Health Care Labour Markets and International Health Worker Migration[i]

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Introduction

Migration has been a vital mechanism equilibrating supply and demand in international health care labour markets. The movement between countries of people with health care skills has been a major force addressing shortages of health care workers in high income countries, it has also filled gaps in low and middle income countries. The largest flows are from low to high income countries but those from low to middle income countries, particularly within Africa and Asia, have also been a feature of international labour markets in recent years.

Migration is impeded by language barriers, restrictions on cross border movements, national regulatory systems (e.g. the recognition of qualifications), and by policies designed to reduce the 'poaching' of highly skilled health care workers by high income countries. Despite such impediments the scale of these flows remains substantial, understanding what motivates them is critical.

Central to understanding migration and mobility is a framework for interpreting the dynamics of labour markets. This chapter reviews concepts central to the economics of the labour market. It looks at the size, scope and dynamics of the health labour market; at key features of both the supply and demand sides of that market and how these may vary by occupation. It outlines how such factors, when set alongside the distinguishing characteristics of health care labour markets, might inform migration policy.

Three theoretical concepts central to labour economics are key to understanding the migration of health care workers, they are; human capital investment and the distinction between general and specific human capital; the production function and the associated concepts of labour complementarity and labour substitution and; pay stickiness. They address respectively, key features of the supply side of the labour market, of the demand side of the labour market and of the market taken as a whole. Before we explore these concepts, we discuss the size and scope of the health care labour market and the central role that migration plays in this market.

The Health Care Labour Market

The size of the market

The labour market for workers who deliver health care is large and international. In 2013, the year for which we have the most recent data, over 43 million people had formal, certified, health care skills (Buchan et.al., 2017). When we include all those working in supporting occupations the number working in health care is considerably larger, in total accounting for around 5 per cent of the paid global workforce. No other industry accounts for such a large part of the global workforce.

The share varies quite substantially between countries. Because health appears to be close to a superior good - the higher an individual's income the more they are willing to spend to improve their health - there is a positive, though far from linear, relationship between the

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share of a countries total employment that is accounted for by the health care workforce and a countries' per capita national income.   In some high income countries the healthcare workforce accounts for almost 20 per cent of the total workforce. In Norway it accounted for over 20 per cent of total civilian employment in 2015 while in Denmark, Sweden and Finland, its share was between 16 and 18 per cent.

Across all OECD countries the average was 10.1 per cent, though in middle-income OECD countries the share was much lower. It was only 5.4 per cent in Greece, 4.0 per cent in Turkey and 2.7 per cent in Mexico in 2015 (OECD, 2017).

The occupational composition of the market

Nurses and midwives are the largest occupational group in the health care workforce accounting for almost half the total and numbering almost 21 million worldwide. Doctors are the second largest group numbering almost 10 million (Buchan et.al., 2017). Associated health professionals - opticians, podiatrists, physiotherapist, pharmacists, emergency service workers, such as ambulance workers, and administrative support staff account for the balance[ii].

High income countries employ large numbers of both nurses and doctors though there are substantial differences in the reliance of health systems on each of these two occupations. This is revealed by data reporting the numbers in these two occupational groups per head of population. Among high income countries Norway has the highest number of nurses and doctors per head of population. In 2015 it employed 173 nurses and 44 doctors per 10,000 population. At the lower end of the range among high income countries, Japan employed 110 nurses and 24 doctors per 10,000, while the USA employed 113 and 26 per 10,000 respectively (OECD, 2017). Across all OECD countries the average was 90 nurses and 34 doctors per 10,000 population (OECD, 2017).

These densities dwarf those of the African region where there were only 11.5 nurses and 2.9 physicians per 10,000 population. In South East Asia there were just over 20 nurses per 10,000 population and close to 10 doctors per 10,000 population (WHO, 2018). In all regions there is substantial variation, because they encompass countries with a substantial differences in average per capita income. In Asia, nurse density ranges from 80 per 10,000 population in the Maldives to 3 per 10,000 in Bangladesh while physician density ranges from nearly 40 per 10,000 population in the Democratic People's Republic of Korea to 4 per 10,000 in Indonesia (WHO 2018). Elsewhere Turkey and Brazil employed, respectively, 20 and 15 nurses per 10,000 population in 2015 and 18 doctors per 10,000 population (OECD, 2017).

A Global Market

The health care labour market is international. In most countries the healthcare workforce comprises locally born and trained staff and large numbers of migrants.

OECD Data for 2010/11 show that in the English-speaking countries of Australia, Canada, and the UK, more than 35% of practicing doctors were born abroad. In Australia, the country with the highest foreign born share, it was 52.8%. In the USA, the country with the largest health care market, the share was 26.4% while the average for 23 OECD countries was 22.2% (OECD, 2015).

Foreign born nurses also account for a large part of the nursing workforce in these same English speaking countries: 14.6% of practising nurses in the USA, were born abroad and the figures for the UK, Canada and Australia were 21.7%, 22.5% and 33.2% respectively.

Several continental European countries also rely on foreign born doctors and nurses to deliver their health care. More than 15% of practicing doctors in France and Germany and 30% in Sweden were born abroad. More than 14% of practising nurses in Germany and Sweden were born abroad. In 22 OECD countries in 2010/11 14.5% of the practising nurse workforce was born abroad.

Still other patterns emerge in high foreign-born worker dependency countries, such as Qatar. WHO data (WHO 2019) reveal that there were substantial flows of doctors to Qatar from other middle-eastern countries, such as Egypt and Syria, and from the UK and India. Pharmacists employed in Qatar came primarily from France and Germany, and nurses from Ghana and Tajikistan.

A Market for Trained Health Workers

The data reveal that the market is for trained health workers. The majority of foreign born doctors and nurses have not trained in the country in which they now work, only a minority migrate to train and stay on to work. WHO report that in 70 countries, across all five continents around 25% of the medical workforce was trained abroad (WHO 2019a) while the OECD record that in 28 countries in 2015, 17% of the medical workforce was trained abroad (OECD 2017). In the English-speaking countries of Australia, Canada, the UK and the USA the OECD report the foreign-trained share of the medical workforce was over 25%, while in Sweden it was 28%, in Norway 38% and in New Zealand above 40%. WHO data record that in some countries in the middle-east almost all the medical workforce is foreign-trained. In Qatar 93% of the medical workforce was foreign-trained, in Saudi Arabia 78%, in Jordan 70% and in Israel nearly 50%.

There is also a substantial international market in trained nurses and in some other health care occupations, such as dentists and pharmacists. In New Zealand and Australia, in particular, 25% and 20%, respectively, of nurses are foreign trained while in the UK 15% are foreign trained (OECD 2015a). WHO report that across a wide range of countries across all five continents nearly 30% of dentists and 25.5% of pharmacists were foreign-trained.

A Unique Labour Market

The labour market for health care workers is one of a number of global occupational markets. The labour market for many, though certainly not all, academic occupations (disciplines) is global as are those for IT specialists, several sports and some fields of finance and management. These global labour markets share a number of characteristics. They have in common that people are drawn into the market from countries spread across the globe - across low, middle and high income countries - to acquire general transferable skills, skills that can be sold on an international stage. In each occupational market demand for the skill is spread across many countries. Each of these markets displays substantial inter-country labour mobility, though in all cases such mobility is far from frictionless for it is inhibited by regulatory restriction and language barriers.

The health care labour market is distinguished from these other global occupational markets by its scope, it embraces all countries as every country employs some health care workers,

and its magnitude, it is the largest global occupational market. Most importantly it is distinguished from these other labour markets by the scale of public investment in general human capital.

A Conceptual Framework

The health care labour market is the market that allocates people with the skills that are required to deliver health care to organisations that require these skills. It coordinates employment decisions; it matches workers to jobs across a very wide range of different organisations and types of jobs in health care. The diversity of these jobs requires a wide range of skills most of which have been acquired through formal training. Occupational titles are used to distinguish the different jobs.

