax revenue, the directions of welfare changes are not ob-

vious anymore. Since in such a situation tax rates are given, one has to compare additional tax revenue with additional costs of public provision—and why should the latter necessarily be larger?

Proposition 3: *If the public capital stock is already completely financed, i.e. no taxes are levied in the initial equilibrium, a migration induced enlargement hurts the resident population, as they then have to participate in additional adjustment costs. If public good supply is instead financed with the help of current tax revenue, i.e. taxes are levied in the initial equilibrium, the residents' welfare is improved (worsened) if the migration induced change in tax revenue is larger (smaller) than additional costs.*

We have seen that changes in the terms-of-trade can influence the residents' welfare. Therefore, the effect of a migration-induced adjustment of public good supply on the countries trade structure and on private goods' prices is now separately analysed in detail.

3.2 Effects on the trade structure and on goods prices

Let us now assume that the non-immigrant population in the destination country calls for an enlargement of the publicly provided good in reaction to an inflow of foreign workers. Then factors have to be removed from the private industries to make this possible. In the emigration country, a shrinkage of the public sector might become necessary, which would lead to an increased factor supply in the private industries.¹¹ In the following, these relationships will be analysed in more detail. It will be demonstrated how a marginal immigration (emigration) that is followed by an enlargement (a shrinkage) of public good supply affects the production and consumption structure of traded goods and the terms of trade.

Terms-of-Trade effects can now be derived for some special cases with two private goods z_1 and z_2 , one public good g and two factors of production, labour (v_1) and capital (v_2). Under these assumptions, the stability condition $S^{-1} = D_p x + D_p X$ is a positive scalar such that the right hand side of (28) is sufficient for the sign of dp/dl . The change in p is given by the total differential of (18).

¹¹Possibly, a decrease in the public capital stock will take place over a longer time horizon than new investments, but we will ignore this point here.

It can be split into two parts: the effect of the migratory movement on world supply and world demand of traded private goods:

$$S \cdot \frac{dp}{dl} = \underbrace{-D_{pl}y - D_{pg}y \cdot \frac{dg}{dl}}_{\text{equals } \frac{dz_1}{dl}} + \underbrace{D_{pLY} - D_{pGY} \cdot \frac{dG}{dl}}_{\text{equals } \frac{dZ_1}{dl}} + \frac{D_p e(p, g, l)}{e(p, g, l)} \cdot \left[w - W + D_{gy} \cdot \frac{dg}{dl} + D_{GY} \cdot \frac{dG}{dl} \right] \quad (28)$$

where it is assumed that the fractions of consumption spent on private goods are independent of g and l such that $D_p e/e$ is not derived. Without loss of generality we can choose good 1 as the non-numeraire good. As a further simplification identical levels of quality adjusted public good consumption, i.e. $\tilde{g} = \tilde{G}$, are assumed in both countries such that $e(\mathbf{p}, g, l) = e(\mathbf{p}, G, L)$. At first, changes in the countries' production structure are analysed, then the effect on the consumption scheme of private goods is considered.

The full employment condition for factors in the private industries of the immigration country implies:

$$\begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \begin{pmatrix} z_1 \\ z_2 \end{pmatrix} = \begin{pmatrix} v_1^p \\ v_2^p \end{pmatrix};$$

full employment of factors in the public sector can be described by:

$$\begin{pmatrix} a_{1g} \\ a_{2g} \end{pmatrix} \cdot g = \begin{pmatrix} v_1^g \\ v_2^g \end{pmatrix}.$$

Total factor supplies thus sum up to $v_1 = v_1^p + v_1^g$ and $v_2 = v_2^p + v_2^g$. A marginal inflow of labour leads to:

$$dv_1 = dv_1^p + dv_1^g > 0 \quad (29)$$

and

$$dv_2 = dv_2^p + dv_2^g = 0 \quad (30)$$

With $dv_2^p = -a_{2g} \cdot dg$ and $dv_1^p = dv_1 - a_{1g} \cdot dg$ the comparative statics of the full employment conditions can easily be written as:

$$\begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \begin{pmatrix} \frac{dz_1}{dv_1} \\ \frac{dz_2}{dv_1} \end{pmatrix} = \begin{pmatrix} 1 - a_{1g} \cdot \frac{dg}{dv_1} \\ -a_{2g} \cdot \frac{dg}{dv_1} \end{pmatrix}.$$

