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The Economic Impact of Medical Migration: a Receiving Country's Perspective

Martine Rutten[1]

Abstract

This paper seeks to determine the macro-economic impacts of migration of skilled medical personnel from a receiving country's perspective, taking the UK as an archetype OECD economy that imports medical services. The resource allocation issues have been explored in theory, by further developing the Rybczynski theorem and empirically, using a Computable General Equilibrium (CGE) model with an extended health component. The main finding is that importing foreign doctors and nurses into the UK yields higher overall welfare gains compared to a generic increase in the NHS budget. Welfare gains rise in the case of wage protection.

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1. Introduction

Health workers migrate from developing to developed countries to better their economic or social situation immediately or for the purpose of career development. The incentives to migrate typically involve a combination of "push factors" (unsatisfactory working or living conditions in the country of origin) and "pull factors" (attractive working or living conditions, availability of positions and active recruitment in the country of destination).[2] While individual motives underlie the observed migration flows – and in this sense are neither new[3] nor unique to the health sector as such – the so-called medical "brain drain" causes the unique problem of severe workforce shortages in developing country health systems that are already under stress.[4] A notable difference with the past is that migration and the accompanying shortage of health personnel for developing countries are now usually permanent.[5] Faced with a dwindling work force, the task facing developing countries in building up their health care systems is particularly daunting. This is the more so for Sub-Saharan African countries which suffer the HIV/AIDS pandemic, which uses up most of health and medical services and claims the lives of many health workers.[6]

Recent studies suggest that the UK has a major role to play in the medical brain drain from (especially English-speaking) Sub-Saharan African countries.[7] Obvious pull factors are that (1) English is an increasingly international language and (2) the shortage of UK-trained doctors and nurses makes immediately available and qualified substitutes a financially attractive alternative. This paper analyses the economic consequences of migration of skilled medical personnel from a receiving country's perspective, taking the UK as an archetype OECD economy that imports medical

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2 Buchan and Dovlo (2004), Eastwood et al. (2005), Hagopian et al. (2004), Forcier et al. (2004), Ahmad (2005). Pull factors tend to dominate as migration is only beneficial if there are vacancies in the destination country (Stilwell et al. 2004; Bach 2004). The Global Commission on International Migration (GCIM) groups them under the '3Ds'; differences in development, demography and democracy (GCIM, 2005).

3 See Bundred and Levitt (2000), Martineau et al. (2002) and Bach (2004) for a historical perspective.

4 Stilwell et al. (2004). Exceptions are countries like India and the Philippines, which have collaborative health-worker migration schemes and are reported to over-produce physicians and nurses intended for an international market (Hagopian et al. 2004, Buchan et al. 2003, Forcier et al. 2004).

5 In countries with better opportunities, such as India, some health workers do return (Eastwood et al. 2005).

6 Dixon et al. (2002) for example report a HIV/AIDS prevalence rate of 20% for South African nurses.

7 Eastwood et al. (2005), Buchan and Dovlo (2004).

services. The paper is part of a broader research project examining the effects of the medical brain drain on both receiving countries and sending countries.[8]

Economic models that have been developed so far to study the effects of increased worldwide labour migration are in the main Computable General Equilibrium (CGE) models and unequivocally find considerable global welfare gains.[9] These gains arise as workers flow from low productivity areas (developing countries) to high productivity areas (developed countries), yielding a rise in world output.[10] Most of the gains are realised in the initial phases of migration, suggesting that even a small liberalisation of the international labour market brings about substantial welfare gains. Generally, while not all gains accrue to developing countries, the size of the gains indicates that liberalising the international movement of labour may be the most important issue from which developing countries stand to gain (and is more important than, for example, global trade reform).

In the latest models that account for remittances and possess a relatively rich household welfare analysis the welfare gains primarily accrue to the poorest developing regions.[11] They stand to gain especially from increased unskilled labour migration due to their relative abundance in this factor and due to its relatively large productivity gap between home and host countries. In addition, since temporary migration avoids the political costs associated with permanent migration (the threat to culture, integration problems and benefit claims), these models have shifted their focus towards liberalising *temporary* unskilled labour migration flows from

8 A second paper will tackle the sending countries' perspective, whereas a third paper will provide an overview.

9 Iregui (2003), Walmsley and Winters (2003), Winters (2003b), Winters et al. (2003) and Global Economic Prospects 2006 (World Bank, 2005c). The first study on the impact of worldwide migration, Hamilton and Whalley (1984), is based on a partial equilibrium analysis and is updated by Moses and Letnes (2003, 2004). Hamilton and Whalley (1984) estimates the worldwide welfare gain of a full relaxation of migration controls at 100% or more of annual world income (7.82$ trillion in 1977). Moses and Letnes' (2003, 2004) updated version of this model finds a worldwide welfare gain of US$3.4 trillion, 9.6% of real world GDP in 1998 and US$0.58 trillion for 1977. Iregui (2003) arrives at global welfare gains 15% to 67% of world GDP. These gains fall to a level of 13% to 59% of world GDP in the presence of a segmented labour market and fall to a level of 3% to 11% of world GDP if only skilled labour is allowed to migrate. The analyses of Walmsley and Winters (2003), Winters (2003b) and Winters et al. (2003) yield welfare gains of $156 billion a year (approximately 0.6% of world income in 1997) following an increase in the inward mobility of skilled and unskilled labour by only 3% of the developed countries' work forces. Based on the previous analysis, the GEP 2006 obtains a global welfare gain of $356 billion (0.6% of global income) over the period 1970-2000.

10 Bhatnagar (2004).

11 Walmsley and Winters (2003), Winters (2003b), Winters et al. (2003) and GEP 2006. The latter study takes into account differences in purchasing power between high-income and developing countries, which deflates the welfare gains for migrants who remit less. It also distinguishes between natives, new and old migrants (the latter two being relatively close substitutes), with old migrants being worse off whereas natives in high-income and developing countries gain. The main beneficiary households are naturally the new migrant households who are earning a higher wage abroad.

developing to developed countries. According to these studies, the only challenge posed by the temporary movement of natural persons governed by GATS Mode 4 is to ensure that local unskilled workers in developed countries are not worse off by the inflow of migrant workers, which can be done via some form of compensation in the short run and education/training or improved asset distribution in the long run.

As previously noted, a far greater challenge is that the migration of skilled workers entails a (permanent) loss of scarce human capital to the developing country of origin, i.e. a brain drain.[12] So, while economic models suggest that the migration of unskilled workers leads to welfare gains worldwide, and for both developing and high-income regions, the impact of liberalising the movement of skilled workers on global welfare is a lot less clear. The research project addresses this caveat, by modelling in greater detail the migration of skilled health workers, i.e. the "medical brain drain", from developing countries to developed countries. The focus on medical migration also allows us to analyse the associated adverse health consequences for many developing countries, particularly in Sub-Saharan Africa, that already suffer from severe medical workforce shortages and, their mirror image, the associated positive health consequences for developed countries, such as the UK, whose health care systems are rationed by limited public funding.

In the analysis we employ a static CGE model for the UK, calibrated to a purpose-built Social Accounting Matrix (SAM) for the year 2000 with considerable refinement in terms of sectors (distinguishing health care and its main input suppliers), factors (capital, skilled and unskilled labour) and household types (based on age and labour market participation of household members). It is the first of its kind in that it has been designed to analyse the macro-economic impacts of changes in health care provision, whilst recognising the simultaneous effects of consequent changes in health on effective labour supplies and the resource claims made by the health care sector. The effects on welfare of higher health provision come through two main channels: (a) the direct gain from increasing the "well-being" of the population, and (b) the

[12] With respect to potential gains in human capital (for example upon return, or those generated by a rise in the expected return on education for those staying behind) Schiff (2005) shows that claims about the size and impact of the brain gain stemming from the increased expected return on education in the country of origin on welfare and growth are greatly exaggerated and that brain drain is likely to just entail a loss for developing source countries. See also the World Bank (2005b, p. 208-210).

indirect effects of an increase in the size of the effective (i.e. “able to work”) endowments of skilled and unskilled labour for use in non-health activities.[13]

The remainder of this paper is organised as follows. Section 2 presents what is known about migration flows of health workers into the UK and their remittance behaviour, using a variety of sources. We focus in particular on doctors and nurses, the two health worker types crucial for the delivery of health care, and contrast the evidence with that available for the largest economy in the world, and the key driver of worldwide migration, the USA. Section 3 gives an overview of UK and international policies on migration and their influence observed and possible future migration flows. Section 4 presents some theory on the economic impacts of medical migration from a receiving country’s perspective. The approach is based on that commonly used in the explanation of ‘Rybczynski effects’ in the Heckscher-Ohlin-Samuelson model, but now following changes in factor endowments which are endogenously determined by government provision of health care. The section presents the effects on sectoral outputs and welfare in the long-term, where the health sector expansion is driven by an increase in the use of domestic skilled and unskilled labour, and in the short-term, where skilled workers in the health sector have health-specific skills so that an increase in health output is driven either by an increase in the use of unskilled labour only, or also by imports of foreign medical skilled workers. Section 5 discusses the model simulations and results. Specifically, the policies of a generic increase in the National Health Service (NHS) budget and the immigration of foreign doctors and nurses at the current wage, whilst varying the share of remittances in migrant income, are contrasted with one another. We assume that doctors and nurses are immobile across sectors and, for the purpose of comparability, that the policies have identical nominal NHS budget implications. In order to illustrate the social welfare effects of protection of the wage of the medical profession following immigration we also report the results of the immigration policy when the wages of doctors and nurses are allowed to fall. The sensitivity analyses reveal the importance of the size of the indirect health effects, i.e. the impacts of an increase in health provisioning on effective (“able to work”) labour endowments. The final section concludes.

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[13] See Rutten (2004) for an elaborate description of the CGE model.

2. Patterns of migration of health workers into the UK

This section describes the flows of medical personnel into the UK, focusing on doctors and nurses, compares these with medical migration flows to other developed countries, and looks at evidence of offsetting financial flows to the country of origin.[14]

The flow of doctors into the UK

Since 1993 the annual inflow of doctors from both the European Economic Area (EEA) and elsewhere has more than doubled (Table 1).[15] In contrast the number of new doctor registrants qualified in the UK has increased only gradually, by 27% over the time period 1993-2004. As a share of all new registrations, those from overseas by far outweigh those from the EEA (45% compared to 19% in 2004, see Figure 1).

Table 1: New registrations of doctors in the UK by region of qualification

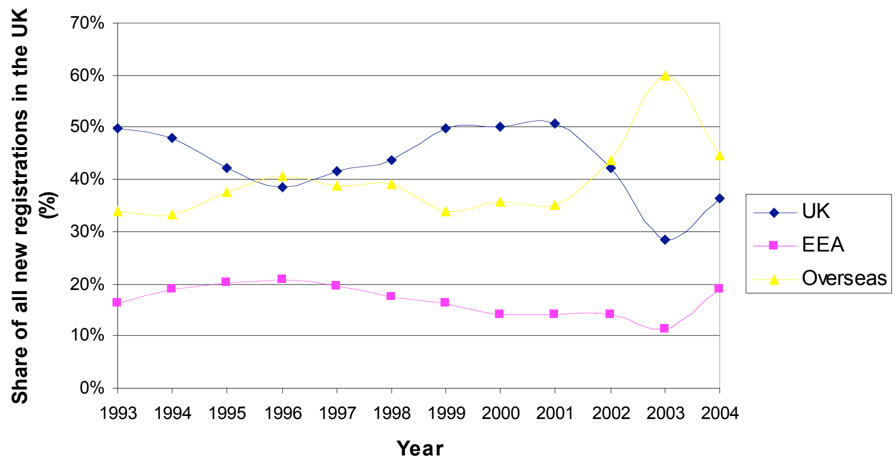
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
UK	3675	3657	3710	3822	3920	4010	4242	4214	4462	4288	4443	4658
EEA	1188	1444	1779	2084	1860	1590	1392	1192	1237	1448	1770	2419
Overseas	2500	2539	3327	4047	3678	3580	2889	2993	3088	4456	9336	5683
Total	7363	7640	8816	9953	9458	9180	8523	8399	8787	10192	15549	12760

Source: General Medical Council Annual Review 2004-2005, Buchan and Dovlo (2004, Table 1)

14 The in-country distribution of health personnel is outside the scope of this paper (see for example Batata (2005) for nurses). Similarly, there is some emigration of health personnel, especially by UK nurses (Nursing and Midwifery Council Statistics 2004-2005), but also by physicians (see Forcier et al. 2004). Since outflows are less than inflows, and most are destined for developed countries, this issue is ignored. We nonetheless recognise that outflows contribute to in-country work force shortages.

15 Registration data. Whilst having the limitation of signifying intent rather than actuality of working in the destination country and multiple cross/in-country applications, the data do give an indication of the trends in and relative importance of international flows (Buchan et al. 2003, Buchan and Sochalski, 2004).

Figure 1: Share of new registrations of doctors in the UK coming from abroad



In 2004 the number of new registrations of doctors from the ten EU accession countries from the EEA increased markedly (by 37% compared to 2003), a break with the trend of previous years. This appears to have been a substitute for new overseas registrations, which declined by 40% compared to the previous year. This has brought down the total of new doctor registrations (from abroad) for the second time since the peaks in 1996 and subsequently in 2003.

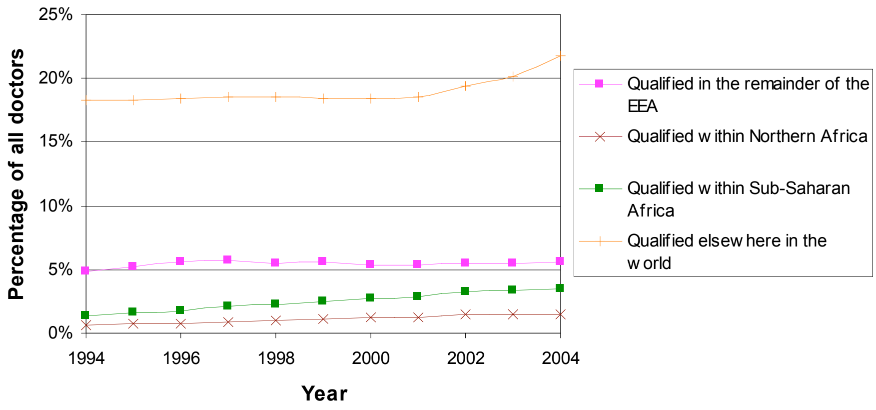
Table 2: Hospital, Public Health Medicine and Community Health Services medical staff and General Practitioners by region of qualification

All Countries of Qualification	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
All Doctors [1][2][3]	77947	81003	83094	86052	88227	90365	92789	95637	99696	105230	113184
Qualified in the United Kingdom	58286	60012	60900	62569	64105	65442	67025	68785	70245	73134	76733
Qualified in the remainder of the EEA	3816	4270	4702	4895	4855	5073	5014	5131	5478	5819	6285
Qualified w ithin the w hole of Africa	1635	1882	2158	2599	2869	3224	3630	4013	4679	5104	5590
Qualified w ithin Sub-Saharan Africa	1109	1292	1489	1821	2008	2225	2499	2772	3242	3578	3928
Qualified w ithin Northern Africa	526	590	669	778	861	999	1131	1241	1437	1526	1662
Qualified elsew here in the w orld	14210	14839	15334	15989	16398	16626	17120	17708	19294	21173	24576

[1] Excludes all staff w ith a dental specialty. Information about country of qualification is derived from the General Medical Council.
For staff in dental specialties, w ith a General Dental Council registration, the country of qualification is unknow n.
[2] Excludes medical Hospital Practitioners and medical Clinical Assistants, most of w hom are also GPs w orking part time in hospitals.
[3] Excludes GP Retainers.

Source: Department of Health

Figure 2: Medical doctors in the NHS by region of qualification



Department of Health data on the region of training of doctors working in the NHS in England give an indication of the level of employment, i.e. the "stock", of doctors by region (Table 2).[16] Although the majority of medical doctors in the NHS continue to come from the UK's education system, the number having increased by 32% over the last ten years, the proportion has declined from approximately 3 in 4 doctors in 1994 to 2 in 3 doctors in 2004. In contrast, the number qualified in the EEA has increased by 60%, whereas the number qualified in the African region has more than doubled during this period (an increase of 243%). The employment in the NHS of medical doctors trained elsewhere in the world has risen by 73%. The latter category, coming from countries such as India and the Philippines, has experienced the greatest increase relative to overall NHS employment levels of medical doctors, from 18% in 1994 to 22% in 2004, most of which has taken place since 2001 (Figure 2).