Individuals who are seeking work or who are already working in health care, have chosen this market for it is in this market that they judge they can maximise their utility, they can maximise their happiness. The principal benefit from work is pay, for pay enables them to buy the commodities - the goods, services and time - that produce utility. The higher the pay the greater is utility and thus individuals offer more work at higher pay. For any health care occupation we can represent this in an upward sloping labour supply curve, as in Box 1.

The organisations producing health care require labour. They seek to balance the productivity of labour against the pay they must offer to recruit and retain that labour. This balance results in a downward sloping labour demand curve as in Box 1; we shall discuss the reasons for this in more detail later in the paper when we discuss production functions.

Box 1 therefore presents a graphical conceptualisation of the labour market for a particular, health care occupation. In the following we look at those factors underpinning labour supply and labour demand in health care labour markets that are critical to understanding the prominence of migration, of labour mobility between countries, in this labour market.

Box 1

The Labour Market for a Health Care Occupation
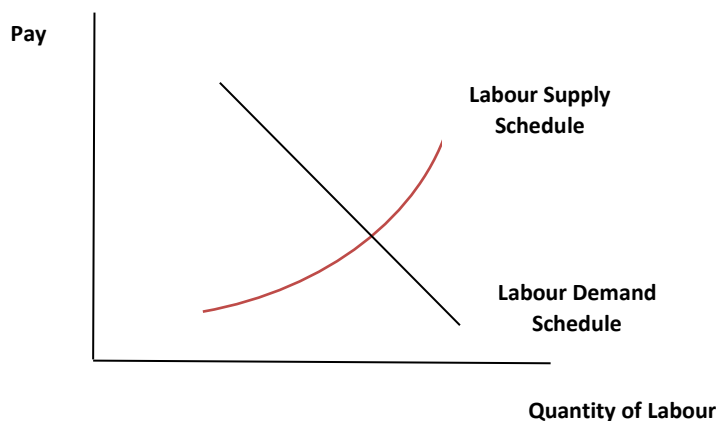
The Supply Side: Investment in Transferable Skills and Migration

The supply side of the health care labour market is distinguished by a highly skilled workforce. Understanding the nature of these skills and the incentives for their creation is central to understanding why migration is such a prominent feature of the global health care labour market.

Training as Investment

Investment produces capital, which is an asset that is expected to produce returns over a period of time. Training constitutes investment, training produces human capital. Investment in human capital incurs costs, outlays of time and money, in the expectation of earning returns on those outlays, benefits, in the future. Costs and benefits are separated in time and since neither can be known with certainty it is their *expected* values that inform these investment decisions.

Economic theory distinguishes between human capital that is general and human capital that is specific. General human capital is transferable, it comprises skills that can be employed equally productively by many employers. Specific human capital comprises skills that are specific to one employer.

The distinction between general and specific human capital and the general and specific training that produces the human capital has implications for who pays for the training. Theory informs us that individuals are expected to bear the costs of general training. Where skills are transferable no employer has an incentive to pay the costs of that training because they cannot be confident of a return on their investment. Once trained, the generally skilled person can transfer to another employer, indeed the employer who has not borne the costs of training can afford to offer higher pay to attract this skilled person. It is only in the rare cases where employers can indenture employees or in other ways 'tie' the trained person to them that they have an incentive to invest in general training. The reverse is the case for specific skills. Now individuals have little incentive to pay for training which is specific to one employer. Their specific training ties them to the one employer and they will likely have little say over the duration of their job with that employer and hence over the time they have to earn a return on their investment.

The skills acquired through training define occupations and the degree of transferability of these skills determines the scope of the occupational labour market. If skills are transferable to employers in several countries, the scope of the market is international. If they are transferable to employers in different sectors of an economy the scope is multi-sectoral.

The market for nurses' skills is both multi-sectoral and international; nursing skills have wide application outside the health sector and internationally. The market for doctors' skills is international but not multi-sectoral - there is little demand for doctors' skills outside the health sector. Where skills are multi-sectoral this also determines the degree of attachment to the health care labour market. Thus, nurses are less attached to the health care labour market than are doctors and it follows that though the initial destination of the migrant with nursing skills may be the health care sector it cannot be presumed to be the ultimate destination.

Migration as Investment

Voluntary migration is also an economic decision and again is conceptualised as an investment, for it involves outlays for expected returns. As for training it requires an evaluation of costs and benefits and since neither can be known with certainty it is again the *expected* values which inform the migration decision. In the case of international migration, it is the expected costs and benefits of moving from one country to another. The expected costs are the pecuniary costs of travel and relocation, the pecuniary outlays during the time taken to obtain licence to practice, and the non-pecuniary costs of severed family and social ties. The expected benefits will take both a pecuniary and a non-pecuniary form; among the former are pay, benefits, and career development opportunities[iii], among the latter working and living conditions.

Some attributes, such as pay, are likely easily discovered but others, working conditions and the residential environment, will be more difficult to identify. Individuals contemplating migration gather information from several sources, attributing different weight to each according to the reliability of the source. Informal networks, friends, family, educators are among the most important sources of information (Price, 2009). The presence of family or friends in the destination country, will likely increase both the quantity and reliability of information. It may also reduce initial transition costs through the provision of accommodation in the destination country. These informal networks are important determinants of migration patterns and result in migration chains.

The magnitude of the costs and benefits will in part depend on whether the migration is intended to be permanent or temporary and whether it is to a first language or foreign language country. There are large flows of temporary migrants between the health care systems of high income, native English-speaking, countries[iv]. Though some of the elements of the cost benefit calculation associated with temporary migration will be the same as those for permanent migration their weighting will be different. Some transaction costs for example the costs of gaining temporary licenses, may be significantly lower.

Household Decision Making

The factors that enter the households evaluation of the costs and benefits of human capital investment and migration, and the weighting of these factors, will differ by household type. They will differ between single and multi-person households and according to the labour market status of household members. Moreover they are affected by the balance of economic power within the household and this has changed in high income countries in recent years. It has become more equally distributed because of the greater labour market attachment and increased earning power of women[v]. The change is likely to be particularly pronounced in health professionals' households which often comprise adults with jobs at similar levels of qualification or professional standing and thus commanding similar earning power.

One consequence of this development is that the relative attractiveness of large urban and smaller, often rural and sometimes remote, labour markets has changed. In multi-person households in which partners have equal labour market attachment and earning power, the choice of labour market location now reflects both partners preferences. Large urban labour markets offer job opportunities to both partners while remote and rural and small urban labour markets are less likely to do so. Attracting permanent migrants to smaller labour

markets has therefore become increasingly difficult. Internal migration flows reflect these developments.

These changes in household composition also have a life-cycle dimension. Much international migration occurs upon completion of training. Completion of training occurs earlier in the life-cycle of a nurse than of a doctor and thus the type of household to which they belong will differ. Different factors are therefore likely to enter the cost-benefit calculations of these two occupations.

Recognising and understanding differences in household composition and type and the life-cycle dimension are important to understanding the patterns of migration of different health care occupations.

Migration and Training

Investment in migration and investment in training, human capital formation, are interconnected. In many low and middle income countries the type of training undertaken is motivated by the opportunities it is perceived to offer for migration; acquiring transferable skills opens up paths to migration. Migration also presents opportunities to earn much higher (private) returns on the prior investment. Local pay levels in low income countries are internationally uncompetitive, and the existence of an international market for trained workers encourages migration. A large part of voluntary migration is motivated by the search for higher, private, returns on prior investment in transferable skills.