Denoting with $k_1(= a_{21}/a_{11})$, $k_2(= a_{22}/a_{12})$ and $k_v(= a_{2g}/a_{1g})$ the capital intensities of the private goods 1 and 2 and the publicly provided good, respectively, and also recognizing that $dv_1 = dl$, the change in the production of both tradable goods in the immigration and the emigration country can be expressed as:

$$\frac{dz_1}{dl} = \underbrace{-\frac{k_2}{k_1 - k_2} \cdot \frac{1}{a_{11}}}_{\text{Rybczynski-effect}} + \underbrace{\frac{k_2 - k_v}{k_1 - k_2} \cdot \frac{a_{1g}}{a_{11}} \cdot \frac{dg}{dl}}_{\text{public good-effect}} \quad (31)$$

and

$$\frac{dz_2}{dl} = \frac{k_1}{k_1 - k_2} \cdot \frac{1}{a_{12}} + \frac{k_v - k_1}{k_1 - k_2} \cdot \frac{a_{1g}}{a_{12}} \cdot \frac{dg}{dl} \quad (32)$$

Each result can be divided in two separate effects. The first effect describes the pure Rybczynski-effect of a labour movement on traded goods' outputs as the government leaves public good supply unchanged. Consequently, as (31) and (32) show, with $dg/dl = 0$ a labour inflow (outflow) always increases (decreases) the output of the labour intensive traded good; the output of the capital intensive traded good decreases (increases). The second effect (so called public good-effect) shows for $dg/dl > 0$ how an enlargement of public supply directly affects the production of private goods via a detraction of production factors from the private industries proportional to the scale of growth dg/dl . The effect $dg/dl < 0$ would describe a shrinkage of the public good and its consequences for private production as factor supply in these industries increases. The results depend strongly on the ordering of capital intensities of production in all sectors. Possible cases are shortly analysed.

- $k_v > k_1 > k_2$: If the publicly provided good is the most capital intensive in production, then a marginal immigration of workers that is accompanied by an enlargement of g unambiguously reduces the production of the capital intensive traded private good which is assumed to be good 1 ($dz_1/dl < 0$) and leads to an increase in the production of the traded labour intensive good 2 ($dz_2/dl > 0$). This is because in addition to the pure Rybczynski-effect of a labour immigration, growth of the public sector goes along with a detraction of a factor bundle from the private industries which is relatively capital intensive such that it puts further downward pressure on the production of the capital intensive private good and further upward pressure on the production of the labour intensive private good.

In the emigration country the production of the capital intensive traded good 1 is unambiguously increased, whereas the production of the labour intensive good 2 is decreased.

- $k_1 > k_2 > k_v$: If the publicly provided good is the most labour intensive in production, then the effect of a labour immigration connected with $dg/dl > 0$ on the immigration country's trade structure is ambiguous. On the one hand an enlargement of the public sector necessitates a detraction of a relatively labour intensive factor bundle from the private industries, which results in a downward (upward) pressure on the labour (capital) intensive traded good and counteracts the upward (downward) pressure connected with the simple Rybczynski-effect. Thus, if the public good effect more than outweighs the Rybczynski-effect it could well be the case that an inflow of labour leads to an increase in the traded capital intensive good and to a shrinkage in the traded labour intensive good.

Analogously, for the emigration country, an emigration of workers combined with a decreased supply of the public good can possibly lead to an increase in the production of the labour intensive private good and a decrease in the capital intensive good.

- $k_1 > k_v > k_2; k_2 > k_v > k_1$: If the capital intensity of g lies between the capital intensities of both traded goods, then, as far as the capital intensive private good is concerned, the signs of the public good and Rybczynski-effect following a marginal immigration coincide, such that an unambiguous downward pressure is put on its production. As far as the labour intensive traded good is concerned, a negative public good effect counteracts a positive Rybczynski-effect. Thus, if the public good-effect outweighs the Rybczynski-effect, an immigration of labour could again lead to a shrinkage in the production of the labour intensive traded good. Nevertheless, this is not as likely as in the preceding case. It is also possible that production of both traded goods is reduced.

In the emigration country, the production of the capital intensive private good unambiguously increases, whereas the effect on the labour intensive good is ambiguous, such that an increase is at least possible.

Let us now turn to the effect of a marginal international migratory movement

on the demand for private goods. Because of the simplifying assumption that a change in public good supply and total resident population combined with possible congestion costs leaves the fractions of consumption spent on the various private goods unchanged — remember that $D_p e/e$ is independent of g and l — the only effect on world demand for private goods results from a change in world income after taxes (represented by the term in square brackets in (28)). This is equal to the change in available income for private consumption. The change amounts to the wage differential $w - W$ if (a) no adjustments of public good supply need to be undertaken or if (b) the change in worldwide public provision costs $D_g y \cdot dg/dl + D_G Y \cdot dG/dl$ is completely internalized by the migrants. A positive (negative) wage differential implies an increase (decrease) in available income for private consumption which therefore leads to an increased (decreased) demand for private goods. The amount of available income for private consumption is additionally increased (decreased) if migration reduces (increases) worldwide public provision costs.