The flow of nurses into the UK

Over the last seven years the inflow of nurses to the UK from non-EEA countries has risen sharply (Table 3). India has become the main source country, displacing the Philippines from that position in 2003/04. Other important source countries are Australia and South Africa.

[16] Since, as with nurses, most recruitment of doctors to the UK is destined for the NHS, the situation that is depicted is representative for the UK as a whole. As with the data in Table 1, a breakdown by country of primary qualification could not be obtained.

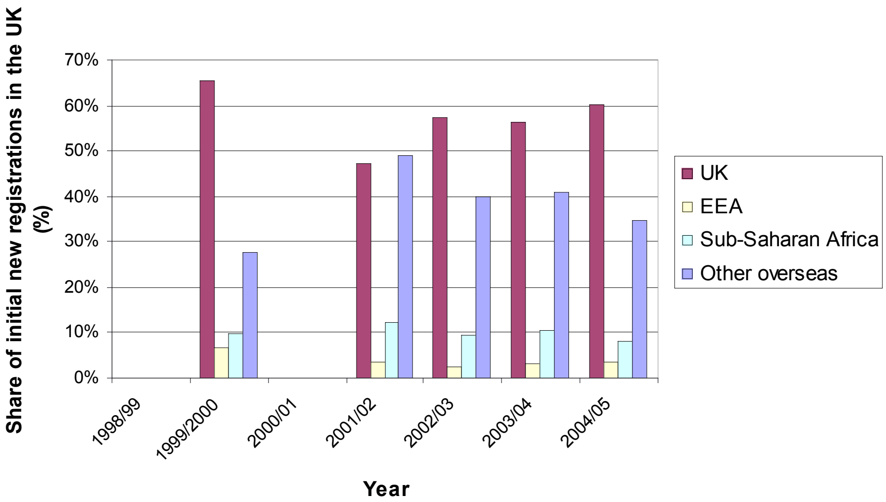
Table 3: Initial admissions of nurses and midwives* by the top 25 countries of training

Country	1998/99	1999/2000	2000/01	2001/02	2002/03	2003/04	2004/05
India	30	96	289	994	1830	3073	3690
Philippines	52	1052	3396	7235	5593	4338	2521
Australia	1335	1209	1046	1342	920	1326	981
South Africa	599	1460	1086	2114	1368	1689	933
Nigeria	179	208	347	432	509	511	466
West Indies	221	425	261	248	208	397	352
Zimbabwe	52	221	382	473	485	391	311
New Zealand	527	461	393	443	282	348	289
Ghana	40	74	140	195	251	354	272
Pakistan	3	13	44	207	172	140	205
Zambia	15	40	88	183	133	169	162
USA	139	168	147	122	88	141	105
Mauritius	6	15	41	62	59	95	102
Kenya	19	29	50	155	152	146	99
Botswana	4	-	87	100	39	90	91
Canada	196	130	89	79	52	89	88
Nepal					71	43	73
Swaziland						81	69
China							60
Malawi	1	15	45	75	57	64	52
Srilanka					23	36	47
Lesotho						50	43
Japan					20	37	34
Singapore							28
Sierra Leone							24
Others	203	329	472	605	418	514	380
Sub-Saharan Africa	915	2062	2266	3789	3053	3640	2624
Other overseas	2706	3883	6137	11275	9677	10482	8853
Total overseas	3621	5945	8403	15064	12730	14122	11477
EEA	1413	1416	1295	1091	802	1030	1193
UK		14035		14538	18216	19462	19982

* Only 22 out of 11,477 admissions to the registry were midwives. The UK currently does not admit midwives from any of the top three countries.
Source: Nursing and Midwifery Council Statistical Data 2001-02 to 2004-05

Since 2003/04 the number of new entrants on the nurse registry from overseas has fallen – from Sub-Saharan Africa by 28% and from elsewhere in the world by 16%, although some countries within these groups have witnessed a rise in new nurse registrants in the UK, most notably India (by 20%). With the total of nurse admissions from abroad declining since 2003/04, the share of new entries on the nurse registry coming from the UK is rising again (Figure 3). The share of new admissions from the EEA has remained broadly constant, despite the accession of 10 countries to the EU.

Figure 3: Share of new registrations of nurses and midwives in the UK coming from abroad



No data are available as yet on the level of employment of nurses by region of primary qualification. Buchan and Dovlo (2004) suggest that in October 2002 approximately 42000 international nurses were employed in the UK, equivalent to 8% of the total 525,000 number of nurses registered. Glover et al. (2001) report that 31% of practising doctors and 13% of nurses were born outside the UK.[17]

Migration of other health personnel: how do migration flows compare?

Data on migration flows of other health personnel are not available, although data on work permits granted to health care professionals (Table 4) show that the majority are granted to nurses (61%) and doctors (7%), all higher skilled, suggesting that inflows of other types of workers are relatively less important for the UK health system. Moreover, whereas the number of work permits given to foreign nurses increased significantly from 2000 to 2001 (by 59%), this growth seems to have slowed down markedly, the increase in work permits granted to nurses over the period 2002-2003 being only 5%. In contrast, the growth in work permits granted to foreign doctors, starting from a low level in 2001, grew by 156% and 51% over the periods 2001-02

[17] The authors also state that half of the 16,000 increase of the NHS workforce over the last decade consisted of those who had qualified abroad.

and 2002-03 respectively (in absolute terms this was less than the increase in work permits granted to nurses).

Table 4: Work permits granted to health care professionals by occupation

Occupation	2000	2001	2002	2003
Nurse	14123	22414	25926	27171
Doctor	na	762	1948	2947
Pharmacist	411	471	443	409
Physiotherapist	157	261	357	389
Radiographer	na	155	352	384
Medical practitioner	543	852	524	340
Researcher	243	267	378	339
Social worker	na	na	na	208
Dental surgeon	162	218	238	201
Psychiatrist	99	188	213	189
Assistant dentist	140	na	na	na
Veterinary surgeon	114	na	na	na
Occupational therapist	90	135	194	na
Others	3879	4854	7884	11866
Total	**19961**	**30577**	**38457**	**44443**

na: not available
Source: House of Commons Hansard. Written answers for 23 February 2004

Note that with a total of 113,184 doctors working in the NHS in 2004/05 (Table 2), the 8,102 new doctors on the registry from outside the UK (Table 1) have a share of 7%. This exceeds the 3% that the newly registered nurses from abroad (12670 in 2004/05 from Table 3) represent in a total of 397,500 qualified nurses working in the NHS.[18] Hence, the inflow of doctors into the UK health sector is relatively large compared to the inflow of nurses when taking into account present "stocks" of doctors and nurses. Evidence of nurses having to take over some of the responsibilities of doctors, so as to alleviate their task, suggests that doctors in the UK are in relatively short supply, causing greater migration flows in relative terms.[19]

A breakdown by country of origin (Table 5), unfortunately only available for the aggregate, reveals similar source countries as for admissions of nurses to the UK (Table 3).

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[18] Department of Health (2004a). Using the total number of registered doctors, 216,468 in 2003 (General Medical Council, 2003), and nurses, 639,390 in 2004 (Nursing and Midwifery Council Statistical Data 2004-05) in the UK, the percentages are 4% and 2% for doctors and nurses respectively.

[19] *Nurses as good as trainee doctors*, BBC News, December 6, 2002. According to this report, the NHS may not have a shortage of nurses; perceived shortages may be caused by nurses having to perform non-clinical tasks.

Table 5: Work permits granted to health professionals in the UK by country of origin

Country of origin	1995	1996	1997	1998	1999	2000	2001	2002	2003
Philippines	na	na	na	na	1770	6592	10017	11143	12014
India	209	276	318	457	916	1939	4137	6482	9835
South Africa	102	190	420	753	2024	2880	4132	5728	5880
Zimbabwe	76	146	142	225	581	1149	1959	2646	2825
Nigeria	116	133	196	338	688	1046	1329	1814	1510
Australia	100	189	357	438	720	827	1097	1241	1292
China Peoples Republic of	na	na	na	na	na	na	539	713	1068
Pakistan	68	96	112	na	na	391	799	861	964
Ghana	na	na	na	na	na	na	565	631	850
Bulgaria	na	na	na	na	na	na	na	599	787
Mauritius	157	200	162	187	na	na	na	na	na
Trinidad and Tobago	151	192	198	278	501	471	na	na	na
United States of America	112	127	187	232	376	401	na	na	na
Malaysia	57	82	na	178	272	na	na	na	na
Canada	na	na	102	na	na	na	na	na	na
New Zealand	na	na	na	192	259	390	488	na	na
Others	475	650	926	1465	2629	3874	5514	6598	7417
Total	**1623**	**2281**	**3120**	**4743**	**10736**	**19960**	**30576**	**38456**	**44442**

na: not available
Source: House of Commons Hansard. Written answers for 23 February 2004

How does the UK compare to other developed countries?

The effects of medical migration on source countries are worst for English-speaking Sub-Saharan African countries, stemming from the "pull" of the English speaking countries, especially the UK and North America.[20] As a result, about 12% of all Sub-Saharan doctors work in the UK, USA and Canada.[21] While data on international migration flows of medical personnel are patchy[22], we nonetheless aim to provide an overview of the main trends, focussing on English-speaking countries, with the USA as the largest country of destination.

Given its history of migration and the unprecedented scale of health expenditure, it is not surprising that the USA is the key driver of worldwide medical migration. The USA is reported to have a shortage of pharmacists and nursing staff, and the previous physician surplus is predicted by many to change into a shortage.[23]

[20] Forcier et al. (2004). Eastwood et al. (2005) notes that despite the importance of French language internationally, only around 5% of practicing doctors in France qualified overseas.
[21] Hagopian et al. (2004).
[22] Diallo (2004) elaborates on sources, uses and challenges for migration data.
[23] Bach (2003).

Table 6: International Medical Graduates (IMGs) in the USA and Canada in 2002

Country of training	Number of IMGs in USA	Number of IMGs in Canada
Sub-Saharan Africa	**5334**	**2151**
Nigeria	2158	123
South Africa	1943	1845
Ghana	478	37
Ethiopia	257	9
Uganda	133	42
Kenya	93	19
Zimbabwe	75	26
Zambia	67	7
Liberia	47	8
Other	83	35
Top 4 source countries		
India	36634	
Philippines	17755	
Mexico	10404	
Pakistan	8563	
Low and lower-middle income countries	115835	
All countries	179978	
Total number of physicians in USA	771491	

Source: Hagopian et al. (2004)

The USA has attracted 5,334 Sub-Saharan African medical graduates to work as physicians in 2002 compared to 2151 going to Canada (Table 6) and 3,242 to the UK (Table 2). The majority (86%) come from Nigeria, South Africa and Ghana. The most popular four origin countries for the USA in 2002 were India, the Philippines, Mexico and Pakistan, together accounting for 10% of all physicians in the USA. Of the 23% of internationally qualified physicians working in the USA, approximately two-thirds come from low and lower-middle income countries.[24]

The main source countries of nurses for the USA over the period 1997-2000 are the Philippines, Canada and Africa, primarily Nigeria and South Africa (Table 7). Over this period applicants from the Philippines roughly doubled whereas those from Canada fell by approximately half. The ratio of newly licensed foreign-trained nurses to US-trained nurses fell from approximately 10.5% in 1995 to 5.5% in 1998, after

[24] In 2004, the most popular source countries are India, Philippines, Pakistan and Canada, accounting for 9.3% of all physicians in the USA (Mullan, 2005). In this year, international medical graduates make up 25% of the medical workforce, of which 60% come from low- and lower-middle income countries.

which it increased to nearly 15% in 2002.[25] Consequently, the share of international nurses as a percentage of current stock has risen to 11% (303,000 nurses), of which 80% comes from developing countries (approximately 31% from the Philippines, 26% from the Caribbean/Latin America, 5% from India, 10% from rest of Asia, 5% from Africa and 3% from Eastern Europe/Russia).[26]

Table 7: International nurses applying for a US Registered Nurse licensure, 1997-2000

Country of origin	Number	Percentage
Philippines	8641	33
Canada	5831	22
Africa (mainly Nigeria and South Africa)	1961	7
Republic of Korea	1882	7
India	1537	6
UK	1166	4
Russian Federation	583	2
Australia	345	1
People's Republic of China	345	1
Poland	265	1
Jamaica	186	1
Other	3764	14
Total number of applications	26506	100

Source: Buchan et al. (2003)

The average of 6,627 international nurses per year applying for a US Registered Nurse (RN) licensure in 1997-2000 only slightly exceeds the 6,198 average new international admissions to the UK nurse registry for 1998/99-1999/2000 (Table 3), but is less than the 14,123 work permits granted to nurses in the UK in 2000 (Table 4). Although the number of applicants to the US RN licensure has risen to over 14,000 in 2004[27] and exceeds the 12,670 new international admissions to the UK nurse registry in 2004/05 (Table 3), the data suggest that the UK is an important recruiter of nurses internationally, especially when the size of each country's health care system is taken into account.[28] Buchan et al. (2005) and Buchan and Sochalski (2004) moreover find that the UK in particular has become increasingly reliant on recruitment from developing countries, with approximately 79% of nurse inflows coming from lower-

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[25] Buchan and Solchalski (2004).
[26] Aiken (2005)
[27] Aiken (2005).
[28] The average American spends about 2.5 times as much on health care as a UK citizen. With a population of 5 times that of the UK, the health sector in the USA (measured by total health expenditures) is approximately 12.5 times that of the UK (*World Health Report 2005*, World Health Organization).

middle and low-income countries in 2001-02, compared to 72% for the USA and 36% for Ireland.

Financial flows: are inflows of workers accompanied by outflows of remittances?

The benefits of inflows of health professionals to the UK, as has been documented in the previous subsections, are obvious; rather than having to train a doctor for 5 or 6 years at a cost of approximately £220,000 or a nurse at a cost of about £12,500 to fill up staff shortages, a migrant doctor or nurse is immediately available at zero cost.[29] In this way the UK has saved £65 million in training costs for the doctors and £38 million for the nurses it has taken from Ghana since 1998.[30] Empirical evidence does not substantiate offsetting negative effects of migration on unemployment rates: effects on wages are found to have been negative but small, and migrants seem to contribute more in taxes than they receive in social security, thereby contributing to the fiscal system and economic growth in general in industrial countries.[31] The total net gain from medical migration to the UK however depends largely on the total of remittances sent home by migrant workers.

The evidence on the magnitude of world-wide remittance flows by migrant workers is mixed and difficult to establish since large proportions are transferred informally and are therefore not recorded in official statistics. The World Bank estimates that in 2005 total remittances world-wide exceeded 232$ billion, of which developing countries received US$167 billion, less than FDI inflows but larger (and more stable) than capital market flows and official development assistance.[32] There is little information on how much can be attributed to health workers.

Health workers, who generally come from higher income households that are in lesser need of remittances, and in particular those who migrate permanently seem to remit

[29] Eastwood et al. (2005). Note that some migrant workers need additional language/professional training (Glover et al. 2001, Forcier et al. 2004).

[30] Mensah et al. (2005). Martineau et al. (2002) state that this may hinder the development of domestic health worker supply and speaks of the perverse incentive arising from the potential cost savings to underestimate the need of workers as the gap can be filled from overseas. Whereas migrant workers are willing to work in less popular areas, they do tend to go home for public holidays and are often being lured to other countries with competitive salaries complicating work force planning.

[31] Buchan et al. (2003), World Bank (2005a). Glover et al. (2001) estimate a net fiscal gain in 1998/99 for the UK of £2.6 billion. The challenge of migration to local workers is equivalent to that imposed by imports of labour-intensive goods from developing countries, which could easily be compensated out of the overall welfare gain of migration (Winters, 2003b).