Voluntary migration is also motivated by the desire for training. A growing proportion of health care migration is accounted for by people who have moved for this reason[vi]. Flows of migrants can be explained by international differences in the costs of training. Where individuals bear the costs of training, they are likely to seek out lower cost training opportunities. Training cost differences explain an important part of pre-training migration flows. Thus, around half of the foreign trained doctors in Norway were born in the country but chose to pursue their medical studies abroad (OECD 2017, p164), while 80% of Caribbean-trained doctors who applied for US certification to practice between 1995 and 2008 were USA and Canadian nationals (WHO 2019).
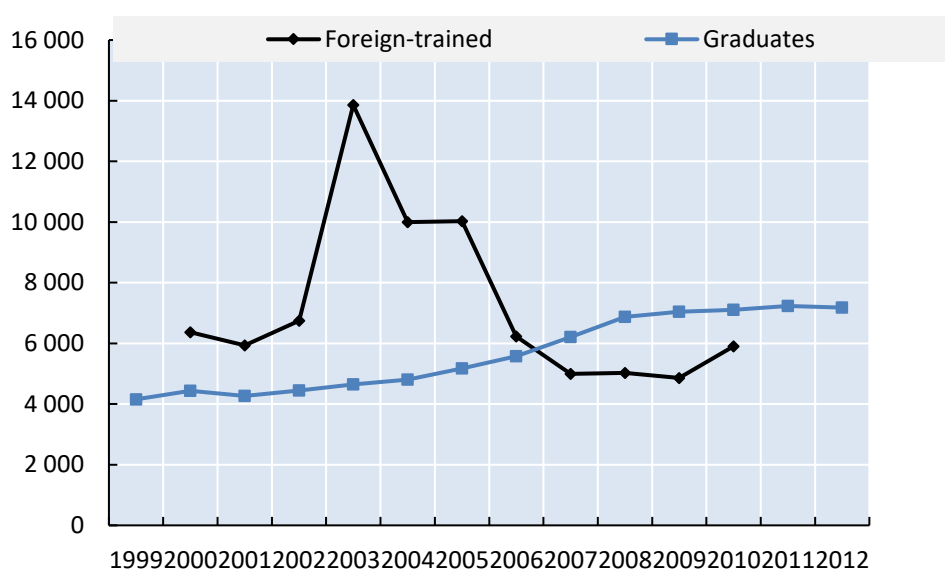
Government Investment in Training

Despite the economic argument against government funding of general training governments around the world continue to fund training in general transferable health care skills. This financial support has been concentrated on medical training. The vast majority of doctors trained in Africa are trained with public funds. Governments throughout Europe devote substantial resource to medical training.

Government support for medical training appears based on the judgement that without government funding few people would invest in medical training. Medical training is very costly and capital markets are imperfect with the result that loans to support this type of human capital investment may be unavailable. Yet it is evident that in most countries the private returns of medical training exceed the outlays required to undertake the training. Moreover low interest rates have reduced the cost of loans and increased the supply of loans as lenders seek profitable lending opportunities. In some countries there is substantial private investment in medical training.

Over the period 1999 to 2012 the UK invested heavily and increasingly in medical training. Over this period the number of medical graduates almost doubled as shown in Box 2. Box 2 also reveals that over this same period the UK depended heavily on foreign born doctors. Dependency on foreign born doctors is a prominent and persistent feature of the UK medical workforce. Structural factors may account for this dependency. In the UK the numbers in training are agreed between representatives of the medical profession and government. Both parties have incentives to reduce numbers in training below those required to balance locally trained supply to demand. Shortages exert upward pressure on pay to the benefit of incumbent medical professionals and reduced numbers in training minimise public outlays on training to the benefit of government. Where the resulting shortages can be addressed through migration the shortfall in numbers in training is without detriment to service delivery.

Box 2

Changes in the Number of Medical Graduates and Registrations of Foreign-trained doctors. UK 1999-2012

Source OECD International Migration Outlook 2015, Chapter 3. Figure 3.22

Government investment in training can also result in cyclical fluctuations in the share of domestically trained workers in the health workforce. Cyclical reductions in public expenditure are frequently accompanied by more severe cuts in training budgets as governments seek to minimise the impact of public expenditure cuts on front-line health services. The impact of such cuts is not immediate and can be mitigated by increased migration when public expenditure cuts are restored.

Governments' support medical training by offering bursaries and scholarships but few extend the same support to other health care occupations. Box 3 illustrates that this support has recently been further reduced in England. Box 3 also illustrates, that while there is no economic case for public funding of general training withdrawing such support, increasing the costs of human capital formation, without any compensating increase in the returns from such investment will reduce numbers in training.

Box 3

> ### English government withdraws support for nurse training
>
> Prior to 2017 student nurses and midwives and a range of other allied health professionals in England (occupational therapists, speech and language therapists, podiatrists, radiographers) did not pay tuition fees and received either non-means-tested or means-tested bursaries and reduced-rate student loans to finance living costs. They were subsidised by government to acquire transferable health skills and this was estimated to cost £800 million. To cap expenditure training places were restricted. Two-thirds of those who applied for a university nursing course were not offered a place.
>
> In 2017 bursaries were replaced by loans to cover tuition fees and maintenance costs. The Department of Health and Social Care stated the changes would give those in training about 25% more financial support while they studied. The change transferred the costs from the state to the individual. The change increased the private costs of acquiring general transferable health care skills.
>
> However, the costs of human capital formation were increased without any compensating increase in the rewards from that investment thereby affecting the cost-benefit calculation. Such a calculation would reveal a reduction in the attractiveness of such investment. All else remaining the same the number of applicants for training places would be expected to fall. In 2018 there was a 17.6% fall in applications to study nursing.

Barriers to mobility

The transferability of skills is determined by the nature of the training, whether it is general or specific. However transferability also requires the absence of barriers to labour mobility. Where there are effective barriers to mobility they transform transferable skills into specific skills.

Barriers to mobility might be judged the necessary counterpart of government investment in general transferable skills, for barriers will increase government's return on their investment. Governments seeking to ensure a return on investment in transferable skills have therefore explored various mechanisms to inhibit mobility. Beyond simple prohibition, governments have introduced periods of required service post training, posting bonds returnable after an agreed period of service and concluding no-poaching agreements with potential recruiters. To date such policies have met with limited success[vii].

Policy Issues

A substantial part of the health care workforce in most high income countries was trained abroad. It appears high income countries are depriving low income countries of the vital skills needed to deliver health services and sequestering the resources used to train these health care workers. Concern about high income countries 'poaching' health care workers from low income countries has motivated the development of the WHO Global Code of Practice on International Recruitment of Health Personnel. The appropriateness of this concern turns on who pays for training health care workers.

There is substantial private investment in the acquisition of health care skills in low and middle income countries. There has been recent growth in the private for-profit industry offering

training in health care skills in several low and middle-income countries (McPake et. al. 2015). The skills acquired through this training are transferable and the global demand for these skills offers a strong incentive for individuals to invest in them. Migration and mobility are the requirements for realising a return on these investments. Where private investment has developed the skills that are now employed in high income countries there should be less concern over poaching.

Governments have also invested heavily in the creation of internationally transferable health care skills. Moreover, they have invested most heavily in those health care occupations in which the pecuniary incentives to migrate are greatest – medical training. These same governments have failed to devise mechanisms which secure a return on their investment. It might thus be concluded that such investment should be reviewed and where retention rates are low part of the resource currently spent on training should be redirected to the design and construction of measures aimed to improve retention and reduce migration.

The introduction of blanket barriers to migration by health care workers is counter-productive. Blanket barriers will reduce private incentives to invest in health care skills and thus reduce human capital formation in low and middle income countries. Moreover, where health care workers from low and middle income countries migrate temporarily and acquire higher skills when abroad they reduce knowledge transfers to low and middle income countries. Intervention requires the careful design of incentives to encourage trained workers to employ their skills in low and middle income countries.