Terms-of-trade effects can now only be derived for some special cases in which public production is the most capital intensive in both countries and demand for private consumption is increased. Furthermore, $dg/dl = dG/dl = 0$.

1. If the immigration country's production structure is diversified, while the foreign country is specialized in the production of the labour intensive private good, a migration solely decreases the production of the capital intensive good in the domestic country; additionally its demand increases, such that $dp/dl > 0$.
2. If there is a general technological advantage in domestic compared to foreign private production, a migration leads to a larger decrease in the capital intensive good production in the immigration country than the increase in the emigration country's production, such that world supply decreases; with increased demand $dp/dl > 0$.
3. If there is a capital intensity reversal in production such that the non-numeraire good is produced relatively capital intensive in the domestic country but labour intensive in the foreign country, a migration leads to a decrease in the production of the non-numeraire good in both countries; in addition to an increased demand this leads to $dp/dl > 0$.

As was demonstrated, governments can influence the country's trade structure and — if being large enough — its terms-of-trade by deciding on the amount of public good to be supplied to residents. Thus, the government has to be well aware of the effects of public production on the structure of international trade and should consider these relationships carefully when decisions on public investments have to be made.

Now that we have discussed the welfare effects of an international migration in the presence of public goods and its effect on the terms-of-trade in some detail, the next chapter is concerned with the derivation of migration policy devices. As almost every nation state controls the immigration of foreigners and not the emigration of its own people (for a discussion of this aspect see Bhagwati 1984, Krugman 1991), migration policy devices only concern the regulation of immigration.

4 Implications for migration policy

We consider appropriate mechanisms for regulating migration (in-)flows under various policy objectives that the government can pursue. For instance, the immigration country's government can follow a migration policy designed to completely compensate the resident population for possibly incurred welfare losses. Alternatively, the government can use immigration as an instrument to increase and consequently maximize the residents welfare. Basically, this chapter is concerned with a thorough discussion of the role and suitable design of entry fees as an instrument for migration policy.

4.1 Compensating migration policy

A compensating migration policy is supposed to aim at a compensation for welfare losses accruing to non-immigrants through an exogenous marginal inflow of foreign workers such that the residents' initial utility level prevails. As was demonstrated in the preceding chapter, the resident population is not hurt by the usage of a given stock of pure public goods by immigrants. This is because these costs are sunk costs and marginal costs of an additional user are zero. If we now first abstract from endogenous goods prices, a need for governmental action does not exist as the residents' welfare is completely left unaffected. It is only

in the presence of impure public goods that the government has to compensate for arising congestion costs through levying an equivalent entrance fee. That is, entrance fees as a pure compensation for immigrants' now participating at the stock of public capital is critical if the residents' welfare is left unaffected.

If, on the other hand, the public good is financed by current tax revenues in which the migrants participate, and if furthermore the public capital stock does not need to be adjusted, only the difference between potential congestion costs and the tax price would have to be levied as an entrance fee. More interesting is the case where the government has to adjust public good supply following immigration. A discussion of the welfare effects of migration has shown that in the case of an optimal public good supply no welfare losses occur. An entrance fee is justified only if a migration-induced adjustment in public good supply is combined with overprovision. This implies that additional production costs of g are larger than the residents' willingness to pay. Immigrants would then have to pay an entrance fee ζ equal to

$$\zeta = -\mathbf{x} \cdot \frac{d\mathbf{p}}{dl} - \underbrace{\delta \cdot \frac{dg}{dl}}_{(-)} + (m \cdot u_m + n \cdot u_n) \cdot D_l e - t \cdot w_1. \quad (33)$$

as we see from (24). The maximum possible entrance fee needed for compensation would have to be levied if the aggregate welfare loss to residents is balanced with the help of additional investments in public provision such that the initial utility level and the combined level of \tilde{g} are reestablished. If, on the other hand, non-immigrants wish to substitute private for public consumption in order to attain their initial utility level, dg/dl will be smaller than in the previous case. Consequently, entrance fees will have to be lower. This is because, by revealed preferences, a situation in which consumers wish to substitute private for public consumption must be relatively welfare improving; otherwise they would not have done it.

A positive (negative) terms-of-trade effect would lead to a lower (higher) entrance fee in the presence of public goods.