[32] World Bank (2005c). Unrecorded flows are conservatively estimated to add at least 50% of official remittance flows.

less than lower skilled short-term migrants.[33] Evidence suggests that doctors generally migrate permanently and so remit insignificant amounts, while nurses migrate temporarily and remit a lot more.[34] Other studies point out that, while fewer high skilled migrants remit, when they do then they may well remit more, especially when lucrative investment opportunities are involved.[35] More importantly however, the magnitude of outward remittances largely depends on where migrants come from: countries such as China, India, the Philippines, Egypt and Cuba with a surplus of health professionals actively send health professionals abroad since remittances are considered an important source of revenues. For the Pacific islands of Tonga and Samoa the income from remittances is estimated to equal total GDP, and remittances by migrant nurses not only exceed those made by other migrants but also outweigh the cost of additional human capital in nurse training.[36] Similarly, remittances by Philippine physicians were found to outweigh the economic losses of emigration.[37] In contrast, recorded remittances to Sub-Saharan Africa are highly volatile and comprise the lowest dollar amounts of any poor world region (less than US$ 5 billion), primarily due to a high level of informal flows stemming from strong intraregional migration and an underdeveloped financial sector.[38]

Since magnitudes of remittance flows are difficult to establish and vary by the migrants' country of origin, we vary the share of migrant income remitted in the CGE model experiments.

33 Martineau et al. (2002), World Bank (2005a).
34 Dovlo and Martineau (2004).
35 Lowell and Findlay (2002).
36 Connell and Brown (2004).
37 Forcier et al. (2004), Diallo (2004).
38 Hagopian et al. (2004), Stilwell et al (2003), World Bank (2005a). Remittance flows nonetheless vary by country, as does the development impact.

3. Existing national (UK) and international policy on migration

Flows of workers to the health sectors in the UK and other developed countries depend not only on the push and pull factors encouraging health workers to migrate, but also on national and international migration policies. Given that in the future both push and pull factors are likely to remain important – and in the case of the latter may well increase in strength due to an ageing population and medical work force, insufficient medical education levels and rising health expenditures in developed countries – it has been argued that it is important to actively "manage" migration flows such that they benefit both destination and source countries.[39] This section documents the UK and international policies currently in place that govern international medical migration.

UK policy towards medical migration

Concerns about ethical recruitment led the UK to develop in 2001 a Code of Practice for International Recruitment by which it limits recruitment to the two countries with which it has signed a health worker-migration agreement (India and the Philippines) which allows for controlled migration of health personnel.[40] All other developing countries are on the so-called "proscribed list", which will not be targeted for active recruitment by the NHS.[41] A major drawback of the original Code of Practice was that it did not cover private employers and recruitment agencies, which led the Department of Health to change the Code in 2004.

Since migration could be related to education, individual initiatives by health workers or (up to 2004) non-NHS employers, the continued inflow of nurses and doctors from developing countries does not necessarily suggest that the impact of the Department of Health Code of Practice has been limited.[42] However, the decline between 2003 and 2004 in both nurse and doctor inflows from overseas (Tables 1 and 3) may indicate that it is starting to take effect. Developments in medical migration flows into

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[39] Glover et al. (2001).

[40] Department of Health (2004b). The original Code from 2001 does not cover non-NHS employers, individual initiatives by health workers themselves and inflows related to education purposes. The revised 2004 Code does cover non-NHS employers.

[41] Department of Health (2005). The list is based on the OECD/DAC list of aid recipients. Underlying criteria: economic status and relative position with regards to numbers of health personnel.

[42] Buchan and Dovlo (2004).

the UK over the longer term will signify whether this is a one-off event or a sustained effect resulting from a more ethical recruitment process as governed by the Code of Practice. It is clear however that the Code of Practice on its own does not address the push and more notably the pull factors which govern migration flows to the UK in the first place. These require developed and developing country policies which are targeted at increasing the training of medical personnel worldwide and promoting the retention of health professionals, especially in underserved areas, and the return of migrant workers.[43]

The international institutional architecture related to medical migration

At the international level, a number of institutions are active in the area of health worker migration. The World Bank, as a proponent of increased globalisation for the purpose of long-term economic growth, has in the past proposed that "health services are another area in which developing countries could become major exporters,..., by temporarily sending their health personnel abroad."[44] The International Labor Organization (ILO), the World Health Organization (WHO), the International Organization for Migration (IOM) and the independent Global Commission on International Migration (GCIM) also acknowledge the importance of labour migration in general for the world economy, but have expressed their concern about the impact of medical labour migration in undermining the performance of health systems and the achievement of the health-related Millennium Development Goals.[45]

International migration of health personnel is expected to gain momentum in future through progress within the negotiations on Mode 4 of the General Agreement on Trade in Services (GATS) of the World Trade Organisation (WTO). GATS Mode 4, by which services can be traded via the movement of natural persons, relates to the provision of health services by individuals in another country on a temporary basis.[46]

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[43] Eastwood et al. (2005), Buchan et al. (2003).

[44] Hilary (2002). The World Bank and IMF have also been accused of enforcing public expenditure cuts on the health sector as a condition of their assistance, which they say rather reflect a county's perverse prioritisation.

[45] GCIM (2005).

[46] See Benavides (2002), Hilary (2001), WHO (2001, 2002), WTO-WHO (2002) for more on trade in health services and GATS. GATS does not cover public services, i.e. services provided in the exercise of government authority (defined as being provided neither on a commercial basis, nor in competition). Commitments under Mode 4 take the shape of access conditions granted by potential host countries and so do not cover commitments by countries of origin.

There are, however, several problems with the current formulation of Mode 4.[47] Firstly, the term 'temporary' has been defined only negatively as excluding permanent migration and there is no international consensus on the definition. This could be to the benefit of source countries by limiting the time for which health workers can go abroad and so reducing the possibility of permanently losing costly human capital. However, the term 'temporary' may not entail much significance since is difficult to enforce in practice: temporary workers, once they have migrated, may be unwilling to move back to their home country after their contracts have finished and may become permanent residents (to the point where they disappear into illegality). Secondly, persons are seen as service providers, not as entrants to the labour market. This distinction is difficult to maintain in practice since a temporary residency often implies that the service provider will have entered the local labour market. This, and the modest commitments made on Mode 4 so far (currently accounting for only 1.4% of the value of services trade), can be explained by the fear of (developed) countries that they may lose their ability to regulate immigration and the fear of potential negative impacts on the national economy. Thirdly, the GATS framework allows for domestic regulations regarding the requirements to practice of health professionals in order to safeguard the quality and safety of health service provision. These act as a barrier to entry by health professionals to developed host countries so as to protect the income of domestic health professionals. In some cases requirements regarding qualification and licences are said to have led to discrimination against foreign physicians.[48] More generally, GATS service liberalisation is typically biased towards liberalising the movement of highly skilled personnel, rather than creating new employment opportunities worldwide for the unskilled, an area of comparative advantage for developing countries. This may however benefit the health sector, since it is relatively skill-intensive.

Despite these problems and the limited progress so far, expectations are high for future progress in the area of international medical migration since there is a continuing momentum towards the enlargement of regional trade blocks and the

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[47] Bach (2003), Forcier et al. (2004), Stilwell et al. (2003), Lowell and Findlay (2002), Hilary (2001), WHO (2001, 2002), Winters (2003a), Winters et al. (2003), Bhatnagar (2004).

[48] Forcier et al. (2004).

harmonisation of medical qualifications worldwide. The WTO recognises that in this process there will be benefits from surplus countries filling up gaps in shortage countries and more generally benefits of lower health care prices worldwide, but also risks of brain drains exacerbating health personnel shortages and problems of access to and the quality of health services in developing countries.[49] The WTO thus recommends that countries impose appropriate regulations so that national health policy goals are not undermined by trade in health services.[50]

International organisations other than the WTO have attempted to draw up and strengthen codes of practice. Ratification by all members, however, often does not materialise since the priorities of destination and source countries, cost-effective international recruitment and a more equitable terms of trade respectively, are found to be incompatible.[51] As a long-term solution, the GCIM therefore proposes an overhaul of the institutional migration architecture by establishing, in 2006, one Inter-agency Global Migration Facility responsible for all migration policies to create a more effective and coherent response to the opportunities and challenges posed by international migration. As a short-term solution a high-level inter-institutional group could pave the way for such a facility.[52] When these proposals will be implemented and how they will affect international medical migration remains as yet unknown.

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[49] WTO-WHO (2002).

[50] GATS for example allows sending countries to discourage medical migration via negative measures, such as taxing emigrating personnel or demanding financial compensation from recruiting countries/organisations, and positive measures, such as better employment/living conditions at home. Since most developing countries have insufficient regulatory and enforcement capacity to do so, strengthening their regulatory capacity is a major challenge for the coming years.

[51] The Commonwealth has for example adopted a Code of Practice in 2003, though Canada, Australia and the UK have not signed the agreement, seemingly due to the addition of clauses related to compensation for countries of origin (Buchan and Dovlo, 2004). See Bach (2003) for more on international standards and trade agreements.

[52] GCIM (2005).

4. Medical migration into the UK: some low-dimension analytics

In order to provide some intuition in support of the formal analysis that follows we start with a simplified diagrammatic representation of the interrelationships between health provision, the number of workers treated successfully and so returning to work, and the outputs of two tradable goods. The approach is based on that commonly used in the explanation of 'Rybczynski effects' in the Heckscher-Ohlin-Samuelson[53] (HOS) model following exogenous changes in factor endowments.

The Rybczynski theorem[54] predicts that at constant product prices, and hence constant factor prices, and with factors of production that are perfectly mobile between domestic sectors, an exogenous increase in the endowment of one factor (but not of the other) will lead to an increase in output in the sector using the increased factor more intensively and a decrease in the output of the other sector. An important corollary is that an exogenous equiproportionate increase in the endowments of both factors will lead to the same proportionate increase in the output of both sectors. Since any increase in both factor endowments can be decomposed into an equiproportionate increase in both endowments and an increase in the endowment of one of the factors, we have the more general result that the output of one sector must increase while the change in the output of the other is in general indeterminate.

Here however we are concerned with changes in factor endowments that are endogenously determined in that the government decides on, and finances, the size of the non-tradable health care sector. An increase in the size of that sector reduces the factor endowments available to the tradables production sectors[55] directly. However it also increases those endowments indirectly via a decrease in the numbers of workers who cannot work due to ill health and so are on the health-care waiting list, leading to a range of possible outcomes. A further complication is that most of the skilled workers in the health sector have health-specific skills that take time to acquire and are not readily transferable to other domestic sectors. This implies that in the short term the health sector can only expand by using more unskilled labour or by recruiting

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53 Characterised by the assumptions of two goods, two factors that are perfectly mobile within each country but immobile between countries, perfect competition and constant returns to scale.

54 Rybczynski (1955).

55 In the simple model used here these are an export good and an import good.

skilled workers with health-specific skills from other countries. In this case the standard 'Rybczynski effects' predicted by the HOS model must be modified, and the analysis becomes closer to that of the Specific Factors model.

The diagrammatic analysis starts with the specification of an initial equilibrium, using the standard 'factor endowment box' diagram. It next considers the two ways of expanding the output of the health sector in the short term identified above: first by increasing the employment of unskilled labour with no change in the use of skilled labour, and then by recruiting immigrant skilled labour (with an accompanying increase in the use of unskilled labour).

Finally it examines the effects of increasing the supply of domestic skilled (and unskilled) workers to the health sector (in the absence of immigrant skilled workers), which implies the possibility of a reduction in the skilled workers available to the tradables sectors.[56] It is probable that a high proportion of the skilled workers in the health sector have health-specific skills, and that there are few skilled workers in the tradables sectors who possess those skills. Thus such an expansion is likely to be feasible only in the longer term (i.e. existing skilled domestic workers who do not have health-specific skills would have to be taught those skills before they could enter the health sector). For simplicity we assume here that *all* skilled workers in the health sector have sector-specific skills.

The diagrammatic analysis is useful in identifying the varied effects of different ways of expanding of the health sector on the effective endowments of labour and the outputs of the other production sectors. However it is limited in that there are a number of possible cases, consideration of which would require multiple diagrams. Moreover, it does not cast any light on induced changes in the welfare of those able to work or of the population as a whole. To remedy this the final sections use the standard 'Jones' analysis to derive formally the changes in sectoral outputs in a more general setting and to identify the changes in the per capita income both of those in employment and of the population as a whole.

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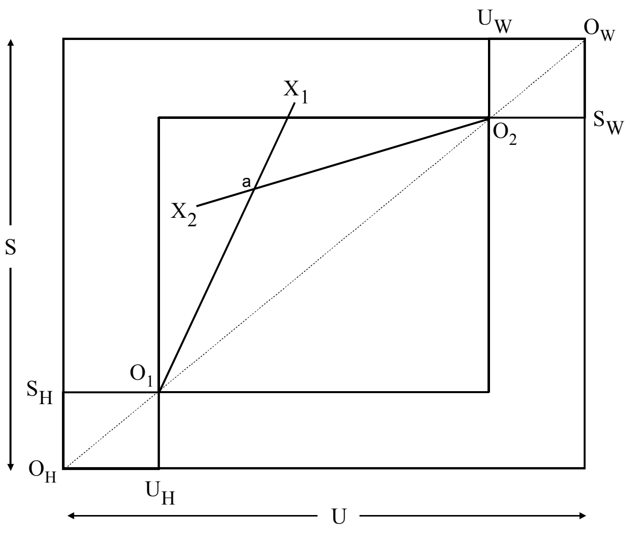
[56] We assume that only skilled workers can be given health-specific skills. This reduces directly the supply of skilled workers to the tradables sectors, but will lead to an reduction in the number of skilled workers who are unable to work because of ill health.

A possible initial equilibrium

Figure 4 shows a 'factor endowment box', identified by the south-west and north-east corners O_H and O_W respectively. The vertical and horizontal dimensions measure the total endowments of skilled labour (S) and unskilled labour (U) respectively. Inputs of skilled and unskilled labour to the health sector are measured from O_H, and the numbers of skilled and unskilled workers unable to work (on the 'waiting list' for health care) are measured from O_W. The skilled and unskilled workers available to work in the tradables sectors 1 and 2 are thus shown by the dimensions of the inner factor box, identified by the south-west and north-east corners, O_1 and O_2 respectively. Labour inputs to tradables sector 1 are measured from O_1 and those to tradables sector 2 from O_2.

For simplicity it is assumed that at the given factor prices[57] the health sector has the same skill intensity as the economy, and that the incidence of illness, the provision of treatment and the responsiveness to that treatment are identical for all workers. Thus the north-east corner of the 'health box' and the south-west corner of the 'waiting list box' lie on the diagonal of the total endowment box, O_HO_W.

Figure 4: An initial equilibrium



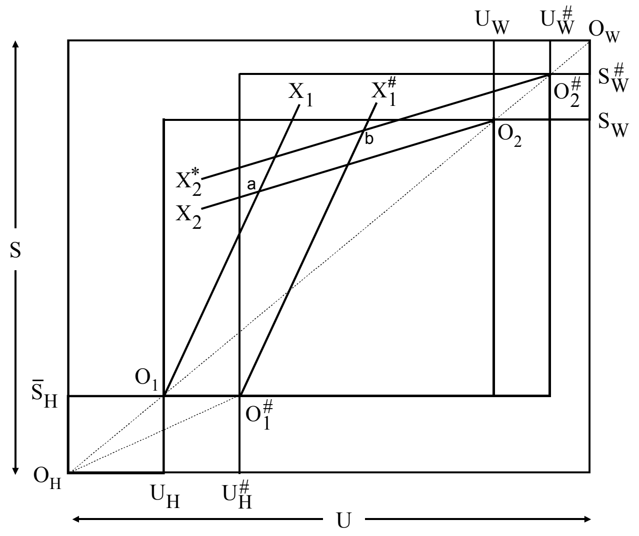
[57] In the tradables sectors in a small open economy (i.e. one trading at given commodity prices) the wages of skilled and unskilled labour are uniquely determined. The health sector employs unskilled labour that could work in the tradables sectors and so receives the same wage. This then determines the wage of the health-specific skilled workers (the standard result for a small open economy with a non-tradables sector).