The Demand Side: The Level and Pattern of Labour Demand

Factors on the demand side of the health care market are also key to understanding the drivers of migration. Expenditure on health care is a major component of total spending in high income countries and as a result levels of labour demand in high income countries dramatically exceed those in low income countries. High levels of expenditure on health reflect a diversity of demands for health care and a diversity of production methods to satisfy those demands. The diversity of production methods is accompanied by a diversity of employment opportunities.

The very different labour requirements of high and low income countries mean that the occupational composition of the health workforce differs between these countries. Within high-income countries there are also differences in skill requirements between the primary and secondary care sectors and moreover, the balance between these sectors is changing. These factors on the demand side determine the skills that are required and thus determine patterns of migration.

The Level of Labour Demand

The level of demand for health care and the accompanying demand for health care workers differs very substantially between countries. Though the need for health care is very high in low income countries their levels of GDP mean this cannot be translated into levels of effective demand for health care and health care workers which match those of high income countries. If Burundi, the poorest sub-Saharan country in Africa devoted the same share of national income to health spending as the country with the highest share of health spending, the USA, per capita spending on health would have been $51 in Burundi compared to $10,628 in the

USA in 2018. In fact the latest data available for Burundi show it spent 8% of GDP on health in 2016, a per capita spend of $24[viii].

Spending on health and social care is generally the single largest category of spend out of national income in high income countries. Among countries that are members of the OECD, spending on health and social care averaged 9.0% of GDP in 2016 (OECD, 2017). In that same year the USA spent 17% of national income on health care. In these countries around 60% of the total spend on health care goes on the health care workforce. High income countries feature prominently among destination countries for migrants and low income countries prominently among the origin countries.

In low income countries the share of national income devoted to spending on health care is much smaller. WHO (2019) estimate that in Africa spending on health accounts for 5% of GDP. WHO data also shows that in Sri Lanka, Thailand, India and Bangladesh spending on health accounted for between 3.5% and 3.9% of GDP in 2010. In these countries where spending on drugs and other medical supplies are likely to account for a smaller share of total current spend the percentage of total spend that goes on workforce may well exceed 60%.

## *The Production of Health Care: Health Care Production Functions*

The demand for health care workers derives from the needs of individuals and households for health care services. In most countries these needs are translated by government into the provision of health care services.[ix] Governments decide how much public money to spend on health care and they construct the regulatory and organisational environment within which health services are delivered.

The level of government expenditure on health care is a major determinant of the level of effective demand for health care services and thus of the overall *size* of the health care labour market in most countries. The regulatory and organisational environment determines the way in which health care services are to be produced and by whom. In this way governments determine the types of health care skills required and the *occupational composition* of the health care labour market. Governments are of course not the only influence on either the level of effective demand or the production process. Households and individuals spend on health care and technology is a major driver of the production process.

A production function describes a production process. It details the combinations of inputs, of labour and capital, that will produce different levels of output. In health care the feasible combinations are determined by available technology and what regulations and protocols permit. A distinction is made between production in the long-run and the short-run. The former is a period over which all inputs can be varied, the latter one during which all but one of those inputs, labour, is fixed: thus, in the short-run more output can be produced only by employing more labour.

An example of a production process in healthcare would be radiologists working with MRI scanners to produce completed scans. The short-run production function relating to this process then describes how the output of completed scans changes as the number of hours worked by the team of radiologists working with a given number of MRI scanners changes.
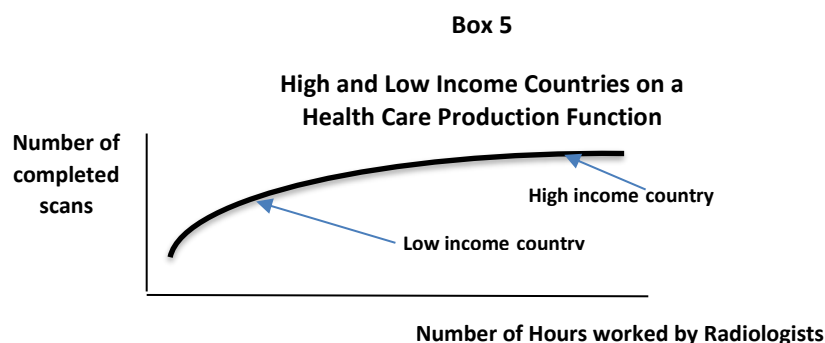
Box 4

A Health Care Production Function

Number of
completed
scans

Number of Hours worked by Radiologists
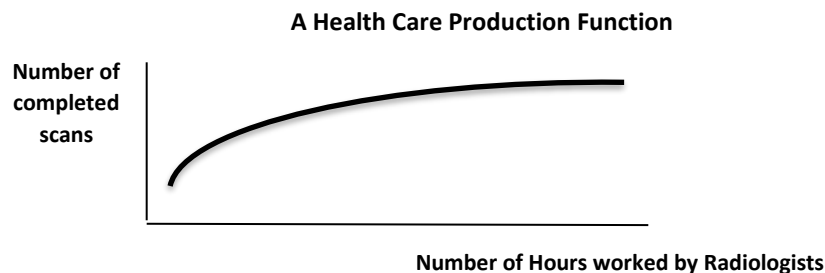
The short-run relationship can be depicted graphically, as in Box 4[x]. Here the number of completed scans increases as the number of hours worked increases throughout the range of hours shown; more input of labour means more output. However an important concept is illustrated; along the curve its' slope is changing and though output continues to increase it does so at a decreasing rate. This is the law of diminishing returns which states that as more units of a variable input are added to a fixed amount of capital the change in total output will first rise and then fall. Another way of expressing this is that beyond some point on the production function the marginal product, the incremental addition to output, declines and thus the productivity of each additional hour, the marginal product of labour, declines.

The production function is therefore central to measuring the productivity of labour. It can be generalised to all health care activities where health benefits can be measured in terms of QALYs or DALYs. The health care production function then describes how the production of health benefits measured in this way increases, in the long run as all inputs are varied and in the short run as only more labour is employed.

The productivity of labour differs according to the point on the production function chosen, it depends upon the scale of activity. Low income countries are likely to exhibit lower levels of activity than high income countries because they are more severely resource constrained. Thus, where low and high income countries are operating on the <u>same</u> production function the point at which the low income country is located will be to the left of the high income country. This is illustrated in Box 5.

Box 5

**High and Low Income Countries on a
Health Care Production Function**

Number of
completed
scans

High income country

Low income country

Number of Hours worked by Radiologists

When the low income country is located to the left of the high income country on any given production function, it is located where the slope of the production function is steeper. Thus,

the productivity of labour is greater in the low income country than in the high income country. It follows that the transfer of a health worker engaged in this production from a low income country to a high income country diminishes global health output, for it detracts more from health output in the low income country than it adds to health output in the high income country. Under these circumstances the transfer of resources should be discouraged.

However, these circumstances will be relatively rare. Because low income countries have less access to capital and drugs, they will in most cases be producing health care using different production functions to high income countries. Low and high income countries are most likely to be operating on similar production functions only in those areas of health care that deal with chronic conditions, such as cancer and COPD, and acute conditions, such as myocardial infarction. For these conditions countries employ almost identical technologies (drugs and medical technologies) and guide practice by similar protocols. However, these conditions account for a minority of health care provision in low income countries.

Moreover, health care needs are often very different. The incidence of such chronic conditions as Alzheimer disease and dementia, diabetes, HIV/AIDS and respiratory diseases differ markedly between countries. Further, low income countries are unlikely to have the resources required to access the same technologies as high income countries and therefore treatment methods and protocols will differ. The result is very substantial differences between high and low income countries in the production functions that produce health care and very substantial differences in the occupational composition of the associated workforce.

