Head-content or Headcount?
Temporary Labour Movements as a Source of Growth

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Abstract: This paper studies the growth effects of short-term international labour movements. In particular, it suggests that temporary migration affects not only a nation's endowment of factors but also contributes to the knowledge used for producing and innovating. The theoretical model extends the neoclassical framework of Solow and Swan. The empirical application is based on US, British and Australian data on international business visits (one of the larger and better documented forms of short-term work-related movements). Temporary labour movements emerge as having a small but not insignificant positive effect on growth.

Key Words: international labour movements, temporary migration, growth.

JEL Classification: F2, J6.

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1 Introduction

International migration is typically associated with the idea of a permanent or a long-term movement. As the accumulation of factors of production is a source of economic growth, there is interest and literature on the growth effects of labour migrations (e.g. Simon, 1989; Barro and Sala-i-Martin, 1995). One characteristic of these studies is the general treatment of international migration as a change in the labour endowment for both countries of origin and destination. A similar representation of migration also emerges from the economic analysis of international labour movements that thanks to improved communication and transportation technologies and the globalisation of markets are only temporary (e.g. OECD, 2002).

This traditional approach however appears increasingly at odds with the empirical finding that knowledge exchanges are a common reason for various forms of temporary movements (e.g. Ohmae, 1990, Moss Kanter, 1995; Ouaked, 2002; Tani, 2003; Park, 2004). Existing surveys, case studies and anecdotal observations support the hypothesis that short-term labour movements are a channel to diffuse technology and ideas across firms (e.g. Slaughter, 2000) and countries (e.g. Dosi et al., 1988; Cohen and Levinthal, 1989).

This paper addresses the question whether growth can occur as a result of movements transporting ideas (head-content) rather than migrants (headcount), and if so how. In particular, it contributes a theoretical model that formally represents the mechanics of this possible effect, and a preliminary estimate of the growth impact of international business visits (one of the largest and better documented forms of temporary movements) for the US, the UK, and Australia. The paper focuses on work-related

movements; therefore it excludes the movement of international students.

The rest of the discussion is organised as follows: Section 2 presents some of the challenges and briefly reviews the literature about temporary labour movements. Section 3 presents the theoretical model, which is based on the Solow-Swan framework, as adapted by Barro and Sala-i-Martin (1995). Section 4 discusses data, empirical results and their implications for migration policy. Section 5 concludes.

2 What is temporary migration?

Broadly speaking temporary labour migrations are international labour movements that last for only a short period of time, though there is no internationally agreed definition about how short the time span should be. The United Nations and the International Monetary Fund, respectively, use a 12-month convention before recording non-residents as migrants rather than visitors, and accounting for compensation earned abroad as income for the host rather than the sending country. Other institutions use different conventions. The World Trade Organisation applies the word temporary to mean up to 90 days for certain labour movements and up to 5 years for others. National governments too use the term differently. For example a temporary migration visa for Australia is valid for four years.

This heterogeneity of interpretations is reflected in the legal and statistical treatment of various forms of temporary movement, and the extent of their economic analysis. Some movements, such as seasonal migration, international commuting, and guest-workers programs, are viewed as a form of migration that is clearly economically motivated. These labour flows are regulated by a country's employment and migration laws, and tend to be relatively well documented (e.g. OECD, 1994). Their

economic effects are therefore investigated in some detail, particularly with regards to labour markets and welfare for both countries of origin and destination (e.g. Priore, 1979; Gould, 1980; Martin and Teitelbaum, 2001; Constant and Zimmermann, 2004).

In contrast, other temporary movements, like international business trips, temporary assignments, and short intra-company transfers (let alone work-related exchanges that do not involve a physical transfer such as videoconferencing and telecommuting) are more difficult to classify and interpret as a genuine form of labour mobility. Part of the problem is related to data. Information is generally unavailable or confidential for some of these movements (e.g. transfers and assignments) or it is of limited use for economic analysis. For example International Passengers Surveys provide a large amount of data on the in- and out-bound flows of temporary visitors to a number of countries, the length of trip, and the main reason for travel (e.g. tourism, business, conference, education, settlement), but typically do not report the motivation for doing so. As a result, marketing and follow up trips facilitating an international transaction cannot be distinguished from business visits aimed at transferring or developing specialist knowledge in a foreign country. Notwithstanding the problems related to data, there is a small and fragmented literature on the economic effects of business travel, which documents the high human capital content of its users, its increasing substitution with more permanent forms of labour migration (Salt, 1992), and its possible impact on rising wage inequality in the industrialised world, as travellers can apply their skills across the combined labour markets of countries of origin and destination (Anderson, 2002).

The World Trade Organisation, in the General Agreement on the Trade of Services (GATS), undertakes an alternative approach, which follows the legal discipline for which if a labour movement occurs as a result of a contract for the provision of services then it should be treated as a service (*contract for services*), but if it arises from an employment contract it should be viewed as a labour movement (*contract of services*). The GATS (Mode 4) argues that certain temporary movements should be viewed as a part of the international trade of services[1], and therefore be governed by its legislation, rather than as a form of labour migration subject to national regulation. Unfortunately the distinction between contracts *for* and *of* service is practically impossible to apply: the legal categories are not mutually excludable[2] and they do not take into account alternative ways in which an identical service can be delivered[3]. In practice the GATS still allows each country to impose quotas and other restrictions[4] on the same flows it sets to liberalise, implicitly supporting that these movements can be viewed, after all, as a form of labour migration.