Proposition 4: *Entrance fees as a measure for a compensating migration policy can only be justified, if they are designed to*

1. *compensate for incurred congestion associated with a public capital stock which is already completely financed,*

2. *fill the gap between additional tax payments and congestion costs associated with a public capital stock that is financed with current tax revenue,*
3. *equal the arising welfare loss combined with a governmental misadjustment of the public good in the presence of an initial over-supply,*
4. *compensate for a decrease in the country's terms of trade.*

Entrance fees for the migrants' use of a given capital stock cannot be justified.

4.2 Welfare maximizing migration policy

Because nations — in contrast to regions in a federal system — normally restrict the movement of persons, they could be interpreted as "clubs" (Buchanan 1965), explicitly implementing migration policies in order to control the population (i.e. membership) size.¹² A welfare maximizing migration policy now implies the use of immigration as a measure to reach the country's optimal club or population size. For an optimal club size, the Samuelson condition (21) and the condition for an optimal membership size have to be fulfilled. The latter is reached by setting ψ in (24) equal to zero:

$$t \cdot w_1 = -\mathbf{x} \cdot \frac{d\mathbf{p}}{dl} + (m \cdot u_m + n \cdot u_n) \cdot D_l e \quad (34)$$

Consequently, for a small open economy with pure public goods, the optimal rate of immigration is reached when the wage rate is driven down to zero such that no additional tax revenue is raised through immigration. For impure public goods the optimal membership size is attained when additional tax income equals marginal congestion costs. If a positive (negative) terms-of-trade effect additionally benefits (hurts) the non-immigrants, the optimal population size would be larger (smaller) than with $d\mathbf{p} = 0$.

A discriminatory migration policy can further improve the non-immigrants' welfare as migrants pay more than their part in public provision costs. This is the case if immigrants have to pay entrance fees for the pure usage of a given supply of public capital although it is already completely financed such that its costs are

¹²See also the discussion in Arad & Hillman (1979) and Straubhaar (1992).

sunk. In the extreme case almost whole migration gain in form of the net income differential, to be denoted with π can be taxed away. The immigration country's maximum possible membership size is thus reached at:

$$t \cdot w_1 + \pi = -\mathbf{x} \cdot \frac{d\mathbf{p}}{dl} + (m \cdot u_m + n \cdot u_n) \cdot D_l e \quad (35)$$

For a small open economy, (34) and (35) show that it is always better to attract high income immigrants as incurred congestion costs are independent of the type of immigrants but additional tax income raised is then higher. Nevertheless, the terms-of-trade effect will be different.

Proposition 5: *If a non-discriminating welfare-maximizing migration policy is pursued the government would have to use immigration as a measure to implement the country's optimal club size. Instead, a discriminating welfare-maximizing migration policy would have to aim at (almost) completely taxing away the migrants' gain. Moreover, entrance fees for the social capital stock also fall in this category.*

A more detailed discussion of the welfare effects of international migration in the presence of public goods would have to exactly compare the length of time over which the public good is financed with the capacity's length of life. An interesting aspect discussed in Simon & Heins (1985) and Simon (1989) is that a clear gain arises for natives if public good supply is bond financed and the length of life of a project is shorter than the periods left to finance it. In the very extreme case, immigrants would pay for a public capital stock that is not in existence anymore. From this follows an interesting policy implication: If a country's government decides to allow immigration at a later point of time, it would always be rational to finance the public good with the help of bonds. This is because migrants then participate in these costs.

5 Conclusion

In this paper the relationship between international migration and public goods was analysed in a two-country trade model. At first, comparative static welfare effects were derived. We were able to contradict the wideheld opinion that

a migration induced adjustment of public good supply always hurts the resident population, if the enlargement is exclusively due to immigration. It was demonstrated that (i) if taxes are raised prior to immigration, increased tax revenues could also be larger than the costs for a migration-induced adjustment in public provision and (ii) if an underprovision of the public good exists prior to immigration, a migration-induced enlargement in its supply increases the non-immigrants' welfare as their marginal willingness to pay for the additional supply is larger than the associated marginal costs.

If the existing public capital stock is already financed by the resident population, a migration policy designed to completely compensate welfare losses for residents only has to impose entrance fees for incurred congestion. In contrast to other opinions in the literature, it was demonstrated that entrance fees for the immigrants' participation at the immigration country's public capital stock are needless. This is because provision costs are sunk. If the public capital stock is instead financed with the help of current tax revenues, immigration policy can then be implemented as a measure for maximizing national welfare. This can be done by following club theoretic arguments.

Furthermore, the effects of a migration-induced adjustment of public good supply on the countries' trade structure were analysed. In a Heckscher-Ohlin framework it was demonstrated that an immigration (emigration) of workers can be connected with a decrease (increase) in the production of the labour intensive private good. For some special cases terms-of-trade effects were derived.