The Labour Demand Function

The production function enables us to measure the productivity of labour and as result derive a labour demand function. The conventional derivation of the labour demand function is based on the behavior of a profit maximizing firm. Such a firm will continue to employ labour up to the point at which the incremental value of the output the labour produces is just equal to the pay for that labour: when deciding how much labour to employ the firm must balance the productivity of that labour against the payment for that labour. While this conventional derivation might not appear appropriate to the health care labour market, in which it is typically either government or a not-for-profit provider of health care that is the employer of labour, the central proposition still holds. All organisations must balance productivity against pay.

Government purchasers are limited in terms of budget and for that reason need to economise on or ration the use of resources. When considering health care the usual criteria for determining that rationing is cost-effectiveness. A health maximising government will wish to employ health workers up to the point where their cost is equal to the value it places on the health gains they can produce. The marginal worker will therefore be the one whose contribution to health is valued equal to their pay. In this way the apparatus of conventional labour demand can be translated to a health care setting when there is a government purchaser.

The situation is a little different when considering private not-for-profit providers. These are usually assumed to place some value on health gains produced though the value may differ from the government's valuation. They may also pursue other objectives, including the generation and retention of a surplus (profit) to further their organisational goals. However the basic intuition carries through, although making a different calculation such providers will

also wish to continue employing health workers up to the point where the weighted value of their contributions (to health and other things) just equals to their pay.

Thus, for all types of health care provider a labour demand function can be derived which shows the quantity of labour that is demanded at each price for that labour (the pay for that labour). Because they are operating on that part of the production function along which the marginal product of labour is declining the labour demand function is downward sloping; more hours will only be demanded at lower hourly rates of pay which match the declining marginal productivity of labour[xi].

An example, from the production function in Box 4 is shown in Box 6. This shows the number of hours of work by radiologists that will be demanded by employers of radiologists at different hourly rates of pay for radiologists.

Box 6

The labour Demand Function

Hourly Rate of Pay

Labour Demand Function

Hours Worked by Radiographers
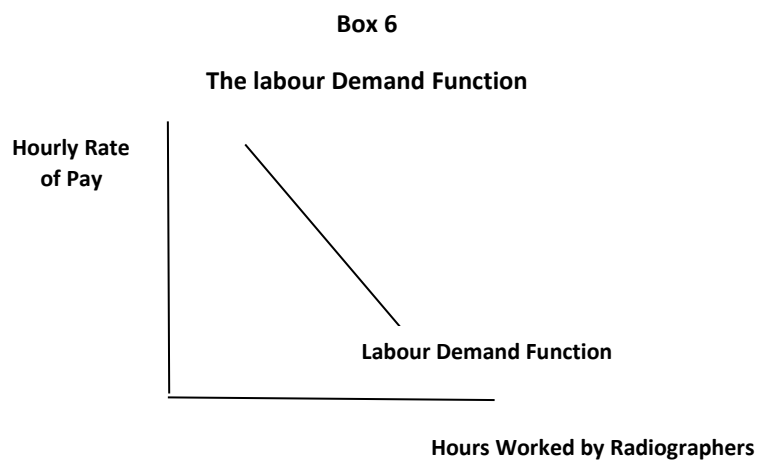
The slope of the labour demand function reflects the responsiveness of quantity demanded to changes in rates of pay. The more responsive is quantity to price – the greater is the change in the quantity demanded for any given change in price – the shallower will be the slope of the labour demand schedule. One of the determinants of slope is the ease with which the work done by one occupation can be done by another; the ease with which tasks can be shifted from one occupation to another, in labour economics terminology, the ease of substitution.

Labour Substitution.

If the production process is such that it is easy to substitute one occupation (occupation A) for another (occupation B) then an increase in the pay of occupation A would be expected to result in a reduction in employment of A and an increase in employment of B in order to sustain output. Thus, the labour demand schedule for occupation A will be very shallowly sloped; any increase in their pay will lead to a large fall in their employment. If, in contrast, it is very difficult to substitute one type of labour for another, if one type of labour is indispensable to the production process, the labour demand schedule will be very steeply sloped: employment will be very insensitive to changes in pay[xii].

Through health care production functions the labour markets for many different health occupations are interconnected. Those for doctors and nurses, in particular, are **complements**

in the production of some health care services and **substitutes** in the production of others. They are complementary in production where a health care procedure can only be effectively delivered when different health care occupations cooperate - an example would be surgery in a hospital operating theatre where the procedure requires that surgeons, nurses and other occupations, such as anaesthetists, work in specified numbers in a team. They are substitutes in production where a task can be performed by more than one occupation, as for example where both nurses and doctors are licensed to undertake certain diagnostic tests or to prescribe medicines[xiii].

Complementarity and substitutability are driven by technology, regulation and custom (norms). Technology defines what is possible, regulation what is permitted and custom what are established but informal ways of doing things. Custom is being rapidly overtaken by protocols, which set out how tasks are to be performed, in what sequence and by whom. Protocols assume many of the characteristics of regulation. Thus, technology and regulation increasingly determine the nature of health care production functions and in so doing the nature of labour demand.

There are important differences between the hospital and primary care sectors in the substitutability and complementarity of health care occupations. This is in part due to differences between the sectors in their production processes, with those in the primary care sector much less capital intensive.

Complementarity in Hospitals. In the secondary sector the different health care occupations work together in teams. The size and composition of these teams is driven by technology, is prescribed by regulations and protocols and, to a decreasing degree, by custom. In consequence team composition, at least in the short run, is fixed and the scope for substituting any single occupation in the team severely limited. The labour demand schedule for each occupation in the team is, while these conditions hold, steeply sloped: the employment of each occupation is insensitive to its own pay rate. This enhances the bargaining power of each occupation during such a period. Moreover, any change in the number in one occupation in the team, should be accompanied by an equi-proportional change in the number in all other occupations in the team. This complementarity between occupations in the hospital sector is seldom recognised when high income countries set targets for immigration of health professionals.

Substitution in Primary Care. In primary health care there is greater fluidity in team composition and greater scope for occupational substitution[xiv]. The labour demand schedules for occupations delivering primary care are thus more shallowly sloped than those for occupations delivering secondary care: employment is much more sensitive to pay change in primary care than in secondary care. One consequence of the greater sensitivity to pay change is that migration will have a greater impact on the employment and pay of domestic health care workers in the primary health care sector.

At the margins where there is scope for substitution new occupations have emerged: Advanced Practice Nurses (APNs) in high income countries and Assistant Medical Officers (AMOs) and Community Health Workers (CHWs) in African and Asian countries. As a result, there are increasing differences between countries in the production functions that produce primary health care.

In high income countries important changes in health care delivery are underway. In many high income countries the balance of care is switching from the secondary to the primary sector (Mossialos et. al. 2016). As a result demand for the specialist medical skills required in the secondary and tertiary sectors is increasing less rapidly (indeed for some it is reducing) than is demand for the more generalist skills required by the primary sector. As the balance in provision of care switches from the secondary to the primary health care sectors the pattern of labour demand in high income countries is changing.

Country Differences in Health Care Production Functions

We have no robust data on the differences in the labour inputs to countries health care production functions. However, at the whole system level it is evident countries combine the inputs required to produce health care in very different ways. One indicator is the proportions of nurses and doctors they employ.

World-wide nurses are employed in the ratio of roughly 2.5 to every doctor while across OECD countries the ratio was 2.8 to 1 in 2015. OECD data are compiled for both high and middle-income countries and they reveal very substantial variation between these two groups. Among a group of high income countries, the ratios are very similar. In Japan it was, 4.6 to 1 in Denmark, 4.5 to 1, in the USA, 4.4 to 1, and in Norway, 3.9 to 1 in 2015. This suggests that among this group of high income countries there may be some degree of consensus about this component of the health care production function.