The literature on temporary labour movements is limited but can be broadly divided in two. The first group treats migration as a change in labour (or skill) supply in both countries of origin and destination (e.g. Barro and Sala-i-Martin, 1999; Wood, 2001; OECD, 2002). This interpretation reflects the traditional economic perspective of

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[1] The GATS Mode 4 (Provisions regarding the international movement of natural persons) identifies five broad categories of movements for which this would be the case: (i) business visits of natural persons who maintain residence in their country of origin but move temporarily to negotiate the provision of a service; (ii) movements of natural people following the decision by a foreign firm to establish a branch in the host country; (iii) internal corporate transfers with the same employer; (iv) hiring of specialists who move from a prior employment with a service company (Australia and the US only); and (v) contractual service suppliers employed by a foreign firm with no local branch (Switzerland and European Union members only) (Lavenex, 2002).

[2] For example, the test applied by the tax law in the UK to separate a contractor (contract *for* services) from an employee (contract *of* services) is wider than the corresponding tests applied by industrial or patent law.

[3] The GATS makes no provisions for either self-employed temporary migrants or foreign citizens temporarily employed by a domestic company. Hence identical services delivered by the same person under an employment contract with a local company or a services contract with a foreign provider may be treated differently (Charnovitz, 2002; Winters, Walmsley, Wang and Grynberg, 2002).

[4] These include (among others): minimum educational qualification level and professional experience, determined periods of prior employment, economic needs tests giving preference to domestic workers, and the very definition of 'temporary'.

viewing labour as a factor of production (e.g. World Bank, 1995), which highlights its contribution as, and on, 'headcount'. Under this approach temporary and permanent migrants differ for a number of reasons, but not in their economic effect. As written by Winters (2002), temporary labour migration "has none of cultural, social or political dimensions that are associated with international migration because it explicitly does not entail shifts in residence. However, its direct economic consequences can be thought of as those of migration. Workers enter a country temporarily to carry out particular jobs and thus labour inputs in one economy are reduced while those in another are increased" (p.6).

The second group of studies treats labour and migrants as agents in forming and diffusing knowledge. Migrants enhance knowledge in both countries of origin and destination by facilitating technological spill-overs and contributing new ideas, or 'head-content'. The contribution of permanent and temporary migrants normally differs, as it also depends on the frequency of movement. Existing work principally focuses on the characteristics of the innovation process (e.g. Dosi et al., 1988; Cohen and Levinthal, 1989), exploring the role played by temporary migrants insofar as they can help a country to absorb and transfer new technology and information (e.g. Rogers, 1995; Leahy and Neary, 2003). However no formal treatment of the mechanisms through which temporary labour movements affect growth is offered.

This paper combines both approaches in a single theoretical growth model where permanent and temporary migrants are separately identified. As a result it allows one to analyse not only the relationship between growth and permanent and temporary individually taken, but also whether the economic effects of each one reinforces or

weakens the other. A precise definition of temporary migration is not necessary to the argument made in the paper, and therefore the words short-term visits and temporary migration are used interchangeably.

3 A growth model with permanent and temporary migrants

The neoclassical growth framework of Solow and Swan is a convenient starting point to study the relationship between migration and economic growth. The analysis can benefit from previous theoretical work (Barro and Sala-i-Martin, 1995 or BS in the rest of the paper). Empirically, the variables appearing in the model are well suited to exploit the format and the aggregate nature of available data on temporary labour movements.

Permanent migration is treated as in BS as it is not the core of the paper. The economic impact of temporary migrants is assumed to occur through two distinct mechanisms. The first is the traditional labour supply channel: temporary migration changes the input (and normally quality) of labour in both countries of origin and destination. The ensuing economic impact arises because skills are *embodied* in, and hence move with, the temporary migrant (*embodied effect*). As a result, the economic impact is proportional to the net flows of migrants (headcount).

The second mechanism is the contribution to knowledge arising from participation in the international flow of ideas and technologies that are continuously developed around the world. This effect is modelled as an externality due to labour mobility itself: the higher the number of workers exchanging information and ideas, the higher the contribution to knowledge that a country receives from its in- and outbound

visitors, and vice-versa (*disembodied effect*). The disembodied effect therefore depends on gross (rather than net) in- and outflows of visitors (head-content). It also operates differently for permanent and temporary migrants: for the destination country the addition to knowledge of permanent migrants is high after arrival, but it fades as time goes on (assuming no further movements). On the contrary, the contribution to knowledge of temporary migrants is directly related to the frequency of their international travels.