In the initial equilibrium numbers S_H and U_H of skilled and unskilled labour respectively are employed in the health sector. These provide a health output that treats ill workers to the extent that numbers S_W and U_W of skilled and unskilled labour remain on the waiting list and hence are unable to work. Thus the numbers of skilled and unskilled labour available to work in the tradables sectors are $S_T = S\text{-}S_H\text{-}S_W$ and $U_T = U\text{-}U_H\text{-}U_W$ respectively, these being the dimensions of the factor box defined by O_1 and O_2. The given relative factor prices determine the skill intensities in the two tradables sectors (sector 1 being the more skill-intensive), and the intersection of the rays O_1X_1 and O_2X_2 at point a determines the full employment outputs of sectors 1 and 2.

Expanding the health sector using only unskilled domestic workers

Figure 5 illustrates the effects of an expansion of the health sector using only domestic unskilled workers (the endowment of health-specific skilled workers remaining at $\overline{S}_H$). The employment of unskilled workers increases from U_H to $U_H^{\#}$, so that the health sector's factor box is now that defined by O_H and $O_1^{\#}$. The additional health provision reduces the numbers of skilled and unskilled workers on the waiting list from S_W and U_W to $S_W^{\#}$ and $U_W^{\#}$. The supply of skilled workers to the tradables sectors necessarily increases (by $S_W^{\#}\text{-}S_W$), but the supply of unskilled workers to those sectors rises if $U_W^{\#}\text{-}U_W$ is greater than $U_H^{\#}\text{-}U_H$ and falls otherwise.

Figure 5: An expansion of the health sector using only domestic unskilled workers



The factor box for the tradables sectors is now that defined by $O_1^{\#}$ and $O_2^{\#}$, and the new tradables equilibrium is at point b. Given the assumption that the incidence of illness, the provision of treatment and the responsiveness to that treatment are identical for all workers, the output of sector 1 necessarily increases. The output of sector 2 will decrease unless the growth in the supply of unskilled workers to the tradables sectors is large enough to overcome the reduction effect of the expansion of the supply of skilled workers.[58] These results depend on, inter alia, the 'efficiency' of the health sector in treating and curing workers who are on the health care waiting list. For example, a neutral improvement in health sector technology will further increase the output of sector 1 and reduce the likelihood of a decrease in sector 2 output. The increase in the ratio of unskilled to skilled workers in the health sector implies that the marginal product of the skilled workers increases, and so their real wage also increases.

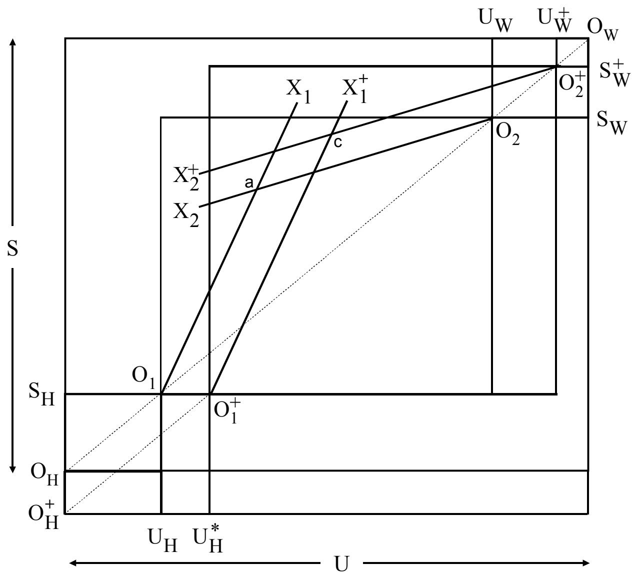
Expanding the health sector by importing workers with health-specific skills

The alternative short-term method of expanding the health sector is to recruit workers with equivalent health-specific skills from other countries. This increases the vertical

[58] If the increase in the supply of unskilled workers is less than or equal to zero then the output of sector 2 necessarily falls. If the proportionate increases in the supplies of both types of worker are the same then the outputs of both sectors increase by that proportion. Thus there must be some increase in the supply of unskilled workers that leaves sector 2 output unchanged.

dimension of the economy's factor box, which is shown in Figure 6 by extending its vertical dimension downwards. If the immigrant skilled workers are paid the same wage as their domestic counterparts then the skill intensity in the health sector will be unchanged. Figure 6 has been drawn on the assumption that the recruitment of skilled workers is that which will result in the same increase in the employment of unskilled workers in the health sector as in the previous case (i.e. $U_H^*-U_H=U_H^{\#}-U_H$). The increase in the employment of skilled workers in the health sector, with the same increase in unskilled labour, increases its output compared to the previous case, and so results in greater reductions in the waiting lists, i.e. $S_W^+<S_W^{\#}$ and $U_W^+<U_W^{\#}$.

Figure 6: An expansion of the health sector using immigrant skilled workers

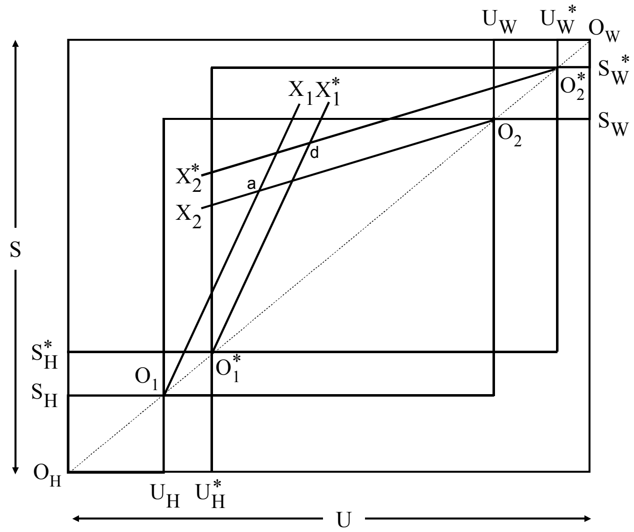


Compared to the previous scenario there is a greater increase in the supply of skilled labour to the tradables sectors, and a smaller fall (greater rise) in that of unskilled labour, the new factor box for the tradables sectors now being that defined by O_1^+ and O_2^+, with the new equilibrium at point c. Thus the output of sector 1 will increase by more than previously, while that of sector 2 will fall by less (or increase by more). The expansion of the health sector by recruiting immigrant skilled workers thus has favourable implications for the outputs of the two tradables sectors compared to an expansion using only the additional unskilled workers.[59]

Expanding the health sector by using more skilled and unskilled domestic workers

Figure 7 shows the consequences of an expansion of the health sector using both domestic skilled and unskilled workers but no immigrant labour with health-specific skills. To facilitate comparison with the health sector expansion using immigrant skilled labour the expansion of the health service is the same: the size of the increase in skilled labour, S_H^*-S_H, is the same as the importation of immigrant skilled labour, and the increase in the use of unskilled labour is again U_H^*-U_H. This implies that the reductions in the waiting lists are the same, i.e. S_W-S_W^* and U_W-U_W^* in Figure 7 equal S_W-S_W^+ and U_W-U_W^+ in Figure 6. The direct reductions in workers available to the tradables sectors due to the expansion of the health sector are S_H^*-S_H and U_H^*-U_H. However, the number of workers on the waiting list falls, so that the offsetting increases in the workers available to the tradables sectors are S_W-S_W^* and U_W-U_W^*.

Figure 7: An expansion of the health sector using domestic workers



59 Note that if wages of domestic health-specific workers are not maintained at pre-immigration levels, the numbers of unskilled workers employed in the health sector vs. the tradables sectors and hence sectoral outputs depend on the elasticity of substitution between health-specific skilled and unskilled labour in the health sector.

Whether the net change in the supply of workers to the tradables sectors is positive or negative again depends on the ‘efficiency’ of the health sector. In the case shown in Figure 7 the increase in the supply of skilled and unskilled workers due to successful treatment is lower than the increase in the employment of skilled and unskilled workers in the health sector, so that there is a net (and equiproportional) fall in the supply of workers to the tradables sectors, and thus their outputs fall, the new equilibrium being at point d. If the health sector were sufficiently more efficient in treating both types of workers then the supply of workers to the tradables sectors would increase, and thus so would their outputs.[60]

Abandoning the simplifying assumption that the skill-intensity of the health sector is identical to skilled-unskilled national endowment ratio complicates the analysis, but reference to the standard Rybczynski results gives us some insight. For example, if the health sector is more skill-intensive than that assumed then an expansion of that sector will reduce the skilled-unskilled ratio of the workers available to the tradables sectors. This will reduce the size of the skill-intensive sector 1 and increase the size of the other sector relative to that shown in Figure 7.

The Heckscher-Ohlin-Samuelson model

The full employment conditions for the two factors are

$$S_H + S_1 + S_2 = S_E = S - S_W \tag{4.1}$$

$$U_H + U_1 + U_2 = U_E = U - U_W \tag{4.2}$$

where S_E and U_E are the effective endowments of skilled and unskilled labour. The amount of factor k used in producing one unit of output in sector i, a_{ki}, is determined by the ratio of the given wages, w_S for skilled labour, w_U for unskilled labour. If the outputs of the three sectors are X_i, $i = H,1,2$, then we may write (4.1) and (4.2) as

$$a_{SH} \cdot X_H + a_{S1} \cdot X_1 + a_{S2} \cdot X_2 = S_E = S - S_W \tag{4.3}$$

60 There is an increase in the supply of skilled (unskilled) workers to the tradables sectors if $S_W^* + S_H^* < S_W + S_H$ ($U_W^* + U_H^* < U_W + U_H$).

$$a_{UH} \cdot X_H + a_{U1} \cdot X_1 + a_{U2} \cdot X_2 = U_E = U - U_W \quad (4.4)$$

Total differentiation of (4.3) yields

$$da_{SH} \cdot X_H + a_{SH} \cdot dX_H + da_{S1} \cdot X_1 + a_{S1} \cdot dX_1 + da_{S2} \cdot X_2 + a_{S2} \cdot dX_2 = dS_E$$

Since the country is, by assumption, small w_S and w_U are exogenously determined, and thus so are factor intensities, so that $da_{SH} = da_{S1} = da_{S2} = 0$, implying

$$a_{SH} \cdot dX_H + a_{S1} \cdot dX_1 + a_{S2} \cdot dX_2 = dS_E \quad (4.5)$$

which may be written as

$$a_{SH} \cdot X_H \cdot \frac{dX_H}{X_H} + a_{S1} \cdot X_1 \cdot \frac{dX_1}{X_1} + a_{S2} \cdot X_2 \cdot \frac{dX_2}{X_2} = S_E \cdot \frac{dS_E}{S_E}$$

Dividing through by S_E and writing the share of the effective endowment of skilled labour used in sector i as $\lambda_{Si} = a_{Si} \cdot X_1 / S_E$,[61] and $\hat{X}_i = dX_i / X_i$ then gives

$$\lambda_{SH} \cdot \hat{X}_H + \lambda_{S1} \cdot \hat{X}_1 + \lambda_{S2} \cdot \hat{X}_2 = \hat{S}_E \quad (4.6)$$

Applying the same approach to unskilled labour gives

$$\lambda_{UH} \cdot \hat{X}_H + \lambda_{U1} \cdot \hat{X}_1 + \lambda_{U2} \cdot \hat{X}_2 = \hat{U}_E \quad (4.7)$$

Suppose that the government finances the provision of health care via a lump-sum transfer, T, from the representative household. The cost of health care provision is given by the product of the number of units of health delivered and the cost per unit:

$$T = p_H \cdot X_H \quad (4.8)$$

where p_H is determined by the unit cost of provision:

$$p_H = w_S \cdot a_{SH} + w_U \cdot a_{UH} \quad (4.9)$$

A change in health care expenditure implies that $\hat{T} = \hat{p}_H + \hat{X}_H$, but with exogenously determined wages $\hat{p}_H = 0$ so that $\hat{X}_H = \hat{T}$. We can now rewrite (4.6) and (4.7) as

61 $\sum_{i=H,1,2} \lambda_{Si} = 1$

$$\lambda_{S1} \cdot \hat{X}_1 + \lambda_{S2} \cdot \hat{X}_2 = \hat{S}_E - \lambda_{SH} \cdot \hat{T} \tag{4.10}$$

$$\lambda_{U1} \cdot \hat{X}_1 + \lambda_{U2} \cdot \hat{X}_2 = \hat{U}_E - \lambda_{UH} \cdot \hat{T} \tag{4.11}$$

Solving these gives

$$\hat{X}_1 = \frac{1}{|\lambda|}\left(\lambda_{U2} \cdot \hat{S}_E - \lambda_{S2} \cdot \hat{U}_E\right) + \left(\lambda_{UH} \cdot \lambda_{S2} - \lambda_{SH} \cdot \lambda_{U2}\right) \cdot \frac{\hat{T}}{|\lambda|} \tag{4.12}$$

$$\hat{X}_2 = \frac{1}{|\lambda|}\left(\lambda_{S1} \cdot \hat{U}_E - \lambda_{U1} \cdot \hat{S}_E\right) - \left(\lambda_{S1} \cdot \lambda_{UH} - \lambda_{SH} \cdot \lambda_{U1}\right) \cdot \frac{\hat{T}}{|\lambda|} \tag{4.13}$$

where $|\lambda| = \lambda_{S1} \cdot \lambda_{U2} - \lambda_{S2} \cdot \lambda_{U1} > 0$ under the assumption that sector 1 is skill-intensive relative to sector 2.

Changes in the health budget will lead to changes in the waiting list for skilled labour and thus in its effective (able to work) endowment. Since $S_E = S - S_W$ and the overall skill endowment is fixed ($dS = 0$) we have $dS_E = -dS_W$ as a consequence of a change in health output of dX_H, i.e.

$$dS_E = -\frac{\partial S_W}{\partial X_H} \cdot dX_H = \left(-\frac{\partial S_W}{\partial X_H} \cdot \frac{X_H}{S_W}\right) \cdot \frac{dX_H}{X_H} \cdot S_W$$

where the term in parentheses is the elasticity of the skilled labour waiting list with respect to health output, ε_H^S. Dividing though by S_E allows us to write the proportionate change $\hat{S}_E$ as

$$\hat{S}_E = \varepsilon_H^S \cdot \delta_{SW} \cdot \hat{X}_H \tag{4.14}$$

where $\delta_{SW} = S_W / S_E > 0$ is the ratio of skilled labour on the waiting list to the effective skilled labour endowment, which may be interpreted as the 'dependency ratio' for skilled labour.

Similarly we may write the proportionate change in the effective endowment of unskilled labour following a change in health output as

$$\hat{U}_E = \varepsilon_H^U \cdot \delta_{UW} \cdot \hat{X}_H \tag{4.15}$$

where ε_H^S is the elasticity of the unskilled labour waiting list with respect to health output and $\delta_{UW} = U_W / U_E > 0$ is the 'dependency ratio' for unskilled labour. Remembering that $\hat{X}_H = \hat{T}$ we may rewrite (4.12) and (4.13) as

$$\hat{X}_1 = \left(\lambda_{U2} \cdot \varepsilon_H^S \cdot \delta_{SW} - \lambda_{S2} \cdot \varepsilon_H^U \cdot \delta_{UW} + \lambda_{UH} \cdot \lambda_{S2} - \lambda_{SH} \cdot \lambda_{U2}\right) \cdot \frac{\hat{T}}{|\lambda|} \tag{4.16}$$

$$\hat{X}_2 = \left(\lambda_{S1} \cdot \varepsilon_H^U \cdot \delta_{UW} - \lambda_{U1} \cdot \varepsilon_H^S \cdot \delta_{SW} - \lambda_{S1} \cdot \lambda_{UH} + \lambda_{SH} \cdot \lambda_{U1}\right) \cdot \frac{\hat{T}}{|\lambda|} \tag{4.17}$$

There are many possible combinations of the factor intensities λ_{ki}, the waiting list elasticities ε_H^k and the dependency ratios δ_{kW}. For simplicity we focus on the outcome when skilled and unskilled labour are homogenous in health status in that $\varepsilon_H^S = \varepsilon_H^U = \varepsilon$ and $\delta_{SW} = \delta_{UW} = \delta$, so that (4.16) and (4.17) become

$$\hat{X}_1 = \left[(\lambda_{U2} - \lambda_{S2}) \cdot \delta \cdot \varepsilon + (\lambda_{UH} \cdot \lambda_{S2} - \lambda_{SH} \cdot \lambda_{U2}) \right] \cdot \frac{\hat{T}}{|\lambda|} \tag{4.18}$$

$$\hat{X}_2 = \left[(\lambda_{S1} - \lambda_{U1}) \cdot \varepsilon \cdot \delta - (\lambda_{S1} \cdot \lambda_{UH} - \lambda_{SH} \cdot \lambda_{U1}) \right] \cdot \frac{\hat{T}}{|\lambda|} \tag{4.19}$$

The first terms in these expressions represent the scale effects of the expansion of the health sector, which depend directly on factor intensities in the tradables sectors.

$$\hat{X}_1^S = (\lambda_{U2} - \lambda_{S2}) \cdot \delta \cdot \varepsilon \cdot \frac{\hat{T}}{|\lambda|} \tag{4.20}$$

$$\hat{X}_2^S = (\lambda_{S1} - \lambda_{U1}) \cdot \varepsilon \cdot \delta \cdot \frac{\hat{T}}{|\lambda|} \tag{4.21}$$

If sector 1 has a skilled/unskilled ratio that is higher than the skilled/unskilled effective endowment ratio then $\lambda_{S1} > \lambda_{U1}$, while if sector 2 has a skilled/unskilled ratio that is lower than the skilled/unskilled effective endowment ratio then $\lambda_{S2} < \lambda_{U2}$.[62] In that case $\hat{X}_1^S > 0$ and $\hat{X}_2^S > 0$. (Note that at least one of the three sectors must have a skilled/unskilled ratio that is higher (lower) than the skilled/unskilled effective endowment ratio.)