Yet there are other high income countries in which the nurse to doctor ratio is lower than in the four above. In 2015 it was between 3.0 to 1 and 2.7 to 1 in France, Sweden and the Netherlands, while in Italy it was 1.4 to 1, revealing that even among high income countries there is no 'generally accepted' way of producing health care, no generally employed health care production function.

Moreover, in a number of middle income countries the ratio was lower still. OECD data record that in Greece, Brazil and Turkey the ratio of nurses to doctors was 0.5, 0.8 and 0.9 to 1, respectively, while WHO data record that in China the ratio was 1 to 1. These middle-income countries appear to concentrate their expenditures on doctors. Again, in contrast several low income countries in Asia employ nurses and doctors in ratios that resemble those of high income countries. In Indonesia, Malaysia, Thailand, the Democratic People's Republic of Korea and India the ratio of nurses to doctors exceeds 3 to 1, indeed in Indonesia it was 5.5 to 1 (WHO, 2018).

Policy Issues

Understanding the health care production process is essential for interpreting developments in health care labour markets. Understanding how, technology, regulation and norms, affect health care production functions and the complementarity and/or substitutability between health care occupations is central to interpreting the changing patterns of labour demand in these labour markets. It is central to an understanding of how the relative demand for the different occupations changes as health expenditures change and how this in turn can feed through to the demand for migrants. As countries rebalance care away from the secondary sector toward the primary health care sector understanding these differences in production functions becomes more important. The demand for specialist medical skills required in the secondary sector reduces while that for the more generalist skills of the primary sector increases.

Health care is unlike most other 'commodities' where it is recognised there is a 'best', a single most efficient and therefore most desirable, way of producing output. Countries evidently have very different views about the relative importance of different health care occupations for delivering health care. They have different health care production functions, and associated labour demand schedules and as a result the occupational composition of their health care workforce differs. It is therefore challenging to identify a 'desirable' ratio of health care workers to population. Labour force requirements are best established by aggregating the requirements of the underling production functions.

The Market as a Whole: Migration and Pay Stickiness

Migration is driven by economic factors on both the demand and supply sides of health care labour markets. On the supply side the drivers have been the choices of individuals to invest in human capital that is transferable and in migration that increases the return on this investment. On the demand side the drivers have been the very substantial differences in levels of effective demand and production processes, which have resulted in different skill requirements and pay levels in high and low income countries.

The scale of migration is determined by the balance between labour supply and labour demand in national labour markets, while the occupational composition of migration is determined by the nature of the underlying health care production functions.

In recent years labour demand has significantly outstripped local labour supply in health care labour markets in many high income countries. Migration increases labour supply in destination countries and depletes it in originating countries. It shifts the supply schedules outwards in recipient countries and inwards in originating countries. This is shown for a representative health care occupation in Box 7.

Box 7
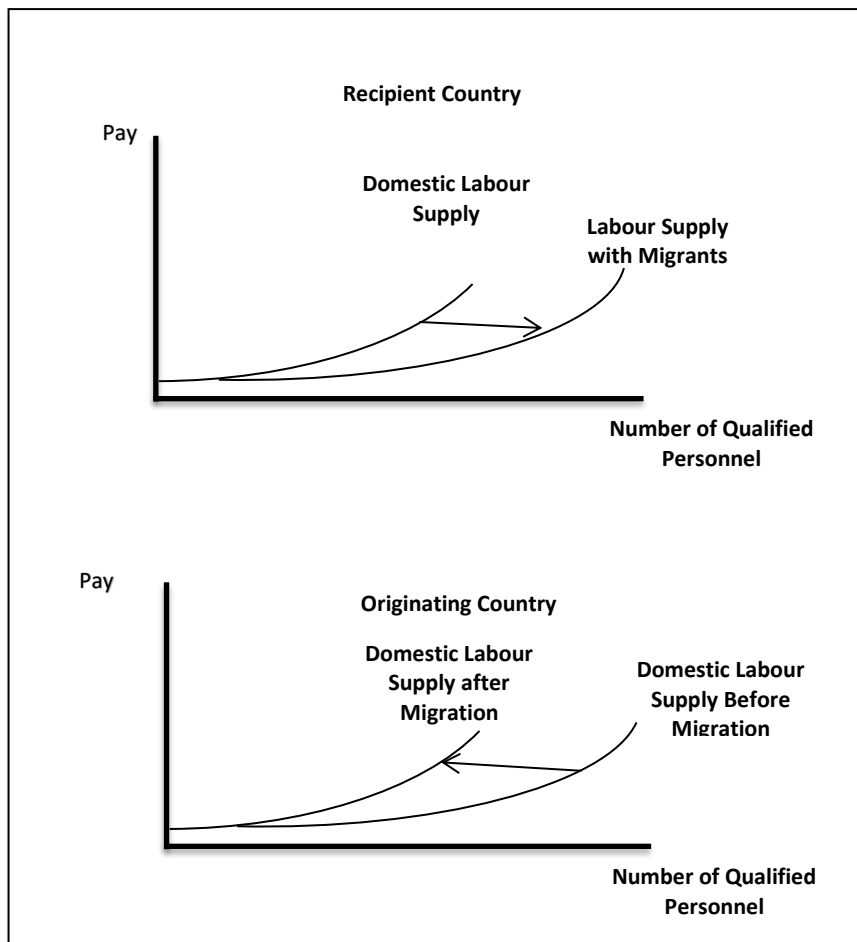
How many migrants are employed in the recipient country depends on both supply and demand. Migration results from an imbalance between domestic labour supply to an occupation and domestic labour demand for that occupation. Putting the supply schedules for the recipient country, depicted in Box 7, together with a labour demand schedule such as that depicted in Box 6, enables us to depict the balance between supply and demand in a representative health care occupation in the recipient country. This is done in Box 8.

At pay level P_1 there is an imbalance between the domestic supply of labour to the occupation and the demand for that occupation, a shortage represented by $Q_2 - Q_1$, prevails[xv]. The magnitude of the labour shortage depends on the position of the labour supply and labour demand schedules. Occupational migration could eliminate the shortage, it could shift the labour supply curve out to the right and balance the supply of labour to the demand for labour at the prevailing Pay rate, P_1.

Pay Stickiness

Box 8 also makes clear that the magnitude of labour 'shortage' depends upon the pay level. If pay had been higher, at P_2, there would have been no shortage; the higher pay would have reduced the demand for labour and increased the domestic supply to the occupation to the point at which supply equalled demand, to the position of equilibrium. Thus, if P_1 is the prevailing pay level, the pay setting arrangements that established pay at P_1, are also part of the explanation for labour shortage and migration. Where pay is flexible and labour markets

frictionless the pay of an occupation will adjust to clear the market. However no occupational labour markets in health care, and indeed few labour markets, conform to this conceptual 'ideal'. Shortages arise because of pay stickiness, pay inflexibility.