Consider a country that uses labour and capital to produce according to:

$$Y_t = F(K_t, A_t L_t) c\left(\frac{AV_{It}}{L_t}, \frac{AV_{Ot}}{L_t}, \frac{K_k}{A_t L_t}\right) \quad (1)$$

where Y_t is the country's GDP at time t, F is a monotonic function exhibiting constant returns to scale, K_t indicates capital in its broad sense (physical and human), A_t is a labour-augmenting technology (as in the original Solow-Swan model technological progress is exogenous), and L_t indicates the country's labour supply.

$c\left(\frac{AV_{It}}{L_t}, \frac{AV_{Ot}}{L_t}, \frac{K_k}{A_t L_t}\right)$ is a function representing the externality associated with the flows of effective incoming (AV_{It}) and outgoing (AV_{Ot}) 'equivalent workers' due to temporary labour movements, respectively, as a proportion of the country's labour force L_t and the amount of capital per effective worker $\frac{K_k}{A_t L_t}$.

The calculation of an equivalent worker is the product of number of visits and their average length divided by 250, which corresponds to the average number of business days in a year (e.g. Anderson, 2002). Taking into account a further adjustment reflecting that only part of a day is spent working:

A_tV_{It} = *gross inflow of travellers * (length of stay/250)*(hours of work/24)*; and

A_tV_{Ot} = *gross outflow of travellers *(length of stay/250)*(hours of work/24)*.

It is assumed that in and out-flows of temporary migrants are proportional to the country's labour force as follows:

$$A_tV_{It} = \lambda_t L_t \qquad (2a)$$

$$A_tV_{Ot} = \theta_t L_t \qquad (2b)$$

where λ_t and θ_t are positive parameters. It is also assumed that $\partial c(.)/\partial\lambda_t > 0$ and $\partial c(.)/\partial\theta_t > 0$, so that each new addition of disembodied knowledge associated with temporary migration improves the domestic production. Making $c(.)$ depending on $\frac{K_k}{A_tL_t}$ reflects that participating in the world-wide exchange of ideas is easier for countries with a good level of infrastructure (e.g. Gaspar and Glaeser, 1998).

As in BS, the marginal productivities of capital and labour are positive but exhibit diminishing returns, so that $\partial Y_t/\partial K_t > 0$ and $\partial Y_t/\partial L_t > 0$ but $\partial^2 Y_t/\partial K_t^2 < 0$ and $\partial^2 Y_t/\partial L_t^2 < 0$. However, private and social marginal returns to capital and labour differ as a consequence of the disembodied effect $c(\lambda_t,\theta_t,k_t)$:

$$\partial Y_t/\partial K_{private} = F_K\, c(.) < \partial Y_t/\partial K_{private} + c_K\, F(.) = \partial Y_t/\partial K_{social}$$

$$\partial Y_t/\partial L_{private} = F_L\, c(.) < \partial Y_t/\partial L_{private} + c_L\, F(.) = \partial Y_t/\partial L_{social}$$

As in BS, trade with the rest of the world occurs only through international labour movements. Capital can move internationally, but the extent of its flows depends on the volume of labour migrants. Commodity trade is not permitted.

The production function (1) is reformulated in the intensive form to simplify the analysis by transforming the variables in terms of the capital per effective labour ratio $k_t = K_t/A_tL_t$:

$$\frac{Y_t}{A_t L_t} = y_t = f(\frac{K_t}{A_t L_t},1)c(\lambda_t,\theta_t,k_t) = f(k_t)c(\lambda_t,\theta_t,k_t) \qquad (3)$$

Labour supply in the home country is the sum of:

(i) native labour, which is assumed to grow at a constant exogenous annual rate n;

(ii) the net inflow of permanent migrants into the country M_t. If $M_t > 0$ then the country is a net receiver of workers, while $M_t < 0$ indicates that the country is a net exporter of labour. For simplicity, each permanent migrant is assumed to carry an identical quantity of physical and human capital κ.

(iii) the net flow of equivalent workers $(\lambda_t - \theta_t)L_t$. When $(\lambda_t - \theta_t) > 0$ the country is a net importer of temporary foreign workers, while $(\lambda_t - \theta_t) < 0$ indicates a net outflow of domestic resident workers[5]. For simplicity, inward and outward temporary migrants are treated as carrying an identical quantity of human and physical capital φ, as suggested by empirical evidence[6].

The *total* domestic labour force grows at the rate:

$$\frac{\dot{L}_t}{L_t} = n_t + \frac{M_t}{L_t} + \frac{B_t}{L_t} = n_t + m_t + \lambda_t - \theta_t \qquad (4)$$

[5] Resident includes natives as well as permanent migrants migrated in previous periods.

[6] Although the assumption might appear restrictive, it is *a priori* unclear why the skill level of travellers from different countries should differ. Empirical data on European, US and Australian business trips suggests that travellers have similar skill levels, based on occupational profiles (e.g. IATS, 1988; Anderson, 2002; Tani, 2003).

where the dot indicates a change over time, $m_t \equiv M_t/L_t$ and $(\lambda_t - \theta_t) \equiv (\lambda_t - \theta_t)L_t/L_t$ are the net permanent and temporary migration rates, respectively.

As in BS, permanent migrants are sensitive to the wage level paid in the host country so that m_t is a positive but decreasing function of the wage in the host country: $m_t = m(k_t)$, $m' > 0$, and $m'' < 0$.