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[62] For example, $S_1 / U_1 > S_E / U_E \Rightarrow S_1 / S_E > U_1 / U_E \Rightarrow \lambda_{S1} > \lambda_{U1}$

The second terms represent the factor bias effects:

$$\hat{X}_1^F = (\lambda_{UH} \cdot \lambda_{S2} - \lambda_{SH} \cdot \lambda_{U2}) \cdot \frac{\hat{T}}{|\lambda|} \tag{4.22}$$

$$\hat{X}_2^F = (\lambda_{SH} \cdot \lambda_{U1} - \lambda_{S1} \cdot \lambda_{UH}) \cdot \frac{\hat{T}}{|\lambda|} \tag{4.23}$$

Here the differences in factor intensities between the health sector and the identified tradables sectors play a part. We may rewrite these equations as

$$\hat{X}_1^F = \lambda_{U2} \cdot \lambda_{UH} \cdot \left(\frac{\lambda_{S2}}{\lambda_{U2}} - \frac{\lambda_{SH}}{\lambda_{UH}} \right) \cdot \frac{\hat{T}}{|\lambda|} \tag{4.24}$$

$$\hat{X}_2^F = \lambda_{UH} \cdot \lambda_{U1} \cdot \left(\frac{\lambda_{SH}}{\lambda_{UH}} - \frac{\lambda_{S1}}{\lambda_{U1}} \right) \cdot \frac{\hat{T}}{|\lambda|} \tag{4.25}$$

If $\lambda_{SH}/\lambda_{UH} > \lambda_{S2}/\lambda_{U2}$, i.e. the health sector is more skill-intensive than tradables sector 2, then the factor bias effect will decrease the output of tradables sector 1, and conversely, while if $\lambda_{SH}/\lambda_{UH} > \lambda_{S1}/\lambda_{U1}$, i.e. the health sector is more skill-intensive than tradables sector 1, then the factor bias effect will increase the output of tradables sector 2. (N.B. by assumption sector 1 is more skill-intensive than tradables sector 2.)

Table 8: Scale and factor bias effects in the tradables sectors

	Sector 1			Sector 2		
	Scale effect	Factor bias effect	Net effect	Scale effect	Factor bias effect	Net effect
$s_H > s_E > s_1 > s_2$ [1]	$\hat{X}_1^S > 0$	$\hat{X}_1^F < 0$	+/-	$\hat{X}_2^S < 0$	$\hat{X}_2^F > 0$	-/+
$s_H > s_1 > s_E > s_2$	$\hat{X}_1^S > 0$	$\hat{X}_1^F < 0$	+/-	$\hat{X}_2^S > 0$	$\hat{X}_2^F > 0$	$\hat{X}_2 > 0$
$s_1 > s_E > s_H > s_2$	$\hat{X}_1^S > 0$	$\hat{X}_1^F < 0$	+/-	$\hat{X}_2^S > 0$	$\hat{X}_2^F < 0$	-/+
$s_1 > s_H > s_E > s_2$	$\hat{X}_1^S > 0$	$\hat{X}_1^F < 0$	+/-	$\hat{X}_2^S > 0$	$\hat{X}_2^F < 0$	-/+
$s_1 > s_E > s_2 > s_H$	$\hat{X}_1^S > 0$	$\hat{X}_1^F > 0$	$\hat{X}_1 > 0$	$\hat{X}_2^S > 0$	$\hat{X}_2^F < 0$	-/+
$s_1 > s_2 > s_E > s_H$	$\hat{X}_1^S < 0$	$\hat{X}_1^F > 0$	-/+	$\hat{X}_2^S > 0$	$\hat{X}_2^F < 0$	+/-

[1] where $s_j = S_j / U_j$ for $j = 1, 2, H, E$

The net effect of the factor bias and scale effects in the HOS model with a non-tradable health sector on which endowments are endogenously modelled, depends on the sign and relative size of the factor bias and scale effects. Table 8 shows that the net effects are generally indeterminate depending on the factor intensity rankings. This is where the values of δ and ε come in. For these indeterminate cases the following 'rule' can be discerned: for $\delta \cdot \varepsilon$ 'small enough', i.e. the health sector is relatively inefficient in treating and curing sick workers, factor bias effects will prevail. Otherwise, scale effects will dominate.[63] The former is likely to hold for developed countries since health systems of these countries are generally well-developed and the marginal impact of an increase in the health budget is likely to be small. The latter is likely to hold for many developing countries, since health systems of many of these countries are underdeveloped and still do not reach the majority of (poor) people.

[63] For an illustration of all possible combinations of relative output changes for the first two cases displayed in Table 8 see Rutten (2004).

Furthermore, all cases shown in Table 8 are representative of the long-term, since skilled and unskilled workers are fully mobile. Introducing health-specific skilled workers further complicates the analysis by introducing separate effective endowments, waiting lists and wages for health-specific and other skilled workers respectively. The added complexities obscure the derivation of the Rybczynski theorem (where the health sector expansion would be driven by an increase in the use of domestic unskilled workers) and the derivation of the impacts of the importation of health-specific skilled workers.[64]

Specifically, the prices of health care and health-specific skilled workers become endogenous and three additional parameters appear in the solution values for the proportionate output changes of the tradables sectors: the cost share of health-specific skilled workers, the elasticity of substitution between health-specific skilled workers and unskilled workers in the health sector, and the ratio of unskilled workers employed in the health sector to unskilled workers employed in the tradables sectors. The latter parameter appears as, due to the sector-specificity of skilled workers, the tradables sectors now compete with the non-tradable health sector only in terms of unskilled workers.

Consequently, and in the spirit of the Specific Factors model, an expansion of the health sector initially reduces the supply of unskilled workers remaining for tradables, so that, on the basis of the Rybczynski theorem, the output of the unskilled-intensive good (sector 2) falls and the output of the other good (sector 1) rises (factor bias effects). An assessment of the net effect, i.e. including scale effects, is not so straightforward since the aforementioned parameters cloud the analysis. It is therefore not possible to derive a generic 'rule' or generic 'rules' for the proportionate changes in the outputs of tradables following from an increase in the use of domestic unskilled workers in the health sector in a model more representative of the short-term. The same is true for the derivation of the impacts of using immigrant health-specific skilled workers in the domestic health sector. Combined with the lack of real-life complexities (such as more sectors, factors of production and households, a tax-charging and transfer- and public good-providing government, intermediate inputs

[64] This is not within the scope of this paper. See Rutten (2004).

and welfare gains from health sector provisioning) this provides a strong argument for the use of an applied general equilibrium model.

Welfare changes

Welfare changes are derived for those in employment and of the total population as a whole (including those not able to work due to ill health), using per capita income as a welfare measure.

In the initial equilibrium per capita income, I, of the working population (denoted by E) is:

$$I_E = \frac{w_S S_E + w_U U_E}{S_E + U_E} \tag{4.26}$$

where S_E and U_E denote effective, i.e. able to work, endowments of skilled and unskilled workers respectively.[65]

Total differentiation of equation (4.26), given that $dw_S = dw_U = 0$, yields:

$$dI_E = I_E \left(\frac{w_S dS_E + w_U dU_E}{w_S S_E + w_U U_E} - \frac{dS_E + dU_E}{S_E + U_E} \right) \tag{4.27}$$

so that the proportionate change in per capita income of the working population equals:

$$\hat{I}_E = \left(\frac{w_S S_E \hat{S}_E + w_U U_E \hat{U}_E}{w_S S_E + w_U U_E} - \frac{S_E \hat{S}_E + U_E \hat{U}_E}{S_E + U_E} \right) \tag{4.28}$$

After further manipulation equation (4.28) yields:

$$\hat{I}_E = (\varpi - \gamma)\left(\hat{S}_E - \hat{U}_E\right) \tag{4.29}$$

where $\varpi = w_S S_E / \left(w_S S_E + w_U U_E\right)$ denotes the share of skilled workers in the total income of the working population and $\gamma = S_E / \left(S_E + U_E\right)$ denotes the share of skilled workers in total effective labour supply.

[65] Throughout the analysis it is assumed that all those able to work are in employment.

Developing the expression for $\varpi - \gamma$ yields:

$$\varpi - \gamma = \frac{(w_S - w_U)S_E U_E}{(w_S S_E + w_U U_E)(S_E + U_E)} \tag{4.30}$$

which is positive assuming that $w_S > w_U$, i.e. skilled workers earn a higher wage relative to unskilled workers.

From (4.29), if the health sector is equally efficient in treating and curing skilled and unskilled workers, i.e. $\hat{S}_E = \hat{U}_E > 0$, per capita income of the working population is not affected. Additionally, if the health sector is more efficient in treating and curing skilled (unskilled) workers relative to unskilled (skilled) workers, i.e. $\hat{S}_E > \hat{U}_E > 0$ ($\hat{U}_E > \hat{S}_E > 0$), per capita income of the working population will rise (fall). Thus if the government is solely concerned with maximising per capita income of the working population and sets aside considerations of fairness and well-being, equation (4.29) provides a, rather perverse, argument for targeting government health policy in terms of the provision and quality of treatments to skilled workers only (or worse, to deteriorate the health of the unskilled). [66]

In the initial equilibrium per capita income of the total population, working and not working, is

$$I = \frac{w_S S_E + w_U U_E}{S + U} \tag{4.31}$$

Total differentiation of equation (4.31) yields:

$$dI = \frac{w_S dS_E + w_U dU_E}{S + U} \tag{4.32}$$

so that the proportionate change in per capita income of the population can be derived as:

$$\hat{I} = \varpi \hat{S}_E + (1 - \varpi)\hat{U}_E = \varpi\left(\hat{S}_E - \hat{U}_E\right) + \hat{U}_E \tag{4.33}$$

[66] Note that substituting for effective labour supplies using (4.14) and (4.15) only complicates equation (4.29) and does not add any ‘explanatory power’. This is therefore not done.

Given that the total population does not change (S and U are exogenous), $\hat{I}$ also represents the proportionate change in total income or GDP and, in the absence of intermediate inputs, the proportionate change in the total value of output at world prices.

From equation (4.33) an improvement in health for both worker types, $\hat{S}_E > 0$ and $\hat{U}_E > 0$, generates an increase in per capita income of the population even if the health sector is equally efficient in treating and curing skilled and unskilled workers (i.e. $\hat{S}_E = \hat{U}_E > 0$). Nevertheless, for a given level of health improvement of the unskilled, $\hat{U}_E > 0$, the increase in per capita income will be higher the more the health of skilled workers is improved relative to the health of unskilled workers. Hence, if the government's prime objective is to maximise per capita income of the total population and sets aside considerations of equity and well-being, equation (4.33) suggests a, still rather perverse, policy predicament of targeting treatments towards all skill types, but relatively more to skilled workers.

The above situation is illustrative for the long-term. The introduction of health-specific skilled workers to make the model representative for the short-term, as before, complicates the analysis significantly. The sign of the changes in the per capita income of the working population and the total population is undetermined so that no predictions can be made with respect to these variables when the health sector expansion is accommodated by an increase in unskilled labour only, let alone by an increase in the import of health-specific skilled workers. However, if we abstract from the fact that the health sector treats and cures ill workers, the per capita income changes of the working and the total population have the same sign as that of the change in the wage of health-specific skilled labour, which is negative in the case of recruitment of health-specific workers from abroad and positive in case of using more of (domestic) unskilled workers only.

A final consideration which plays a key role in the determination of the welfare effects is that throughout the analysis it has been assumed that health solely affects income, via its impact on labour market participation. Were we to allow for changes in well-being, i.e. utility gains from improved health following an expansion of the health sector, any of the observed welfare losses become less and if they weigh relatively heavily in the welfare calculations could turn into welfare gains. These and other real-life complexities, such as remittance behaviour of migrant workers, are accounted for in the comparative static CGE model of the UK economy discussed in the next section.

5. Model simulations and results: reducing rationing in UK health care

The model used in this study is a comparative static CGE model of the UK economy. The Social Accounting Matrix (SAM) underlying the model has been constructed by augmenting the UK Input-Output Supply and Use Tables for 2000, using data from the General Household Survey (GHS) for 2000-01. The CGE model has in most respects a standard structure, the novelty coming from the explicit modelling of the health sector, comprising public (NHS) and private health care, and its interaction with the rest of the economy through its differential impact across sectors, factors and household types (specified in Table 9). An outline of the model is given in the appendix, with special detail on health and welfare effects. [67]

Table 9: The CGE model classifications

FACTORS OF PRODUCTION (f)		HOUSEHOLDS (h)	
Skill	Skilled	Hse1	Pensioners
Unsk	Unskilled	Hse2	Non-working, children
Cap	Capital	Hse3	Non-working, no children
		Hse4	Working, children
		Hse5	Working, no children
SECTORS (i) / COMMODITIES (j)			
1.	Primary	7.	Distribution & transport
2.	Pharmaceuticals	8.	Finance
3.	Medical instruments	9.	Public administration & defence
4.	Other manufacturing	10.	Health care
5.	Energy	11.	Other services
6.	Construction		

[67] For more detail on the model and the data see Rutten (2004).

Setting up the model experiments

We employ the model in two types of experiments, both targeted at alleviating rationing in UK health care and both observed in reality. Firstly we examine the impact of importing medical services from abroad, i.e. skilled health personnel, consisting of doctors and nurses (experiment 1). On entering the UK foreign doctors and nurses are assumed to become part of the existing domestic household structure, i.e. they are perfect substitutes for their domestic equivalents. This assumption takes into account that, in the long-term, many of them are planning to stay and will thus become permanent UK households. Furthermore, their wages are maintained at pre-immigration levels so that domestic workers are not worse off as a consequence of the policy. This is a realistic assumption given that wages of health workers in the UK are essentially fixed in bilateral bargaining rounds between the Department of Health (constrained by the Treasury) and the medical profession (represented by, among others, the British Medical Association).[68] However, in order to illustrate the welfare implications of wage protection of the medical profession, we subsequently consider the impact of allowing the wage of migrant health workers to fall. The experiment is carried out using three alternative assumptions regarding the share of foreign worker income remitted abroad, adopting illustrative values of 0%, 50% and 100% respectively. Varying the share of migrant income remitted will have differential welfare implications since remittances have to be compensated for by a rise in exports and/or a fall in imports so as to maintain the balance of payments.

Secondly, we consider the alternative policy of increasing government health expenditures, so that not only more doctors and nurses, but also more of other skilled workers (technicians, managers), unskilled workers (hospital ward assistants, ambulance staff, ancillary workers), capital (electronic machinery, land, buildings) and intermediate inputs (pharmaceuticals and medical instruments) can be bought (Experiment 2).