The paper had to center on the discussion of various partial comparative static effects of international migration, as the underlying model with endogenous goods and factor prices is quite complex. It would therefore be helpful to analyse the theoretic framework in a computable general equilibrium context, as interactions would then become clearer.

The present analysis underlined the importance of immigrants as tax payers sharing in public provision costs. The question, whether immigrants subsidize the resident population, that is, whether they pay more in taxes than they use public goods or whether they are themselves subsidized, remains an empirical one. If congestion effects are small such that the cost sharing argument dominates other effects, immigration probably is welfare improving. Furthermore, it has to be taken into account that the industrial destination countries experience declining birth rates. In the absence of immigration a diminishing population would imply a

lower level of public good supply or alternatively constant public good provision at increased cost per capita. Immigration can then be used as a measure to sustain the level of public good provision. This becomes increasingly important if public goods additionally are used as productivity enhancing inputs into private production.

Clearly, the aspect of public goods in designing migration policies is only one among others, as for example the problem of unemployment in the destination countries. Nevertheless, its discussion in a trade theoretic framework contributes to understanding fundamental consequences of migration in an international context.

6 Appendix

The complete totally differentiated system can be written in matrix form and determines $(m \cdot u_m + n \cdot u_n), (M \cdot U_M + N \cdot U_N), t, T, g, G$ and \mathbf{p} :

$$\mathbf{AB} = \mathbf{C}$$

$$\mathbf{A} = \begin{pmatrix} 1 & 0 & 0 & 0 & -\delta & 0 & -\mathbf{x} \\ 0 & 1 & 0 & 0 & 0 & -\Delta & \mathbf{x} \\ 0 & 0 & y^* & 0 & e & 0 & -[a_g(\mathbf{w})]^T D_{\mathbf{p}}\mathbf{w} \\ 0 & 0 & 0 & Y^* & 0 & E & -[A_G(\mathbf{W})]^T D_{\mathbf{p}}\mathbf{W} \\ 0 & 0 & 0 & 0 & a & 0 & b \\ 0 & 0 & 0 & 0 & 0 & A & B \\ 0 & 0 & 0 & 0 & D_g\mathbf{x} & D_G\mathbf{X} & D_{\mathbf{p}}\mathbf{x} + D_{\mathbf{p}}\mathbf{X} \end{pmatrix}$$

$$\mathbf{B} = \begin{pmatrix} m \cdot du_m + n \cdot du_n \\ M \cdot dU_M + N \cdot dU_N \\ dt \\ dT \\ dg \\ dG \\ d\mathbf{p} \end{pmatrix}$$

$$\mathbf{C} = \begin{pmatrix} -(m \cdot u_m + n \cdot u_n) \cdot D_l e + t \cdot w \\ (M \cdot U_M + N \cdot U_N) \cdot D_L e - T \cdot W \\ D_l C_g(\mathbf{w}) \cdot g - t \cdot w \\ -D_L C_G(\mathbf{W}) \cdot G + T \cdot W \\ y/e \cdot D_{gl}e - D_{gl}y + D_{ge}/e \cdot [w_1 - (m \cdot u_m + n \cdot u_n) \cdot D_l e] \\ -Y/e \cdot D_{GL}e + D_{GL}Y - D_{Ge}/e \cdot [W_1 - (M \cdot U_M + N \cdot U_N) \cdot D_L e] \\ D_L \mathbf{x} - D_l \mathbf{X} \end{pmatrix} \cdot dl$$

with

$$\begin{aligned} \delta &= D_g y - (m \cdot u_m + n \cdot u_n) \cdot D_g e \\ \Delta &= D_G Y - (M \cdot U_M + N \cdot U_N) \cdot D_G e \\ a &= D_{gg} y - (m \cdot u_m + n \cdot u_n) \cdot D_{gg} e < 0 \\ A &= D_{GG} Y - (M \cdot U_M + N \cdot U_N) \cdot D_{GG} e < 0 \end{aligned}$$

$$\begin{aligned}
b &= -\frac{D_g e}{e} \cdot \mathbf{x} + D_{gP} y - \frac{y}{e} \cdot D_{gP} e \\
B &= \frac{D_G e}{e} \cdot \mathbf{x} + D_{GP} Y - \frac{Y}{e} \cdot D_{GP} e \\
e &= -(C_g(\mathbf{w}) + a(\mathbf{w})^T D_g w \cdot g) \\
E &= -(C_G(\mathbf{W}) + a(\mathbf{W})^T D_G W \cdot G)
\end{aligned}$$

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