The net temporary migration rate $(\lambda_t - \theta_t)$ is modelled as depending only on the ratio of in- and outbound equivalent workers to domestic labour, respectively. Treating λ_t and θ_t as functions of the level of economic activity is perhaps more realistic. However using $\lambda_t = \lambda(k_t)$ and $\theta_t = \theta(k_t)$ raises the complexity of the solutions without modifying their substance, and it is not pursued further.

By definition the stock of human and physical capital grows annually by the amount of new investments net of depreciation, and the capital carried by permanent and temporary migrants:

$$\dot{K}_t = sF(K_t, A_t L_t)c(\lambda_t, \theta_t, k_t) - \delta K_t + \kappa_t M_t + \varphi_t L_t(\lambda_t - \theta_t) \qquad (5)$$

where s is a positive constant representing the country's exogenous rate of investment as a proportion of GDP, δ is a positive constant reflecting the annual depreciation rate of physical and human capital, and $\kappa_t M_t$ and $\varphi_t L_t(\lambda_t - \theta_t)$ are the amount of capital carried by permanent and temporary migrants, respectively. The latter are likely to carry predominantly human capital.

The growth path of the capital per effective worker is obtained by dividing both sides of equation (5) by A_tL_t. Rearranging the expression in terms of change in capital yields:

$$\dot{k}_t = sf(k_t)c(\lambda_t, \theta_t, k_t) - (x + n + \delta)k_t - m(k_t)(k_t - \hat{\kappa}_t) - (\lambda_t - \theta_t)(k_t - \hat{\varphi}_t) \qquad (6)$$

where $sf(k_t)c(\lambda_t, \theta_t, k_t)$ is the change in the capital per effective worker arising from new investments and the externality of the disembodied effect due to temporary labour movements. This term is positive and will be referred to as capital accumulation. Its value depends directly on k_t, even though it can not be established *apriori* as the sign of $\partial(sf(.)c(.)/k_t)/\partial k_t = s[k_t(f'(.)c(.) + c'(.)f(.)) - f(.)c(.)]/k_t^2$ is indeterminate: $k_t(f'(.)c(.) + c'(.)f(.))$ is positive while $-f(.)c(.)$ is negative. In particular capital accumulation grows with the capital per effective worker ratio k_t whenever the marginal productivity of labour $(k_tf'(.) - f(.))$ is greater than the marginal value of the externality $k_tc'(.)f(.)/c(.)$, and vice-versa. When $c(.)(k_tf'(.) - f(.)) = k_tc'(.)f(.)$ then capital accumulation becomes independent of k_t. Hence, despite capital's diminishing returns, capital accumulation can be an increasing, decreasing or constant function of capital per effective worker.

The term $[(x + n + \delta) + m(k_t)(k_t - \hat{\kappa}_t) + (\lambda_t - \theta_t)(k_t - \hat{\varphi}_t)$ represents the depreciation rate of capital per effective worker, comprising the exogenous rate of technological change x, the depreciation rate of capital δ, and the growth rates of natives (n), permanent ($m(k_t)$) and temporary migrants $(\lambda_t - \theta_t)$. The parameters $\hat{\kappa}_t$ and $\hat{\varphi}_t$ indicate the effective human and physical capital brought by permanent and temporary migrants, respectively, i.e. $\hat{\kappa}_t = A_t\kappa_t$ and $\hat{\varphi}_t = A_t\varphi_t$.

The impact of permanent and temporary migration on the steady state and growth can be either positive or negative depending on whether there is a net *in*- or *out*flow of migrants, and their capital content relative to natives. In general, net *in*flows of permanent and temporary immigrants carrying less capital than natives raise capital depletion. A similar effect occurs when there are net *out*flows of permanent and temporary emigrants with more capital than natives. Table A1 in the Appendix summarises the possible combinations of migration and capital content leading to an increase of the capital per effective labour ratio.

Similarly to the original Solow-Swan model, the growth rate of income per effective labour is obtained from the path describing the corresponding growth rate of the capital stock. Combining equations (1) and (5) and transforming the variables in the intensive form yields:

$$\dot{y}_t / y_t = \gamma_{y,t} = f'(k_t)c(\lambda_t, \theta_t, k_t)\dot{k} / f(k_t) = [k_t f'(k_t)c(\lambda_t, \theta_t, k_t) / f(k_t)]\gamma_{k,t} \qquad (7)$$

where the term inside the square brackets represents the share of income belonging to capital owners. When the production function (1) takes the form of a Cobb-Douglas, the capital share is constant and the growth rate of GDP per effective worker $\gamma_{y,t}$ directly mimics the behaviour of the growth rate of capital per effective worker $\gamma_{k,t} = \dot{k}_t / k_t$.