For the purpose of comparability, we carry out the two experiments so that they will have identical implications for the nominal government budget on health care (i.e. the

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[68] In such an environment the medical profession does simply not accept a wage decline resulting from the import of foreign health workers.

NHS budget). In experiment 1, it is assumed that an equivalent of 10% of the current domestic endowments of doctors and nurses takes up the chance to migrate to the UK, so that the NHS budget has to rise by 12.8% (approximately £6.9 billion) to maintain their wages at the pre-immigration levels in the UK health sector. This budget increase is taken as the point of departure for experiment 2.[69]

Since we expect that alleviating the shortage of health personnel and medical services in general – as evident from, for example, long waiting lists and, relative to other OECD countries, poor health outcomes in some areas – will entail significant health benefits to the population of the UK, we run the experiments in the presence of (positive) health effects. The effects on welfare of higher health provision come through two main channels: (a) the direct gain from increasing the "well-being" of the population, and (b) the indirect effects of an increase in the size of the effective (i.e. "able to work") endowments of skilled and unskilled labour for use in non-health activities. As best and rather conservative estimates of the indirect health effects, we use elasticity values of 0.06 and 0.09 for skilled and unskilled labour respectively, so that a doubling in their health status (following from a rise in NHS and/or private health care provisioning) will lead to a rise in the effective endowments of skilled and unskilled labour of 6% and 9% respectively.[70]

Before we run the model experiments, we adjust the model specification (as summarised in the appendix) to account for the fact that doctors and nurses are highly-skilled and specific to the health sector, and therefore immobile in the short-run.[71] Doctors and nurses account for approximately 85% of skilled labour employed in health care and earn a fixed wage, whereas the remaining 15% of skilled labour in the model remains mobile and earn a market-clearing wage.

69 Note that the two policy experiments will differ in terms of their real budgetary impact due to differential price effects. In addition, in a setup where, given the NHS budget, wages of doctors and nurses are allowed to fall following immigration, the comparability with a generic NHS budget increase logically breaks down, immigration being essentially costless since the NHS budget does not have to increase to accommodate an increase in NHS provision levels.

70 The indirect health effect is higher for unskilled labour due to the fact that a relatively higher proportion of the unskilled suffer illness, so that the health expenditure's "leverage" is greater for this labour type. See the appendix.

71 This is arguably less or not the case for other health personnel such as managers and ancillary workers. Note that health effects differ for skilled and unskilled labour but are the same across doctors, nurses and other mobile skilled labour types.

Experiment 1: importing doctors and nurses at the current wage

In the absence of remittances abroad the specified rise in the NHS budget (of 12.8%), which is targeted towards the immigration of foreign health care-specific skilled workers, yields a rise in real levels of NHS provisioning of approximately the same amount. The demand for and the domestic production of pharmaceutical products and medical instruments increase by 6.4% and 2.7% respectively. While the wages of the domestic *and* foreign workers of the aforementioned types are sustained at benchmark levels, the costs of intermediate inputs of pharmaceuticals, rents on capital, and so unit costs of health care rise slightly so that private health care contracts (by 0.3%).

The increase in public health care boosts both the health and its participation in the labour market of unskilled labour relative to skilled labour (12.2% relative to 10.5% and 0.9% relative to 0.5% respectively), as unskilled labour is affected primarily by changes in public health care provision, whereas the skilled labour is also affected by changes in private health care provision, which is now more costly and less available.

The changes in (effective) factor supplies and sectoral factor demands result in a (minor) fall in wages of mobile skilled and unskilled labour, whereas capital rents rise slightly. Despite this fall in wages, the increase in labour market participation ensures that all households' income from labour rises. Although government income from tax revenue rises, the NHS budget expands by more so that the government has to reduce state benefits to households (by 4.8%). Taking into account that the increase in NHS provisioning (and other public goods) in itself constitutes a welfare gain, the expansion yields welfare gains for all households except pensioners, who lose by 0.3%. Non-working households with and without children gain by 0.2% and 0.1% respectively, whereas working households with and without children gain by 0.8% and 1.1% respectively. In total, welfare rises by £5.678 billion (a gain of 0.6% relative to the original level of welfare).

Accounting for remittances abroad reduces (increases) the previously observed income and welfare gains (losses) for households so that overall welfare gains fall to a level of £4.733 billion (0.5% in relative terms) and £3.787 (0.4% in relative terms) respectively when 50% or 100% of migrant income is remitted.

If the government does not maintain the wages of doctors and nurses at pre-immigration levels, NHS (and private health care) provision levels increase by approximately 4.4% at the given NHS budget and in the absence of remittances. This is made possible by a fall in wages of doctors and nurses of 12.8%, yielding a fall in unit costs of health provisioning by approximately 4.2%.[72] Despite the fall in wages, the increase in labour market participation ensures that, with the exception of the original domestic doctors and nurses in the UK, the income of all households from labour rises. Government transfers to households in the form of state benefits now also increase given the rise in government tax revenues, since NHS provision levels expand by less. Consequently, all households experience welfare gains, with pensioners and non-working households now benefiting relatively more compared to the working households (gains in the range of 0.5%-1% for the former compared to 0.3%-0.4% for the latter). In total, welfare rises by £3.892 billion in the absence of remittances (a gain of 0.4% in relative terms), which is less than if the government would protect the wages of doctors and nurses. This counterintuitive result can be explained from the fact that NHS provision levels expand by less if wages of doctors and nurses are not sustained, yielding lower indirect welfare gains from increased effective, i.e. "able to work", labour endowments.[73] Hence, in a second best environment in which health care provision is rationed at too low a level from a social welfare point of view, wage protection following the immigration of foreign health workers is welfare-improving.

The changes in household and overall welfare are shown in Table 10 and Figure 8 for each of the remittance and wage scenarios.

Experiment 2: a generic increase in the NHS budget

A 12.8% increase in the NHS budget leads to a rise in real levels of NHS provisioning of only 8% and, via input-output linkages, increases the demand for and domestic production of pharmaceutical products and medical instruments by 3.8% and 1.6% respectively. The remainder of the NHS budget is spent on higher wages of doctors

[72] Slight differences in percentage changes can be explained from rounding errors.
[73] If indirect welfare effects from improved health on effective labour supplies would be absent, overall welfare gains are actually higher (by £333 million or 0.04% in the absence of remittances).

and nurses, showing increases of 13.3%, which results in higher unit costs and hence a contraction in private care of 4.5%.[74]

As before, the increase in public health care improves the health and participation in the labour market of unskilled labour relative to skilled labour (7.4% relative to 5.8% and 0.6% relative to 0.3% respectively), as the former is affected primarily by changes in public health care, whereas the latter also responds to changes in private health care provision, which is more costly and less available.

Again, the changes in (effective) factor supplies and sectoral factor demands result in a (minor) fall in wages of mobile skilled and unskilled labour, whereas capital rents rise slightly. Despite this fall in wages, the increase in labour market participation ensures that the income from labour rises for all households.

While experiments 1 and 2 have equal nominal NHS budget implications (assuming that in the former the wages of doctors and nurses are maintained at pre-immigration levels), the income from state benefits fall by relatively more (5.3%) compared to experiment 1 since government tax revenue is lower. Consequently, household welfare falls for pensioners and non-working households (in the range of 0.6% to 0.9%) and rises for working households (in the range of 0.4% to 0.8%). In total, welfare increases by £1.770 billion (a gain of 0.2% relative to the original level of welfare).

The total welfare gains are lower than those observed in experiment 1, even when migrant workers remit all income. This result can be explained as a consequence of the immigration of doctors and nurses in the first experiment addressing the bottleneck of the scarcity of this type of labour in the UK, while increasing the NHS budget in the second experiment aggravates it (by putting upward pressure on the wages of doctors and nurses).

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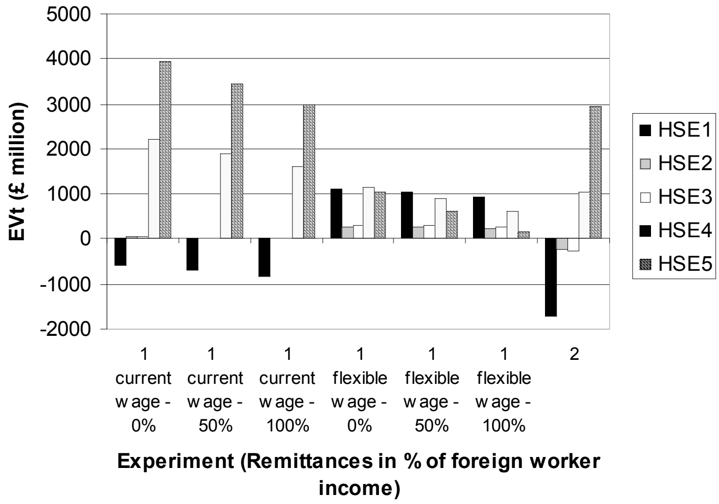
74 Note that if all skilled labour was perfectly mobile, NHS production would increase by 12.8% and private health care would contract only slightly, by 0.4%. Total welfare would increase by £3.033 billion, a relative gain of 0.3%. The presence of health care-specific skilled labour thus constrains the production expansion of health care and related sectors, the health of the population and effective labour supplies and so yields lower overall welfare gains, cutting total welfare gains by 42%.

Table 10: Welfare changes measured by Equivalent Variation

Experiment	Remittances	Welfare changes (EVT)	HSE1	HSE2	HSE3	HSE4	HSE5	Overall
1. 10% immigration of doctors and nurses at current wage (12.8% increase in NHS budget)	0%	Millions £	-572	47	50	2211	3942	5678
		%	-0.27	0.18	0.11	0.75	1.07	0.60
	50%	Millions £	-695	32	31	1906	3459	4733
		%	-0.33	0.12	0.07	0.65	0.94	0.50
	100%	Millions £	-818	16	12	1602	2975	3787
		%	-0.38	0.06	0.03	0.55	0.81	0.40
1. 10% immigration of doctors and nurses at current NHS budget (wages fall by 12.8%)	0%	Millions £	1127	262	309	1164	1030	3892
		%	0.53	0.98	0.68	0.40	0.28	0.41
	50%	Millions £	1023	249	293	896	602	3064
		%	0.48	0.93	0.64	0.31	0.16	0.32
	100%	Millions £	920	237	278	629	174	2236
		%	0.43	0.88	0.61	0.21	0.05	0.24
2. Generic rise in NHS budget (12.8%)		Millions £	-1710	-228	-266	1042	2932	1770
		%	-0.80	-0.85	-0.58	0.36	0.79	0.19

Figure 8: Changes in household welfare



Sensitivity analyses

Sensitivity analyses for the elasticities of substitution and transformation show that the results of the counterfactual simulations are relatively robust: although sign changes do occur for some variables, the impact of changing the respective elasticities upon overall welfare is negligible.

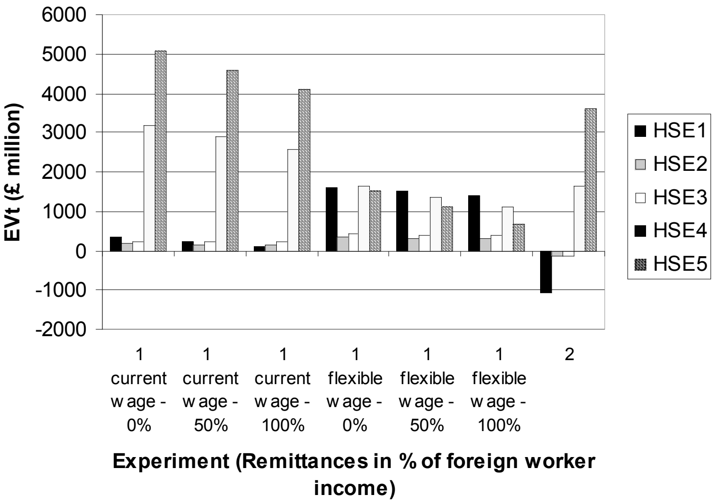
Varying the health elasticities for skilled and unskilled labour, which govern the indirect health effects of improved health on effective labour supplies, does however affect the results considerably: generally, in the presence of increasingly strong health effects for both skilled and unskilled labour, the expansion of NHS care, while drawing away resources from other sectors, yields substantial welfare gains in the long-run through increases in effective labour supply and production, and by enhancing the tax revenue of the government, which in turn benefits both working households (in terms of their wage income) and non-working households (in terms of their receipt of state benefits).

Table 11 and Figure 9 report the results of our experiments when we double the health elasticities for skilled and unskilled labour. Comparison with Table 10 and Figure 8 reveals that, given the incidence of illness, if the health sector is twice as efficient in 'producing' healthy workers, overall welfare gains increase in the range of 60% to 90% for immigration at the current wage, in the range of 40% to 70% for immigration at the current NHS budget, and by 110% for a generic increase of the NHS budget. Further, apart from the latter policy experiment, all households now benefit from the policies implemented.

Table 11: Welfare changes if health sector is twice as efficient in 'producing' healthy workers

Experiment	Remittances	Welfare changes (EV_T)	HSE1	HSE2	HSE3	HSE4	HSE5	Overall
1. 10% immigration of doctors and nurses at current wage (12.8% increase in NHS budget)	0%	Millions £	330	162	239	3180	5086	8997
		%	0.15	0.61	0.52	1.09	1.38	0.95
	50%	Millions £	209	147	221	2877	4604	8058
		%	0.10	0.55	0.48	0.98	1.25	0.85
	100%	Millions £	88	132	202	2574	4121	7117
		%	0.04	0.49	0.44	0.88	1.12	0.75
1. 10% immigration of doctors and nurses at current NHS budget (wages fall by 12.8%)	0%	Millions £	1611	324	409	1622	1534	5499
		%	0.76	1.21	0.89	0.55	0.42	0.58
	50%	Millions £	1511	311	394	1358	1110	4685
		%	0.71	1.16	0.86	0.46	0.30	0.49
	100%	Millions £	1412	299	378	1094	686	3870
		%	0.66	1.12	0.83	0.37	0.19	0.41
2. Generic rise in NHS budget (12.8%)		Millions £	-1060	-146	-133	1652	3604	3917
		%	-0.50	-0.55	-0.29	0.56	0.98	0.41

Figure 9 Changes in household welfare if health sector is twice as efficient



These results suggest that if we were to employ the model for a different country then we could get quite different results, depending on the incidence of illness (which determines the number of people treated by the health sector and so the number of healthy workers that could be produced) and the 'efficiency' of the health sector in producing healthy workers.

At the lower end, welfare gains are guaranteed in experiment 1, even in the absence of health effects,[75] whereas in experiment two welfare rises for relatively low values of the health elasticities (of around 0.01 to 0.02 for skilled and unskilled labour respectively), so that the main results continue to hold.

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[75] Exception: if wages of doctors and nurses are sustained and all migrant income is remitted abroad, a slight (0.003%) decrease in overall welfare is observed.

6. Conclusions

This paper seeks to determine the macro-economic impacts of migration of skilled medical personnel from a receiving country's perspective, taking the UK as an archetype OECD economy that imports medical services.

The contributions of the paper to the existing literature on medical migration are three fold. Firstly, we present evidence regarding migration flows of health workers into the UK and other countries, and migration policies that may be of influence, in a comprehensive manner. Secondly, we use some simple general equilibrium theory to study the effects of an expansion of the health sector, in the long-term driven by an increase in the use of domestic skilled and unskilled labour, and in the short-term driven either by an increase in the use of unskilled labour only, or also by imports of foreign medical skilled workers, since skilled workers in the health sector have health-specific skills that are not easily transferable. The novelty here comes from the use of an approach based on that commonly used in the explanation of 'Rybczynski effects' in the Heckscher-Ohlin-Samuelson model, but now following changes in factor endowments which are endogenously determined by government provision of health care. Finally, we use a static CGE model for the UK, which is able to capture the simultaneous effects of changes in health on effective labour supplies and resource claims made by the health care sector following a change in health provision in two types of policy experiments. Specifically, the policies of importing medical services of foreign skilled workers (doctors and nurses) at the current wage and a generic increase in the NHS budget are contrasted with each other, assuming that doctors and nurses are immobile, i.e. specific to the health sector, and, for the purpose of comparability, that the policies have identical nominal NHS budget implications. In order to illustrate the social welfare implications of wage protection of the medical profession following immigration we also report results of the immigration policy whilst allowing wages of doctors and nurses to fall.