Box 8

Migration and Wage Stickiness
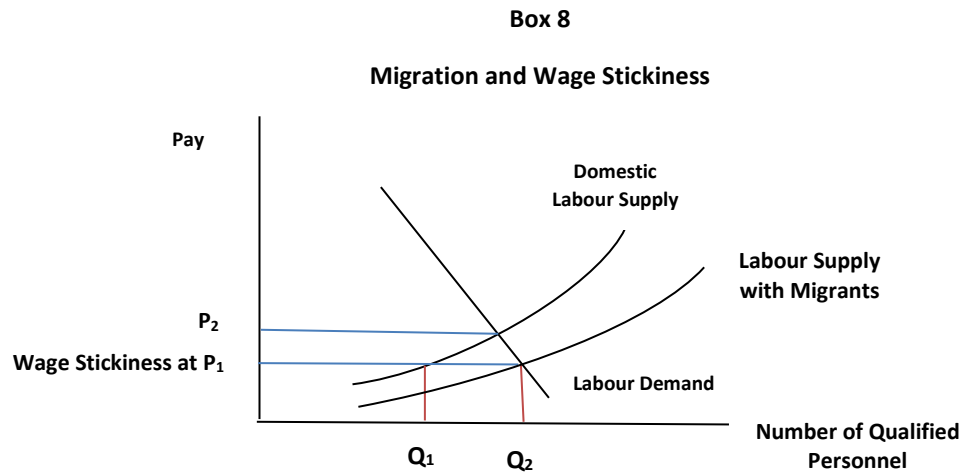
In most health care labour markets occupational pay is set by an administrative process. In many the process involves negotiation, bargaining, between professional bodies and trade unions representing different health care occupations, and their employers: the latter are frequently the government[xvi]. Pay setting takes time and in consequence health care workers pay adjusts slowly; in most high income countries pay is adjusted annually. Further where health care workers are government employees their pay can be subject to restraint when there are restrictions on public expenditure. In these circumstances pay departs further from the market clearing level giving rise to general labour shortages. Health care workers' rates of pay are typically 'sticky' and labour shortages can thus emerge.

Pay Stickiness and Geographical Mismatch

In health care labour markets labour supply and labour demand differ between the areas and regions of a country. On the demand side health care needs and effective demand for labour differ between areas. On the supply side there may be difficulties attracting health care workers to some areas. Persistent regional or local labour shortages are an indication that pay is not matching labour supply to labour demand in all areas of a country.

Mismatch arises because pay structures exhibit too little regional variation and the rates of pay in some areas of the country fail to compensate for the perceived disadvantages of jobs in those areas. These conditions can arise where there is centralised pay setting, also known as national pay bargaining. Under these arrangements the rate of pay for an occupation prevails nationally. Though, typically, such arrangements allow for small regional variation, such as capital city pay premia, this is not sufficient to match labour supply to demand in all areas. These pay setting arrangements are another driver of migration.

The centralised pay setting arrangements for nurses in the UK has been found to undercompensate for the perceived disadvantages of some remote and rural and inner-city areas (Elliott et. al., 2007, and 2010). Attracting family doctors, GPs, to remote and rural areas has also been a persistent challenge for the UK, Australia, the USA[xvii].

Geographical labour shortages that arise because of pay inflexibilities can be addressed through migration. Where the migrant flows are voluntary they reveal that migrants will accept lower compensation for the dis-amenities of an area than will natives. However the migrant flows may also result from the 'direction' of migrants to unattractive areas. The evidence reveals that such directed flows do not offer a permanent solution and therefore that over time migrants come to demand the same compensation for dis-amenities as natives.

Job Matching and Migration

Matching supply to demand requires matching applicants to posts. Assessing and accrediting training and qualifications are central to this process. Determining the appropriateness of a migrant's training involves assessment of both the formal component – certified training – and the informal component - language and caring skills. Assessment is simplified and migration facilitated where standards of training and credentials are the same or very similar in the host and origin countries.

An early example of institutions which enhanced job matching are the medical schools founded by Britain in countries that were once part of the Empire and which are now part of the Commonwealth of Nations. In these countries medical schools were established along similar lines to those in Britain. Academic exchange between these institutions, together with a system of external scrutiny of standards and validation of awards resulted in training to common standards. Instruction in a common language further facilitated a common informal component. These arrangements facilitated the flow of migrants.

The enduring effect of these arrangements is evidenced by the continuing flows of medical professionals between the countries of the Commonwealth. Doctors from Asian Commonwealth countries account for 14% of all doctors employed in the NHS in the UK in 2018[xviii]. Doctors from India and Pakistan featured among the top five countries of origin. Among foreign born nurses India and Jamaica were prominent countries of origin.

More recently the European Commission has sought to facilitate job matching and enhance migration of health professionals between member states, by developing a system for mutual recognition and accreditation of professional qualifications.

The implications for WHO decision making

Health care is a global industry, it is the largest global industry and it employs a large and highly mobile workforce. For that workforce to perform effectively and efficiently the industry must recruit and retain the required skills in the right locations. It must distribute that workforce between countries, and within countries between different localities, in numbers sufficient to meet local variations in health care demand.

Migration plays a central role in balancing labour supply and demand across different countries and within countries. Understanding what motivates individuals to invest in health care skills, to join the health care workforce, and to work in different countries and different areas within countries is therefore an essential requirement for understanding the role of migration in matching supply and demand.

This paper addresses three aspects of this using concepts drawn from labour economics. First on the supply side of the labour market, the role that migration plays in encouraging

investment in health care skills. Second on the demand side, how differences in the way that health care is produced give rise to very different patterns of labour demand in high and low income countries. Third for the labour market as a whole, the impact of pay stickiness arising from pay setting arrangements. From this analysis arise the following conclusions:

- Transferable skills are a central feature of human capital formation in the health care sector. The acquisition of such skills in low income countries has been incentivized by the returns from migration. Restricting migration opportunities may adversely affect human capital formation in the health care sector. Initiatives to support mobility and international recruitment which are based upon ethical principles, such as the WHO Global Code of Practice on the International Recruitment of Health Personnel, must reflect this reality.

- Government subsidies to training in general transferable health care skills may not be cost-effective. Part of the resource currently spent on training might be better redirected to the design and construction of measures aimed to improve retention and reduce migration.

- There appears to be no single, no most efficient and therefore most desirable, way of producing health care. Countries have very different views about the relative importance of different health care occupations for delivering health care. It is therefore challenging to identify the 'right' ratio of health care workers to population. Labour force requirements are best established by aggregating the requirements of the underling production functions.

- Pay setting arrangements in health care labour markets have resulted in 'pay stickiness' and geographical differences in the balance between labour supply and demand. Geographical labour shortages reflect rigidities in spatial rewards and failure to compensate for the unattractiveness of work in certain areas. Reviewing remuneration structures is essential.

References

Bach, Stephen (2010), achieving a self-sufficient workforce? The utilisation of migrant labour in healthcare. In Ruhs, M and Anderson B (eds). Op. cit.

Bärnighausen T and Bloom David E. (2011) "The Global Health Workforce" in Smith P. C. and Glied S. (eds) *The Oxford Handbook of Health Economics*,

Blau, Francine D., (2016) . "Gender, Inequality, and Wages," OUP Catalogue, Oxford University Press, number 9780198779971 edited by Gielen, Anne C. & Zimmermann, Klaus F.

Buchan J, Dhillon I., S. and Campbell J (Eds), (2017), Health Employment and Economic Growth: an evidence base, WHO

Dolea C., Stormont. L., and Braichet, J-M. (2010) Evaluated strategies to increase attraction and retention of health workers in remote and rural areas. Bulletin of the World Health Organisation

Elliott R., and D Bell, A Scott, A Ma and E Roberts,(2007) "Geographically differentiated pay in the labour market for nurses, Journal of Health Economics, Volume 26, 190 – 212.

Elliott R, Matt Sutton, Ada Ma, Diane Skåtun, Alex McConnachie, Stephen Morris and Nigel Rice (2010) "The Role of the Staff MFF in Distributing NHS Funding: taking account of differences in local labour market conditions" Health Economics, Volume 19, May, 532-548

Elliott R., and Scott A., (2004) Programmes and Policies to Redistribute Physicians to High Need Areas: the case of the UK, Paper presented to the 8th International Medical Workforce Conference, Washington, DC, USA.

Elliott, R., F. (2010a) `The utilization of migrant labour in healthcare, a commentary' in Ruhs and Anderson op. cit., 119-123.

Frehywot, S., Mullan, F., Payne, P.W. and Ross, H. (2010) 'Compulsory service programmes for recruiting health workers in remote and rural areas: do they work?', Bulletin of the World Health Organization, 88(5), 364-70.