Steady state and transition dynamics

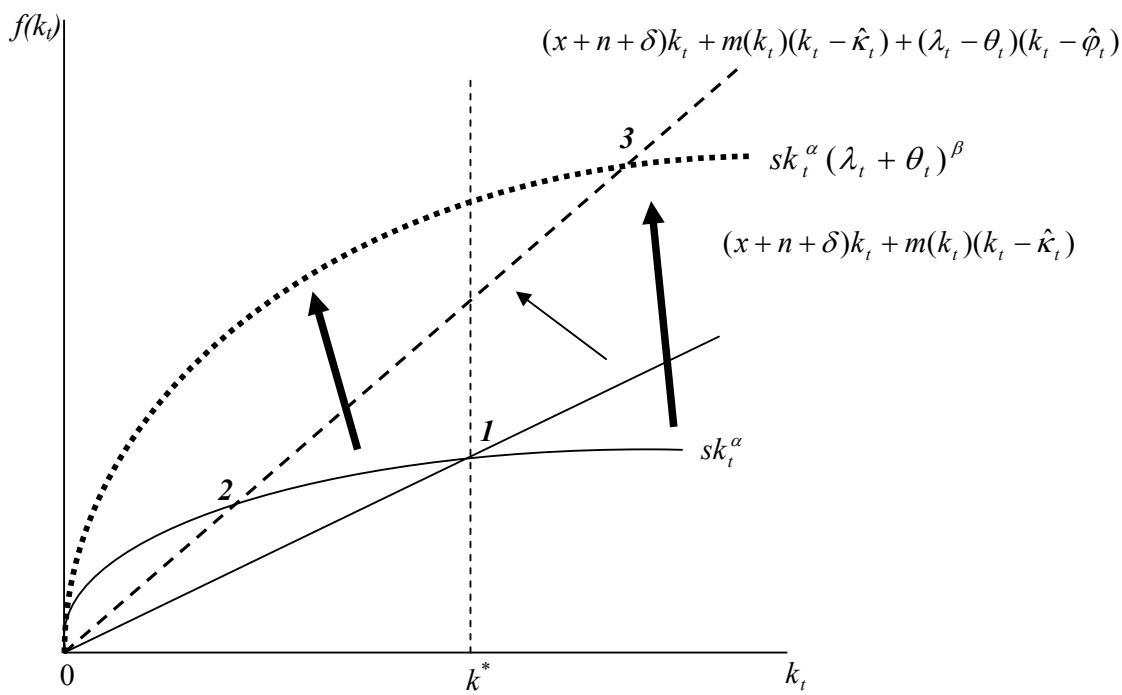
The steady state is reached when the accumulation and depletion of capital per effective worker exactly offset each other:

$$\gamma_{k,t} = sf(k_t)c(\lambda_t, \theta_t, k_t) / k_t - (x + n + \delta) - m(k_t)(1 - \hat{\kappa}_t / k_t) - (\lambda_t - \theta_t)(1 - \hat{\varphi}_t / k_t) = 0 \quad (8)$$

Unlike the neoclassical model where there is a unique stable steady state that depends only on the value of k_t, the steady state of the model with permanent and temporary migration depends on the signs and values of the migration parameters $m(k_t)$, $(\lambda_t - \theta_t)$, $(1 - \hat{\kappa}_t / k_t)$, $(1 - \hat{\varphi}_t / k_t)$, as well as the functional form of the externality $c(\lambda_t, \theta_t, k_t)$.

Consider the case where there is only a net inflow of permanent migrants with a lower capital content than natives and no temporary migration, and let $f(k_t) = k_t^{\alpha}$ with $\alpha < 1$. As illustrated in Figure 1, which is based on Figure 9.2 in BS, capital accumulation is shown with the positive and decreasing sloped line sk_t^{α} while capital depletion is indicated with the positively sloped line $(x + n + \delta)k_t + m(k_t)(k_t - \hat{\kappa}_t)$. The vertical distance between the two lines is the growth rate of capital per effective worker $\gamma_{k,t}$, while their intersection is the steady state **1**, which corresponds to the steady state capital per effective labour ratio k^*.

FIGURE 1 THE GROWTH EFFECT OF TEMPORARY MIGRATION



Let now introduce temporary migration and assume that there is a net outflow of equivalent workers with a higher capital content than domestic labour, so that $(\lambda_t - \theta_t) < 0$ and $\hat{\varphi}_t > k_t$. Let also assume for illustrative purposes that $c(\lambda_t, \theta_t, k_t) = (1 + \lambda_t + \theta_t)k_t^{\beta}$ with $\beta < 1$ implying that the marginal value of each additional piece of disembodied knowledge is decreasing. The *embodied effect* associated with the net outflow of temporary migrants reduces capital per effective labour as $\hat{\varphi}_t > k_t$, and raises capital depletion to the dotted line $(x + n + \delta)k_t + m(k_t)(k_t - \hat{\kappa}_t) + (\lambda_t - \theta_t)(k_t - \hat{\varphi}_t)$ in Figure 1. This has a negative impact on growth, and shifts the steady state towards point **2**.