Key findings are that, while the total number of doctors and nurses from overseas has risen dramatically over the last decade, since 2003 total new entries from overseas into the UK are falling, only partially compensated by a rise in entries from the EEA and UK-trained personnel. Nevertheless, still 1 in 3 doctors comes from abroad (mostly from regions other than the EEA and Africa) and approximately 1 in 10 nurses (popular source countries are India, Philippines, Australia and South Africa). The inflow of doctors is relatively large compared to the inflow of nurses when taking into account present "stocks", which, supported by evidence of nurses taking over some of the responsibilities of doctors, suggests that doctors in the UK are in relatively short supply. Relative to the US, the UK is an important recruiter of nurses worldwide, especially when accounting for their size-difference.

While the slowdown in overseas medical migration could be a consequence of the UK's Code of Practice, we expect international medical migration to be facilitated by progress in GATS Mode 4 negotiations.

From a diagrammatic analysis, the impact of an expanding health sector using only unskilled workers available in the short-run, and assuming homogeneity in illness and health and a skill-intensity of the health sector identical to the skilled-unskilled national endowment ratio, yields a rise in the output of the skill-intensive good, and a fall in output of the unskilled-intensive good unless the health sector is very 'efficient' in treating and curing workers. The alternative short-term method of expanding the health sector by recruiting foreign workers with health-specific skills, assuming that they are paid the same wage and assuming an identical increase in employment of unskilled workers in the health sector as in the previous case, increases outputs of the two tradables sectors by more and thus compares favourably. Would the government be able to recruit health-specific skilled workers on the domestic market, i.e. in the long-run, the supply of workers to the tradables sectors and hence their outputs fall or rise depending on the efficiency of the health sector in treating and curing sick workers. In this context, a more skill-intensive health sector will reduce the size of the skill-intensive sector and increase the size of the other sector.

From a formal derivation of the Rybczynski theorem, the impact of an expanding health sector on the outputs of non-health sectors is more generally shown to depend on the sign and magnitude of the scale effects of increased effective labour supplies and factor-bias effects of changes in the ratio of skilled to unskilled labour. The net effects are generally indeterminate in that they depend on the factor intensity rankings and the 'efficiency' of the health sector in treating and curing sick workers.

Nonetheless, as a general 'rule' the factor bias effects are shown to dominate if the health sector is relatively inefficient in treating and curing people. Such a situation is likely to hold for relatively well-developed health systems, such as that of the UK and other developed countries.

It is not possible to derive a generic 'rule' or generic 'rules' for the net effects on outputs of tradables in a model more representative of the short-term (i.e. accounting for health-specific skilled workers), where an expansion of the health sector can only be accommodated by either an increase in the use of domestic unskilled workers or an increase in the use of imported health-specific skilled workers (and unskilled workers). If one focuses on factor bias effects only, an expansion of the health sector made possible by an increase in the use of unskilled workers yields a contraction of the unskilled-intensive sector and an expansion of the other sector, since the health sector competes with the tradables sectors only in terms unskilled labour.

Similar findings hold for the derivation of the changes in welfare, using per capita income of the working and of the total population as welfare measures. In the long-run and setting aside considerations of equity (fairness) and well-being from improved health, both indicators favour a government policy of targeting the provision and quality of treatments relatively more towards skilled workers. The introduction of health-specific skilled workers to make the model representative of the short-term makes changes in the welfare measures unpredictable. However, if we abstract from the fact that the health sector treats and cures ill workers, the per capita income changes of the working and the total population have the same sign as that of the change in the wage of health-specific skilled labour, which is negative in the case of recruitment of health-specific workers from abroad and positive in case of using more of (domestic) unskilled workers only. However, if changes in well-being, i.e. utility gains from improved health are accounted for, any of the observed welfare losses become less and could turn into welfare gains depending on their relative weight in the welfare measure(s) used.

The theory is useful in that it shows the effects operating in the background. It thereby enables us to interpret the impacts of changes in the provision of health care. Nonetheless, the introduction of characteristics more truthful to reality such as the health-specificity of skills used by workers in the health sector renders outcomes rather unpredictable. This motivates the use of an applied general equilibrium model, which is also able to accommodate other real-life complexities, including more sectors, factors and households, a tax-charging, transfer- and public good-providing government, intermediate inputs and welfare gains from public goods.

On the whole, empirical evidence suggests that the benefits of saving on training costs and tax contributions seems to outweigh costs of social security, unemployment and (small) declines in wages so that migration benefits the industrialised countries such as the UK. This is substantiated by our CGE model results.

Specifically, importing medical services of foreign doctors and nurses yields higher overall welfare gains compared to a generic increase in the NHS budget, even if all foreign worker income is (hypothetically) remitted abroad, since the former policy results in higher government tax revenues. The immigration of doctors and nurses addresses the bottleneck of the scarcity of this type of labour in the UK, while increasing the NHS budget generically aggravates it (by putting upward pressure on the wages of doctors and nurses).

Surprisingly, the protection of wages of doctors and nurses in the UK following an influx of foreign workers yields higher welfare gains compared to a situation where wages would be allowed to fall. This is exemplary of a second best environment created by a rationed health care system such as that of the UK, in which the size of the health sector is too small from a social welfare point of view due to the presence of positive externalities.

In all experiments the increase in the NHS provision levels, while drawing away resources from other non-health related sectors and its private counterpart, yields an overall welfare gain, indirectly through increased worker incomes and directly via increases in population well-being. The sensitivity analyses show that these overall welfare gains are guaranteed, even if the effects of improved health on effective labour supplies are very weak, and rise with increasingly strong indirect health effects. This indicates the importance of the efficiency of the health sector in producing healthy people (workers), which may well differ across countries.

Although we have assumed a balanced government budget in which state benefits adjust, the overall welfare gains allow for compensation of welfare losses of non-working households and in particular pensioners (and UK doctors and nurses if their wages are not protected) should they arise.

The foregoing results do not imply that migration is also a desirable policy given that many migrant workers come from developing countries which need their own educated staff. Another paper will tackle this issue in more detail. Moreover, one may argue that in the long-term, the only sustainable policy which addresses the root cause of the shortage of medical personnel is to increase the number of medical school places in the UK.

Directions for future research should focus on increasing the level of disaggregation in health care in terms of, for example, types of treatments and care (which differ in effectiveness) and in terms of types of health care staff (distinguish managers, doctors, nurses and ancillary staff separately) and equipment to allow for differential elasticities of substitution between them. With respect to migration, the results may differ if we take into account that domestic and migrant workers are (initially) imperfect substitutes, the latter earning a lower wage as they start working in the UK.

References

Ahmad, Omar. B. (2005), "Managing medical migration from poor countries", *British Medical Journal 331: 43-45.*

Aiken, Linda (2005), Professor and Director, Center for Health Outcomes and Policy Research, University of Pennsylvania, "US nurse stock", *Presentation at the Conference on International Nurse Migration*, July 5-10 2005, Bellagio, Italy. Available from: http://www.academyhealth.org/international/nursemigration/aiken.ppt.

Armington, P.S. (1969), "A Theory of Demand for Products Distinguished by Place of Production", *IMF Staff Papers*, Vol. 16, No. 1, pp. 159-176.

Bach, Stephen (2003), "International migration of health workers: Labour and social issues", *Sectoral Activities Programme Working Paper*. Geneva: International Labour Office. Available from: http://www.ilo.org/public/english/dialogue/sector/papers/health/wp209.pdf.

Bach, Stephen (2004), "Migration patterns of physicians and nurses: still the same story?", *Bulletin of the World Health Organization 82(8): 624-625.*

Barham C. and J. Leonard (2002), "Trends and Sources of Data on Sickness Absence", *Labour Market Trends*, Vol. 110, No. 4, pp. 177-185.

Barmby, T.A., M.G. Ercolani and J.G. Treble (2002), "Sickness Absence: An International Comparison", *Economic Journal*, Vol. 112, No. 480, pp. F315-F331.

Barmby, T.A., M.G. Ercolani and J.G. Treble (2003), "Sickness Absence in the UK: 1984-2002", Paper prepared for presentation at The Economic Council of Sweden's Conference *Sickness Absence: Diagnoses and Cures*. Available at: http://www.swan.ac.uk/welmerc/Sickness%20and%20absence.pdf.

Batata, Amber S. (2005), "International nurse recruitment and NHS vacancies: a cross-sectional analysis", *Globalization and Health 1(7)*.

BBC News (2002), *Nurses as good as trainee doctors*, December 6. Available from: http://news.bbc.co.uk/1/2546375.stm.

Benavides, David Díaz (2002), "Trade policies and export of health services: a development perspective", Part II, Chapter 5 in *Trade in Health Services: global, regional and country perspectives*, Vieira, Cesar (ed.). Washington DC: Pan-American Health Organization, Program on Public Policy and Health, Division of Health and Human Development: 53-69.

Bhatnagar, Pradip (2004), "Liberalising the Movement of Natural Persons: A Lost Decade", *The World Economy 27(3)*:459-472.

Buchan, James and Lynn Calman (2004), *The Global Shortage of Registered Nurses: An Overview of Issues and Actions*. Geneva: International Council of Nurses. Available from: http://www.icn.ch/global/shortage.pdf.

Buchan, James and Delanyo Dovlo (2004), *International Recruitment of Health Workers to the UK: A Report for DFID*, London: DFID Health Systems Resource Centre. Available from: http://www.dfidhealthrc.org/shared/know_the/publications.html#dfidrep.

Buchan, James, Mireille Kingma and F. Marilyn Lorenzo (2005), "International migration of nurses: trends and policy implications", *Issue paper 5*. Geneva: International Council of Nurses. Available from: http://www.icn.ch/global/Issue5migration.pdf.

Buchan, James, Tina Parkin and Julie Sochalski (2003), *International nurse mobility: Trends and policy implications*. Geneva: World Health Organization. Available from: http://www.icn.ch/Int_Nurse_mobility%20final.pdf.

Buchan, James and Julie Sochalski (2004), "The migration of nurses: trends and policies", *Bulletin of the World Health Organization 82 (8): 587-594.*

Bundred, Peter E. and Cheryl Levitt (2000), "Medical migration: who are the real losers?", *Lancet 356: 245-46*.

Chikanda, Abel (2004), "Skilled health professionals' migration and its impact on health delivery in Zimbabwe", *Policy and Society Working Paper No. 4*, Centre on Migration, University of Oxford. Available from: http://www.compas.ox.ac.uk/publications/wp-04-04.shtml.

Confederation of British Industry (2001), *Health Care Brief: Business and Health Care for the 21st Century*, December 2001. London: Confederation of British Industry.

Connell, John and Richard P.C. Brown (2004), "The remittances of migrant Tongan and Samoan nurses from Australia", *Human Resources for Health 2(2)*.

Department of Health (2004a), *Staff in the NHS*. London. Available from: http://www.dh.gov.uk/assetRoot/04/10/67/08/04106708.pdf.

Department of Health (2004b), *Code of Practice for the international recruitment of health care professionals*. London. Available from: http://www.dh.gov.uk/assetRoot/04/09/77/34/04097734.pdf.

Department of Health (2005). Proscribed list of developing countries which "should not be targeted for the recruitment of healthcare professionals". Available from: http://www.dh.gov.uk/assetRoot/04/03/46/79/04034679.pdf.

Diallo, Khassoum (2004), "Data on the migration of health-care workers: sources, uses and challenges", *Bulletin of the World Health Organization 82(8): 601-607.*

Dixon, S., S. McDonald and J. Roberts (2002), "The impact of HIV and AIDS on Africa's economic development", *British Medical Journal 324: 232-234*.

Dovlo, Dela and Tim Martineau (2004), "A Review of the Migration of Africa's Health Professionals", *Joint Learning Initiative Working Paper4-4*. Available from: http://www.globalhealthtrust.org/doc/abstracts/WG4/DovloMartineauFINAL.pdf.

Eastwood, J.B., R.E.Conroy, S. Naicker, P.A. West, R.C. Tutt and J. Plange-Rhule (2005), "Loss of health professionals from sub-Saharan Africa: the pivotal role of the UK", *The Lancet 365: 1893-900.*

Emmerson, C., Frayne, C. and A. Goodman (2000), "Pressures in UK Healthcare: Challenges for the NHS", Commentary No. 81. London: Institute for Fiscal Studies.

Folland, S., A.C. Goodman and M. Stano (2001), The Economics of Health and Health Care, Third Edition. Upper Saddle River, N.J.: Prentice Hall.

Forcier, Mélanie Bourassa, Steven Simoens and Antonio Giuffrida (2004), "Impact, regulation and health policy implications of physician migration in OECD countries", *Human Resources for Health 2(12)*.

General Medical Council (2003), *Record number of doctors registered*, Press release August 20. Available from: http://www.gmcpressoffice.org.uk/apps/news/archive/detail.php?key=4.

General Medical Council, *Annual Review 2004/05*. Available from: http://www.gmc-uk.org/publications/annual_reports/annual_review_2004_5.pdf.

Global Commission on International Migration (2005), *Migration in an interconnected world: New directions for action*. Available from: http://www.gcim.org.

Glover, Stephen, Ceri Gott, Anaïs Loizillon, Jonathan Portes, Richard Price, Sarah Spencer, Vasanthi Srinivasan and Carole Willis (2001), "Migration: an economic and social analysis", *RDS Occasional Paper No 67*. London: Home Office. Available from: http://www.homeoffice.gov.uk/rds/pdfs/occ67-migration.pdf.

Hagopian, Amy, Matthew J. Thompson, Meredith Fordyce, Karin E. Johnson, and L. Gary Hart (2004), "The migration of physicians from sub-Saharan Africa to the United States of America: measures of the African brain drain", *Human Resources for Health 2(17)*.

Hamilton, Bob and John Whalley (1984), "Efficiency and Distributional Implications of Global Restrictions on Labour Mobility: Calculations and Policy Implications", *Journal of Development Economics 14 (1-2): 61-75*.

Hilary, John (2001), *The Wrong Model: GATS, trade liberalisation and children's right to health*, London: Save the Children. Available from: http://www.savethechildren.org.uk/scuk_cache/scuk/cache/cmsattach/986_wrongmodel.pdf.

Hilary, John (2002), "Developed countries must say no to trade in medical staff", *British Medical Journal 325: 219.*

House of Commons Hansard, *Written answers for 23 February 2004*. Available from: http://www.publications.parliament.uk/pa/cm200304/cmhansrd/vo040223/text/40223w63.htm#40223w63.html_sbhd2.

Iregui, Ana María (2003), "Efficiency Gains from the Elimination of Global Restrictions on Labour Mobility: An Analysis using a Multiregional CGE Model", *UNU/WIDER Discussion Paper No. 2003/27.* Available from: http://www.wider.unu.edu/publications/dps/dps2003/dp2003-27.pdf.

Johansson, P-O. (1991), An Introduction to Modern Welfare Economics. Cambridge: Cambridge University Press.

Lowell, B. Lindsay and Allan Findlay (2002), "Migration of highly skilled persons from developing countries: impact and policy responses", Synthesis Report, *International Migration Papers 44*, International Migration Branch. Geneva: International Labour Office. Available from: http://www.ilo.org/public/english/protection/migrant/download/imp/imp44.pdf.

Martineau, Tim, Karola Decker and Peter Bundred (2002), *Briefing note on international migration of health professionals: levelling the playing field for developing country health systems*. Liverpool School of Tropical Medicine. Available from: http://www.liv.ac.uk/lstm/research/documents/InternationalMigrationBriefNote.pdf.

Mensah, Kwadwo, Maureen Mackintosh and Leroi Henry (2005), *The 'Skills Drain' of Health Professionals from the Developing World: a Framework for Policy Formulation*, London: Medact. Available from: http://www.medact.org/content/Skills%20drain/Mensah%20et%20al.%202005.pdf.

Moses, Jonathon W. and Bjørn Letnes (2003), "If People were Money: Estimating the Potential Gains from Increased International Migration", *UNU/WIDER Discussion Paper No. 2003/41*. Available from: http://www.wider.unu.edu/publications/dps/dps2003/dp2003-41.pdf.