Grobler L, Marais BJ, Mabunda S. (2015) "Interventions for increasing the proportion of health professionals practising in rural and other underserved areas". Cochrane Database of Systematic Reviews, Issue 6. Art. No.: CD005314. DOI: 10.1002/14651858.CD005314.pub3

Kerry VB, Ndung'u T, Walensky RP, Lee PT, Kayanja VFIB, Bangsberg DR (2011) Managing the Demand for Global Health Education. PLoS Med 8(11): e1001118
https://doi.org/10.1371/journal.pmed.1001118

Makepeace G., and Marcenaro-Gutierrez, O., 2007 The Earnings of Workers Covered by Pay Review Bodies: Evidence from the Labour Force Survey" Manchester School,

McPake B., Squires A., Mahat A. and Araujo E. (2015), The Economics of Health Professional Education and Careers; insights from a literature review. World Bank Group

Mbemba, G., Gagnon, M.P., Pare, G. and Cote, J. (2013) 'Interventions for supporting nurse retention in rural and remote areas: an umbrella review', Human Resources for Health [Electronic Resource], 11(44.

Mossialos, E., Wenzl M., Osborn R. and Sarnak D., (2016), 2015 International Profiles
of Health Care Systems, The Commonwealth Fund, January.

Mullan F., (2005), The Metrics of the Physician Brain Drain, <u>New England Journal of Medicine</u>, 353; 1810 - 1818

OECD (2015), <u>International Migration Outlook 2015</u>, Chapter 3, OECD Paris.

OECD (2015a), Library, <u>Health Statistics</u>, OECD Paris

OECD (2017) <u>Health at a Glance</u>, OECD Paris

Office for National Statistics, (2019) <u>International migration and the healthcare workforce</u>, 15 August

Ozegowski, S. (2013) 'Effective policy mechanisms for an equitable geographical distribution of general practitioners: a qualitative comparative analysis of the accessibility of primary care in Europe', <u>Journal of Health Services & Research Policy,</u> 18(3)**,** 151-9.

Price, S. L., (2009) Becoming a nurse: a meta-study of early professional socialisation and career choice in nursing. <u>Journal of Advance Nursing</u>, 65 (1), 11-19

Ruhs, M and Anderson B (eds) (2010) <u>Who Needs Migrant Workers? Labour shortages and public policy</u>, Oxford, pp 87-118

Scott, A., Witt, J., Humphreys, J., Joyce, C., Kalb, G., Jeon, S.H. and Mcgrail, M. (2013) 'Getting doctors into the bush: general practitioners' preferences for rural location', <u>Social Science & Medicine</u>, 96:33-44.

WHO (2017) update<u>, Global Health Workforce Statistics</u>, Global Health Observatory data repository, World Health Organization, Geneva [http://www.who.int/hrh/statistics/hwfstats/].

WHO (2019) <u>African Health Observatory, World Health Organisation, Geneva</u> http://www.aho.afro.who.int/en/health-financing).

WHO (2019a) <u>International Health Worker Mobility</u>, IOM Migration Health Division Global Training, 16 May 2019

WHO (2018), <u>Decade for health workforce strengthening in the South-East Asia Region 2015–2024: second review of progress.</u>

ENDNOTES

[ii] We have international and comparative data for nurses and doctors but not for the other health care occupations, hence much of what follows will focus on nurses and doctors.

[iii] See Kerry VB, et. Al. 2011

[iv] See OECD 2015 and Mullen 2005. Note some initially classified as temporary becomes permanent.

[v] See Blau, Francine D., 2016

[vi] The OECD record that "the number of medical students pursuing their education abroad has soared in recent years" (p 107, Migration Outlook 2015). They attribute this development to generally increased international student mobility, the internationalisation of medical training and the wider accreditation of skills. all have facilitated such movements, but it also reflects a shifting in the burden of payment for training.

vii See Grobler L, et. al. 2015; Dolea C et. al. 2010; Ozegowski, S. 2013; Mbemba, G.,et.al., 2013; Frehywot, S et. al., 2013 and Elliott R. and Scott A.,2004.

viii The calculations use IMF and World Bank data on per capita income and WHO data on health spending. The spend on health is understood to exclude donor aid spending.

ix In many countries it is hospitals and primary health care units which are charged with recruiting health care workers, they are the agents of government. Where such agents exercise this power recruitment decisions are highly decentralised. Yet in other countries, no such agents exist, and recruitment is still undertaken at a national level.

x The relationship can also be written more formally as follows. Thus, for a process involving both doctors and nurses working with a particular health technology it can be written as follows: $Q_{HC} = f(L_{N,} + L_D + K)$ where Q_{HC} represents the quantity or quality of health care produced, $L_{N,}$ and L_D represent, respectively, the number of nurses and doctors employed and K the quantity of capital, the health technology, with which they work. In each health care setting a different production function will operate and thus in each setting the equation can be given more precise form.

xi The formal derivation of the labour demand function from the production function can be found in most Labour Economics textbooks.

xii Some general rules determine the responsiveness of the demand for an occupation to changes in the pay of that occupation - determine the slope of the labour demand schedule. The steeper the slope the 'better' the position of the occupation, for the steeper slope illustrates that their employment is less sensitive to changes in their pay rates. A steep slope indicates that any increase in their pay will result in a smaller fall in their employment. The slope of the demand schedule for an occupation will be steeper, less sensitive to changes in their pay, the:
(I)   less easy it is to substitute other occupations or inputs for the occupation in question. An occupation can therefore better their position by reducing the ease with which other occupations might take over some of their work. If regulations govern who does what in the medical team, they can better their position by writing these regulations so that substitution is not permitted;
(II)   less responsive to changes in their own (the substitute occupations) pay is the supply of a substitute occupation.
(III)   smaller the share of total costs their pay bill accounts for – the importance of being unimportant.
(IV)   less sensitive to price changes is the demand for the final product they produce.

xiii The degree of substitutability or complementarity will determine how the demand for each health care occupation changes as the pay rates of other health care occupations and health care expenditures change. If two occupations are complements a rise in the pay rates of one occupation that leads to a reduction in the demand for that occupation would also lead to a reduction in the demand for the complementary occupation. A rise in expenditure that results in a rise in demand for one occupation would also lead to an increase in demand for the complementary occupation. If they are substitutes, an increase in the pay of one occupation that leads to a reduction in the demand for that occupation would result in an increase in the demand for the substitute occupation.

xiv Primary care providers are typically reimbursed according to either the number of patients registered for care by the provider (capitation fees) or the number of episodes of care the provider delivers (fee for service). Where payment is on a fee for service basis and the fee is tied to the occupation that delivers the service this type of payment system determines the occupational composition of the primary care workforce, for it prescribes what occupations the primary care provider must employ. In countries where there is no such link and primary health care providers are profit-making organisations the occupational composition of the primary care workforce is fluid. Providers have an incentive to deliver services by the least cost approved method and to employ the least cost occupation approved to do this.

xv Q_2-Q_1 gives the number of job vacancies in the occupation. When standardised by the number employed in the occupation it results in a vacancy rate which allows robust comparison of labour shortages between occupations. In this example the vacancy rate would be calculated by expressing $Q_2-Q_1/0-Q_1$. Most countries report vacancy numbers for some health care occupations, typically nurses and doctors. However I know of no series which brings these together, and reports vacancy rates to allow inter-country comparisons of labour shortages. The availability of such a series would enable the monitoring of changes in the patterns of labour shortages between countries and through time.

xvi There is evidence that at times the pay of doctors in the UK may have been above that required to clear the market, Makepeace and Marcenaro-Gutierrez, 2007.

xvii See Scott et.al. 2013

xviii Office for National Statistics, 2019