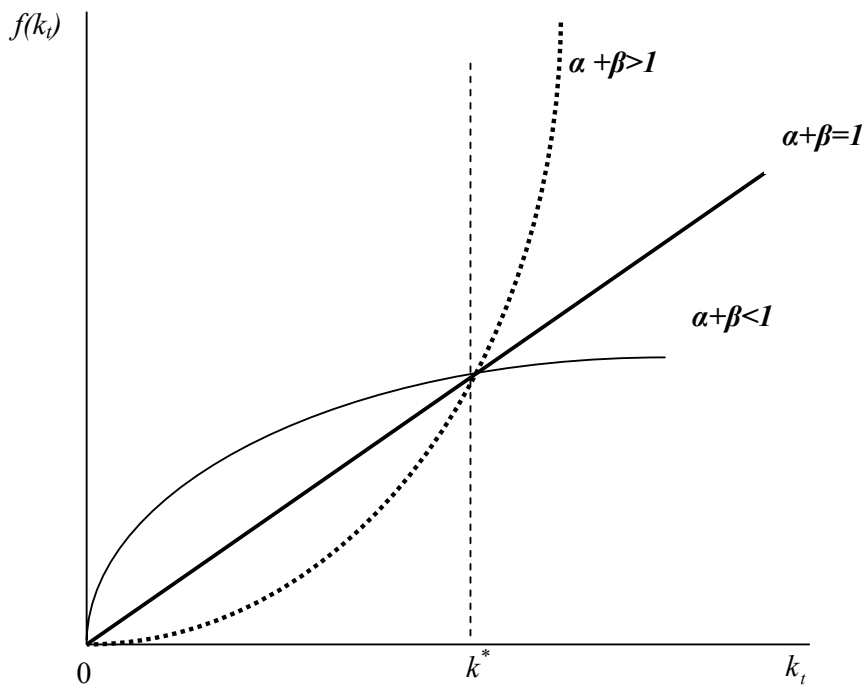
The *disembodied effect* associated with the gross flows of in- and outbound temporary migrants raises the nation's stock of knowledge. The capital accumulation line shifts upwards to the line $sk_t^{\alpha+\beta}(1 + \lambda_t + \theta_t)$. The new steady state occurs at point **3**, which is shown to correspond to a higher capital per effective worker relative to the case with only permanent migration. Here, the disembodied effect is shown to be greater than the embodied effect. As a result growth has increased relative to the initial steady state k^* even though the country has suffered a temporary loss of domestic labour with above-average capital content.

Endogenous growth

An interesting feature of this model is the possible emergence of endogenous growth. When $\alpha + \beta > 1$, the positive influence of the disembodied effect on capital accumulation is so large that the function $sk_t^{\alpha+\beta}(1 + \lambda_t + \theta_t)$ is positively sloped as illustrated by line labelled with $\alpha + \beta > 1$ in Figure 2. In such circumstances the

positive effect of the externality may be so large that capital accumulation and depletion never intersect each other ($\beta >> 1$), suggesting that countries with lower capital per effective labour ratio may never catch up with richer countries ('beta-convergence'), unlike the original Solow-Swan model. The condition for endogenous growth is $sk_t^{\alpha+\beta}(1 + \lambda_t + \theta_t) > (x + n + \delta)k_t + m(k_t)(k_t - \hat{\kappa}_t) + (\lambda_t - \theta_t)(k_t - \hat{\varphi}_t)$ for each value of k_t.

FIGURE 2 INFLUENCE OF THE EXTERNALITY ON CAPITAL ACCUMULATION



Implications for migration policy

Using equation (6) a change in the net permanent migration rate $\partial\gamma_{k,t}/\partial m(k_t) = -m'(k_t)(1 - \hat{\kappa}_t/k_t)$ is *coeteris paribus* negative when $\hat{\kappa}_t < k_t$ and $m(k_t) > 0$, and positive in the opposite case. Permanent immigration reduces the growth in capital per effective worker when immigrants have less physical and human capital than natives, and vice-versa, as in BS.

A positive shock to either θ_t (e.g. improved transport infrastructures) or λ_t (e.g. an international research collaboration program favouring the outflow of domestic researchers) enhances growth in the home country when temporary migrants have similar or higher capital content than domestic workers. In particular the gross inflow of foreign visitors *always* leads to growth when foreign residents are more skilled than domestic workers: $(k_t - \hat{\varphi}_t) < 0$ (in this case $\partial\gamma_{k,t}/\partial\theta_t = sf(k_t)c'(\lambda_t, \theta_t, k_t)/k_t - (1 - \hat{\varphi}_t/k_t) > 0$), while the outflow of domestic labour has a positive effect only when the disembodied effect $(sf(k_t)c'(\lambda_t, \theta_t, k_t)/k_t)$ is larger than its corresponding effect on capital depletion $(1 - \hat{\varphi}_t/k_t)$, and vice-versa $(\partial\gamma_{k,t}/\partial\lambda_t = sf(k_t)c'(\lambda_t, \theta_t, k_t)/k_t + 1 - \hat{\varphi}_t/k_t)$.

In this model temporary migrants can compensate a reduction in the capital per effective labour ratio caused by a net inflow of unskilled permanent migrants, as shown in Figure 1 (steady state at point 3 vis-à-vis point 1). Whether or not temporary migration offsets the growth impact of permanent migration ultimately depends on empirical values (see Table A.1 in the Appendix). The argument worth noting is that temporary migration can offer a solution to a net outflow of permanent migrants with above-average level of skills ('brain drain').