Moses, Jonathon W. and Bjørn Letnes (2004), "The Economic Costs to International Labor Restrictions: Revisiting the Empirical Discussion", *World Development 32(10)*: 1609-1626.

Mullan, Fitzhugh (2005), Health Affairs and George Washington University, "The Metrics of the Brain Drain: IMGs in the United States, the United Kingdom, Canada and Australia", *Presentation at 2005 Health in Foreign Policy Forum*, February 4 2005, Washington DC. Available from: http://www.academyhealth.org/nhpc/foreignpolicy/mullan.pdf.

Munjanja, Olive Kopolo, Sarah Kibuka and Delanyo Dovlo (2005), "The nursing workforce in sub-Saharan Africa", *Issue paper 7*. Geneva: International Council of Nurses. Available from: http://www.icn.ch/global/Issue7SSA.pdf.

Nursing and Midwifery Council, *Statistical Data 2001-02* to *2004-05*. Available from: http://www.nmc-uk.org/(q4ygrpawrh4mhc55xhzseqq4)/aArticle.aspx?ArticleID=1689.

Padarath, Ashnie, Charlotte Chamberlain, David McCoy, Antoinette Ntuli, Mike Rowson and Rene Loewenson (2004), "Health Personnel in Southern Africa: Confronting maldistribution and brain drain", *Equinet Discussion Paper 3.* Available from: http://www.medact.org/content/health/documents/brain_drain/Padarath%20et%20al.%20-%20Medact-HST-Equient.pdf.

Pang, Tikki, Mary Ann Lansang and Andy Haines (2002), "Brain drain and health professionals", *British Medical Journal 324: 499-500.*

Rutten, Martine (2004), *The Economic Impact of Health Care Provision: A CGE Assessment for the UK.* Ph.D. Thesis, 2004.

Rutten, Martine, Geoffry Reed and Adam Blake (2006), "The Economic Impact of Health Care Provision: A Computable General Equilibrium Assessment of some Policy Options in the UK's NHS", GEP Research Paper 2006 (31), University of Nottingham. Available from: http://www.nottingham.ac.uk/economics/leverhulme/research_papers/06_31.htm.

Rybczynski, T.M. (1955), 'Factor endowment and Relative Commodity Prices', *Economica, 22: 336-41*.

Schiff, Maurice (2005), "Brain Gain: Claims about its Size and Impact on Welfare and Growth Are Greatly Exaggerated", *World Bank Policy Research Working Paper 3708*. Washington DC. Available from:

http://wdsbeta.worldbank.org/external/default/WDSContentServer/IW3P/IB/2005/09/01/000016406_20050901171456/Rendered/PDF/wps3708.pdf

Stilwell, Barbara, Khassoum Diallo, Pascal Zurn, Mario R. Dal Poz, Orvill Adams and James Buchan (2003), "Developing evidence-based ethical policies on the migration of health workers: conceptual and practical challenges", *Human Resources for Health 1(8).*

Stilwell, Barbara, Khassoum Diallo, Pascal Zurn, Marko Vujicic, Orvill Adams and Mario Dal Poz (2004), "Migration of health-care workers from developing countries: strategic approaches to its management", *Bulletin of the World Health Organization 82(8): 595-600.*

Vujicic, Marko, Pascal Zurn, Khassoum Diallo, Orvill Adams and Mario R Dal Poz (2004, "The role of wages in the migration of health care professionals from developing countries", *Human Resources for Health 2(3)*.

Walmsley, Terrie L. and L. Alan Winters (2003), "Relaxing the Restrictions on the Temporary Movement of Natural Persons: A Simulation Analysis", *CEPR Discussion Paper No. 3719*. London: CEPR.

Winters, L. Alan (2003a), "GATS Mode 4: The Temporary Movement of Natural Persons", *Background Paper Prepared for UN Millennium Project International Task Force on Trade*, April 2003. Available from: http://www.ycsg.yale.edu/documents/taskForce_trade_papers.html.

Winters, L. Alan (2003b), "The Economic Implications of Liberalizing Mode 4 Trade", Chapter 4 in *Moving People to Deliver Service*, Mattoo, A. and Carzaniga A. (eds.). Oxford: Oxford University Press: 59-92.

Winters, L. Alan, Terrie L. Walmsley, Zhen Kun Wang and Roman Grynberg (2003a), "Liberalising Temporary Movement of Natural Persons: An Agenda for the Development Round", *The World Economy 26(8)*: 1137-1161.

Winters, L. Alan, Terrie L. Walmsley, Zhen Kun Wang and Roman Grynberg (2003b), "Liberalising Labour Mobility under the GATS, *Economic Paper No. 53*, Commonwealth Secretariat.

World Bank (2005a), *Remittances: development impact and future prospects*, eds. Samuel Munzele Maimbo and Dilip Ratha. Washington DC.

World Bank (2005b), *World Development Report 2005*. Washington DC.

World Bank (2005c), *Global Economic Prospects 2006: economic implications of remittances and migration.* Washington DC.

World Health Organization (2001), *Assessment of Trade in Health Services and GATS: Background Note*. Available from: http://www.who.int/health-services-trade/Background-Briefing-Note.20Dec.doc.

World Health Organization (2002), *Assessment of GATS and trade in health services: an international consultation on monitoring and research priorities*. 9-11 January, Geneva.

World Health Organization (2003), "Harmonization and MDGs: A perspective from Tanzania and Uganda", High-level forum on the health millennium development goals, December 2003. Available from: http://www.who.int/hdp/en/Casestudy.pdf.

World Health Organization (2005), *World Health Report 2005*. Geneva.

World Trade Organization – World Health Organzation (2002), *WTO Agreements and Public Health: A joint study by the WHO and the WTO Secretariat*. Available from: http://www.wto.org/english/news_e/pres02_e/pr310_e.htm.

Appendix – The UK CGE model: health and welfare effects

All sectors are perfectly competitive and multi-product industries. The production technologies are Constant Returns to Scale (CRTS), with production a Leontief function of intermediates and value-added, itself a Cobb Douglas (CD) function of homogeneous factors of production. Household preferences are homothetic, with utility a CD function of consumption and savings. Cross-border trade is treated using the assumption that the UK is a small open economy facing exogenous world prices for imports and exports and accommodates 'entrepôt' trade, i.e. the re-exporting (re-importing) of imported (exported) goods and transport and trade margins. In addition, the Armington assumption (Armington, 1969) is imposed on both production and consumption: goods produced domestically are destined for either the domestic market or for the export market, while consumers differentiate between domestic and imported varieties of the "same" good. Substitution and transformation elasticities are assumed to equal two in this model.[76] The government uses its revenue from employment, production and consumption taxes to finance a fixed expenditure on goods (health care, public administration and defence, and other services) and a fixed amount of foreign exchange at the exchange rate to accommodate the trade surplus. The remainder of its budget is spent on income transfers to households which adjust so as to maintain the government account balance. Households allocate the latter income and earnings from the supply of capital, skilled and unskilled labour to savings and consumption, assuming that only working households save. All factor and product markets clear through price adjustments. Equilibrium in the capital goods market requires that the value of total savings equals the value of total investments. With the exchange rate as numéraire and the trade balance fixed in terms of foreign exchange, investments are savings-driven so that the model closure is neoclassical.

Health provision effects

We model the interaction between health care and effective labour supplies by the use of a non-participation rate for each type of labour. Non-participation can be interpreted as being on the waiting list, whereas participation implies employment in

[76] The majority of goods produced in the UK is traded with similar high-income countries and are of the same high quality so that substitution and transformation elasticities are reasonably high. At the multi-commodity level elasticity values in GTAP version 5 (http://www.gtap.org) are around 2 to 2.5.

one of the sectors of the economy. The effective supply of factor endowments f by households h, FE_{hf}, is specified in equation (A1), and the waiting list for factor f by household h, WL_{hf}, is displayed in equation (A2).

$$FE_{hf} = \overline{F}_{hf} - WL_{hf} \tag{A1}$$

$$WL_{hf} = \eta_f \overline{F}_{hf} \tag{A2}$$

where $0 < \eta_f < 1$ for labour types $f \in l$, $l = \{Skill, Unsk\}$; otherwise (for capital) $\eta_f = 0$. The waiting list is a fraction of total given factor endowments of household h ($\overline{F}_{hf}$), and is defined positively only for labour ($f \in l$) whereas capital is always fully effective and fully employed.[77]

The fraction of people on the waiting list, the non-participation rate, is assumed to be identical across all households and is defined as a constant elasticity function of a health composite:

$$\eta_{f\in l} = \eta_{0f} HC_f^{-\varepsilon_f} \tag{A3}$$

where $\eta_{0f\in l} > 0$ is a scale parameter, which measures the effectiveness of a given level of health care in treating and/or curing people and is calibrated so that $\eta_{f\in l} < 1$.[78] $HC_{f\in l}$ is a health composite and $\varepsilon_{f\in l} > 0$ is the waiting list elasticity, which measures the effectiveness of a change in health provisioning in treating and/or curing people. The latter is defined as the proportionate change in the size of labour type l's waiting list for household h following a change in the health composite, $\varepsilon_{f\in l} = -\left(\partial WL_{hf} / \partial HC_f\right) \cdot \left(HC_f / WL_f\right) > 0$.

The health care composite for labour type l is a measure of the 'healthiness' or health status of this labour type and is a CD function of its public and private health care consumption:

$$HC_{f\in l} = G_{"10"}^{\upsilon_f} \left(\sum_h C_{"10"h}\right)^{(1-\upsilon_f)} \tag{A4}$$

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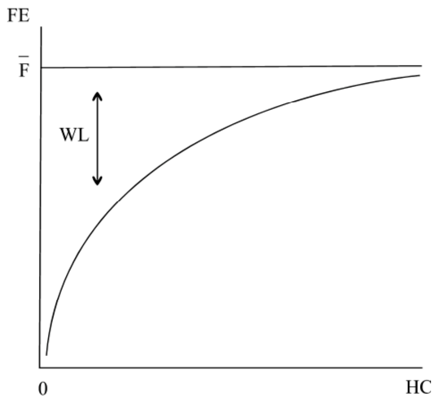
77 This does of course ignore the loss in effective capital when, for instance, machines break down. However, the cost of repairing a machine is internal to the firm, and is assumed to be assimilated into the cost of capital services, whereas the repair (treatment) of ill workers is a cost to the state or to the worker's insurers.

78 Note that $\eta_f \rightarrow 0$ as $HC_f \rightarrow \infty$, but that the upper constraint for η_f is not automatically satisfied. $\eta_{0f\in l}$ also measures the non-participation rate for $\varepsilon_{f\in l} = 0$. Health care is then completely ineffective (i.e. does not cure people) and therefore does not affect waiting lists.

where $0 \le \upsilon_l \le 1$ denotes the share of public health care in the health status of labour type l. $G_{"10"}$ denotes health care (commodity "10" in Table 9) provided via the NHS - as given by real government consumption of health care, G_j - and $\sum_h C_{"10"h}$ represents the level of private health care provisioning - as given by the sum of household consumptions, C_{jh}, of health care.

Given equations (A1) to (A4), waiting lists (effective labour supplies) are decreasing (increasing) in the health composites, at a decreasing rate. Figure A1 illustrates (subscripts are ignored for simplicity).

Figure A1 Waiting lists and effective endowments



The contribution of public health care to the health status of skilled and unskilled labour, as measured by υ, is obtained from Emmerson et al. (2000). Using Family Resource Survey data for the period 1994/1995 to 1997/1998, they calculate the percentage of adults with private medical insurance by social class. By applying population weights corresponding to each social class from the GHS, the proportions of skilled and unskilled labour having private medical insurance are estimated at 16.6% and 4% respectively, yielding a residual of 83.4% and 96% of skilled and unskilled labour for whom health care is financed via the NHS. The latter serve as proxies for υ.

The scale parameter η_0 is calibrated to the benchmark non-participation rate. Its value is based on the Barmby et al. (2002, 2003) measure of sickness absence, calculated as the ratio of the number of hours absent due to sickness to the number of hours contracted to work. Using Labour Force Survey data, the authors find a fairly stable long-run average for the (yearly) sickness absence rate in the UK of around 3.20%.

These and other studies[79] find that sickness absence varies by socio-economic characteristics. Illness-related absence from work is approximately 1.5 times higher for manual than that for non-manual workers. Assuming that the non-participation rate in the base year for unskilled workers is 1.5 times that of skilled workers and postulating an overall non-participation rate of 3.20% yields η_0 = 2.89% for skilled and η_0 = 4.34% for unskilled workers.

The waiting list elasticity parameter, ε, is set to 2 for both labour types, so that a 10% increase in health status leads to a 20% decrease in waiting lists. A value of 2 seems reasonable since it gives health elasticities for skilled and unskilled labour of around 0.1 (0.06 and 0.09 for skilled and unskilled labour respectively), consistent with the scant empirical evidence that exists in this area.[80]

Welfare effects

The effects on welfare of higher health provision are two-fold: it directly increases the "well-being" of the population and indirectly improves welfare by increasing the size of the *effective* (i.e. "able to work") endowments of skilled and unskilled labour for use in non-health activities. Accordingly, changes in household welfare are calculated from private household utility using the Hicksian equivalent variation, to which the benefits from changes in public good provisioning (including NHS care) are added. For linear homogeneous preferences, the equivalent variation for household h can be written as:

$$EV_h = \frac{U_h^1 - U_h^0}{U_h^0} Y_h^0 \qquad \text{(A5)}$$

where U_h and Y_h denote household utility and income respectively, and superscript 0 and 1 respectively refer to the equilibria before and after a particular shock occurs.

79 See for example the Confederation of British Industry (2001) and Barham and Leonard (2002) for an overview.

80 Folland et al. (2001, pp.108-109). These elasticities measure the proportionate change in the size of effective (labour) endowments of skilled and unskilled labour following a change in the health composite, and are calculated as $(\partial FE_{hf} / \partial HC_f)(HC_f / FE_{hf}) = \varepsilon_f WL_{hf} / FE_{hf} = \varepsilon_f \eta_f / (1 - \eta_f)$. The elasticity is higher for unskilled labour due to the fact that a relatively higher proportion of the unskilled suffer illness, so that health expenditure's "leverage" is greater for this labour type.

Assuming that each household receives a share $\alpha_{G_{jh}}$ of the change in the real government consumption of good j (where $0 \le \alpha_{G_{jh}} \le 1, \sum_h \alpha_{G_{jh}} = 1$), the overall change in household welfare becomes:

$$EV_{T_h} = EV_h + \sum_j \alpha_{G_{jh}} \cdot \left(\frac{G_j^1 - G_j^0}{G_j^0} \right) \cdot GEXP_j^0 \qquad \text{(A6)}$$

where $GEXP_j^0$ denotes benchmark government expenditure on good j.[81]

Consequently, overall welfare changes are equal to:

$$EV_T = \sum_h EV_{T_h} \qquad \text{(A7)}$$

Welfare changes related to public good provisioning are allocated to households in proportions $\alpha_{G_{jh}}$, which for health care correspond to each household's share of the total number of NHS general practitioner consultations and for other goods (public administration and defence, and other services respectively) correspond to each household's share in the population. The resulting parameter estimates, including household shares in government transfers, α_{TR_h}, are shown in Table A1.

Table A1 Household shares in government transfers and public goods

Parameter		$\alpha_{G_{jh}}$		
Household type	α_{TR_h}	Public administration and defence	Health care	Other services
Pensioners	0.523	0.176	0.251	0.176
Non-working, children	0.102	0.064	0.087	0.064
Non-working, no children	0.106	0.054	0.076	0.054
Working, children	0.234	0.370	0.306	0.370
Working, no children	0.035	0.336	0.280	0.336

[81] Note that private health care is already included in the utility function and thus in welfare. The current and, for the purpose of this analysis, more appropriate welfare specification postulates that an increase in the provision of public health care (and other goods) constitutes a direct welfare gain. Also, the resulting overall welfare measure, displayed in equation (A7), is equivalent to a social welfare function with equal weights, i.e. a common utilitarian social welfare function (Johansson, 1991, p.32).