Another feature of the model is the prediction that even identical gross in- and outflows of temporary migrants $(\lambda_t = \theta_t)$ lead to growth. This result emerges as a zero net inflow of temporary migrants (embodied effect) still makes a positive contribution to knowledge (disembodied effect) and growth. This result gives scope to reassess the preoccupation with which many developed and developing countries view any outflow of skilled native workers (e.g. Carrington and Detragiache, 1999; Cervantes

and Guellec, 2002; Hugo, 2002; Becker, Ichino and Peri, 2003). At the same time it suggests that focusing only on headcount may be myopic.

4 An Empirical Application

This section presents an estimate of the impact of temporary migrants on a country's growth rate. The calculation has only illustrative purposes aimed at highlighting the potential value of policies focusing on temporary migration. No use of econometric techniques is made, partly to overcome the difficulty surrounding the estimation of $sf(k_t)c(\lambda_t, \theta_t, k_t)$ with the available data (this is beyond the scope of the paper), and partly because the migration parameter $(\lambda_t - \theta_t)(k_t - \hat{\varphi}_t)$ is a number that can be obtained with no recourse to statistical inference. Only available data are used for the empirical exercise as well as estimates from previous work.

The calculation is performed on US, British, and Australian data for the year 1997. Temporary migration statistics are sourced from the International Passengers Survey collected in these three countries, and are restricted to international travel for business purposes. Data on the number of visits and the average length for incoming and outgoing business travellers were used to obtain a measure of equivalent workers, as per (2a) and (2b). Information on the average skill level of native and temporary workers was obtained from previous studies[7]. Employment data came either from existing studies (US: Anderson, 2002) or Labour Force Surveys (UK: Eurostat; Australia: Australian Bureau of Statistics).

[7] Anderson (2002 – US), the International Air Travel Survey (1988 - UK) and Tani (2003 – Australia).

The statistics used for the calculation are summarised in Table 1. The first column shows the gross number of outgoing and incoming business travellers, respectively, as a proportion of domestic employment. The column in the middle indicates the number of equivalent workers (which adjusts the annual flow of travellers by the number of days spent abroad) as a proportion of domestic employment. The third column shows the ratio between the proportion of travellers that are classified as skilled on the basis of their educational (US and Australia) or occupational level (UK) using Keesing (1965), and the corresponding proportion in domestic employment. As in BS (p.292) it is assumed that temporary migrant carry only human capital so that this ratio can be used as a proxy for the term $\hat{\varphi}_t / k_t$ in equation (6) (this time expressed as a growth rate $\dot{k}_t / k_t$).

TABLE 1 SUMMARY STATISTICS OF INTERNATIONAL BUSINESS TRAVEL IN THE US, UK AND AUSTRALIA IN 1997

	Business travellers as a % of domestic employment	Equivalent workers as a % of domestic employment	Ratio of skilled among travellers vs. domestic employment
United States			
Outgoing	6.1	1.9	2.32
Incoming	5.5	0.9	
United Kingdom			
Outgoing	29.9	0.7	2.27
Incoming	26.4	0.5	
Australia			
Outgoing	4.1	0.6	3.77
Incoming	3.9	0.4	

Source: US: Anderson (2002 – Table 1); UK: ONS (Travel Trends, 1999 – Tables 2.05 and 3.05), IATS (1988 – skill composition), Eurostat (2002 – Labour Force Survey); Australia: Australian Bureau of Statistics (2002 - Overseas Arrivals and Departures ABS 3401.0) and Tani (2003 – skill composition).

Despite differences in collection method and other limitations of the data, the figures in the second and third columns in Table 1 indicate that these three countries are *net exporters* of skilled labour through international business travel[8], as the inflows of

[8] The volume of business trips for the UK seems excessively large, as it represents a quarter of the country's employment.

equivalent workers outweigh the corresponding outflows, and the value of $\hat{\varphi}_t/k_t$ is greater than unit. As a result, for each country the embodied effect of temporary migration is expected to raise capital depletion and have a negative impact on the growth rate.

Table 2 shows the estimates of the embodied and disembodied effects of temporary migration on growth. The embodied effect in the first column is calculated as the product of the difference between gross inflows and outflows of equivalent workers, the term (1 - $\hat{\varphi}_t/k_t$), and two adjustments to correct for (i) the measurement of $\hat{\varphi}/k_t$, which captures only human capital, and (ii) the need to rescale the result in terms of growth rate of GDP rather than capital per effective worker, according to equation (7). Similarly to BS, it is assumed that in each country the ratio of human to total capital in the domestic economy of is 5/8 and that the share of capital in each country's total income is 1/3 (p.292). As a result, the embodied effect on GDP growth for the US in 1997 shown in the top left column of Table 2 is calculated as: – (0.009 – 0.019) x (1 – 2.32) x (5/8) x (1/3) = – 0.275%.

The second column of Table 2 shows the disembodied effect. The strategy used follows the assumption that its effect is identical to a higher expenditure in R&D. By so doing the disembodied effect can be calculated as the product of the gross flow of equivalent workers and the *social return* of R&D, for which a consensus estimate is 50% (e.g. OECD, 2000; Dowrick, 2002). The result obtained is further adjusted by

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However, given the geographic proximity of the UK to continental Europe, it is likely that the figure reported reflects frequent travels and not only a high volume of travellers. This suspicion is somewhat supported by the lower average number of days of each visit (4.7 days for incoming and 6.1 for outgoing travellers, respectively), relative to those of the US (12.2 and 13.3) and Australia (14.1 and 29.5).

1/3 (or 8 hours per day) to recognise that only a fraction of a traveller's time abroad may be spent in activities related to the production of knowledge.

The third column of Table 2 reports the net impact of temporary migration on the US, UK and Australian growth rates for 1997, respectively, calculated as the sum of embodied and disembodied effects.

TABLE 2 THE EFFECT OF TEMPORARY LABOUR MIGRATION ON GDP GROWTH IN 1997.

	Embodied Effect	Disembodied Effect	Net Effect on GDP Growth
US	-0.275%	+0.467%	+0.192%
UK	-0.053%	+0.200%	+0.147%
Australia	-0.135%	+0.160%	+0.025%

Table 2 shows that temporary labour migration has a small but non-negligible positive effect on growth. In particular, the cross-section results shown above appear to indicate that the net effect on growth increases with the absolute volume of equivalent workers as the US emerge as the country that benefits the most from temporary migration, followed by the UK and Australia.

These calculations are not too far from the results obtained by Winters, Walmsley, Wang, and Grynberg (2002), who on the basis of a general equilibrium model and better data, estimate that a 3% increase in the flow of temporary migrants produces an increase of 0.6% in the GDP growth. The 3% increase in temporary labour movements simulated in their study is broadly similar to the gross flow of equivalent workers calculated for the US and shown in Table 2 (1.9% + 0.9% = 2.8%).

5 Conclusion

This paper extends the theoretical model of Solow and Swan to study the impact of temporary labour migration on the growth rate of an economy, and calculates such effect for a cross section of countries for 1997. Temporary migration is modelled as affecting a country's labour endowment (as does permanent migration) *and* the amount of disembodied knowledge that enters the domestic production function. One feature of the model is the prediction that growth can occur even when net flow of migrants (headcount) is nil, as a country' ability to accumulate capital crucially depends also on the gross flows of ideas (head-content) accessed through international business visits. The empirical results, albeit only illustrative due to the limitations of existing data, suggest that temporary migration has a small but not insignificant positive effect on growth.

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Appendix

TABLE A.1 PERMANENT AND TEMPORARY MIGRATION MIX LEADING TO AN INCREASE OF THE CAPITAL PER EFFECTIVE LABOUR RATIO

		Skill Composition			
		$\hat{\kappa}_t < \mathbf{k_t}$ **and** $\hat{\varphi}_t < \mathbf{k_t}$	$\hat{\kappa}_t > \mathbf{k_t}$ **and** $\hat{\varphi}_t < \mathbf{k_t}$	$\hat{\kappa}_t < \mathbf{k_t}$ **and** $\hat{\varphi}_t > \mathbf{k_t}$	$\hat{\kappa}_t > \mathbf{k_t}$ **and** $\hat{\varphi}_t > \mathbf{k_t}$
Migration Types	$m(k_t) > 0$ ***and*** $\lambda_t - \theta_t > 0$	*Never*	$m(k_t)(1 - \hat{\kappa}_t/k_t) > (\lambda_t - \theta_t)(1 - \hat{\varphi}_t/k_t)$	$m(k_t)(1 - \hat{\kappa}_t/k_t) < (\lambda_t - \theta_t)(1 - \hat{\varphi}_t/k_t)$	*Always*
	$m(k_t) < 0$ ***and*** $\lambda_t - \theta_t > 0$	$m(k_t)(1 - \hat{\kappa}_t/k_t) > (\lambda_t - \theta_t)(1 - \hat{\varphi}_t/k_t)$	*Never*	*Always*	$m(k_t)(1 - \hat{\kappa}_t/k_t) < (\lambda_t - \theta_t)(1 - \hat{\varphi}_t/k_t)$
	$m(k_t) > 0$ ***and*** $\lambda_t - \theta_t < 0$	$m(k_t)(1 - \hat{\kappa}_t/k_t) < (\lambda_t - \theta_t)(1 - \hat{\varphi}_t/k_t)$	*Always*	*Never*	$m(k_t)(1 - \hat{\kappa}_t/k_t) > (\lambda_t - \theta_t)(1 - \hat{\varphi}_t/k_t)$
	$m(k_t) < 0$ ***and*** $\lambda_t - \theta_t < 0$	*Always*	$m(k_t)(1 - \hat{\kappa}_t/k_t) < (\lambda_t - \theta_t)(1 - \hat{\varphi}_t/k_t)$	$m(k_t)(1 - \hat{\kappa}_t/k_t) > (\lambda_t - \theta_t)(1 - \hat{\varphi}_t/k_t)$	*Never*