In sum, the studies in this category do not provide decisive evidence for monopolistic structures in health care markets. Moreover, none of the studies took consumer benefits into account. It is possible that consumers are better off in a less competitive market than in a more competitive one.[14] For instance, licensure legislation may restrict entry of health workers into the market and at the same time improve the quality of health care. If the outward shift in demand caused by the latter effect exceeds the inward shift in supply caused by the former, consumer welfare will increase. Even if the studies in this category had provided strong evidence for monopolistic structures in health care markets, this evidence would have been insufficient to rule out the possibility that such structures were serving the public interest.

Second category of licensure studies: licensure effects

A second category of licensure studies has investigated the effects of changes in licensure legislation on outcomes in order to establish whether "public interest" or "interest group" explanations of licensure hold true. Outcomes considered in this category of studies included health worker incomes and the price, quality and quantity of health services. A number of studies found that health workers' incomes (G. M. Anderson, Halcoussis, & Lowenberg, 2000; Friedman & Kuznet, 1945; Leffler, 1978; Muzondo & Pazderka, 1980; W. D. White, 1978) or the price of health services and products (Benham & Benham, 1975; Shepard, 1978) increasd when licensure regulations became stricter. The studies inferred from the results that licensure benefited health workers and not consumers. Yet, these studies suffer from the same fundamental weakness that studies investigating the level of competitiveness in the health services market suffer from: Their results do not rule out that the quality-improving effect of licensure legislation has shifted health services demand to such an extent that aggregate consumption and consumer welfare increase despite the supply-restricting effect of the legislation (Svorny, 1987). Hence the results cannot be used to determine whether licensure legislation benefited the public. Two other approaches in this category of studies are better suited for this purpose.

[14] Conversely, lack of evidence of monopolistic structures does not imply that licensure was established to protect the public. As Svorny (1987) points out, "there must have been a one-time gain to practicing physicians when restrictions on practice of medicine were imposed. As in other protected markets, entry may dissipate any rents over time."

First, it is theoretically possible to exclude the possibility that health worker licensure benefited consumers through analysis the quality of health services.[15] If health services quality did not improve in response to licensure regulation, it could be ruled out that the legislation benefited the consumers. (In contrast, if health services quality did improve in response to licensure legislation, additional information would be necessary in order to determine whether the legislation increased consumer welfare, because the quality improvement may or may not have been sufficient in size to compensate for a reduction in consumer welfare due to supply-restricting effects of licensure.)

Three studies investigated the effect of licensure on health service quality. Carroll and Gaston (Carroll & Gaston, 1981) found that some licensure requirements for dentists in the US led to a reduction in the quality of dental services; Feldman and Begun (Feldman & Begun, 1985) found that licensure legislation in the US increased the quality of optometric services; and Haas-Wilson (Haas-Wilson, 1986) did not find any significant effect on optometric service quality of four state restrictions on optometric practice which, if violated, could have led to revocation of optometric license. The three studies have thus come to very different conclusions regarding the effect of licensure on health care quality. More important, it is highly unlikely that the quality measures used in the three studies captured all, or even the most important, dimensions of health services quality. Carroll and Gaston (Carroll & Gaston, 1981) measured quality as waiting time for dental appointments, while Feldman and Begun (Feldman & Begun, 1985) measured it as length and thoroughness of eye exams, and Haas-Wilson (Haas-Wilson, 1986) measured it as the thoroughness of eye exams. The studies thus analyzed the effect of licensure legislation on some specific indicators of process quality, while ignoring other quality dimensions (such as outcome quality). However, in order to rule out the possibility that health worker licensure legislation benefited consumers, information on the effects of licensure on all quality dimensions is necessary.

Second, analysis of the effect of licensure legislation on equilibrium consumption can be used to determine whether consumers benefited from such legislation. If licensure legislation caused an outward shift in the demand for health services that is greater than the inward shift in supply, equilibrium consumption would have increase and consumers would have benefited from the legislation; if, on the other hand, the outward shift in demand were smaller

[15] We use the word 'quality' here to mean all possible dimensions of heath service quality as well as increases in certainty about the level of quality in the market for health services.

than the inward shift in supply, equilibrium consumption would have decreases and consumer welfare would have been reduced.[16]

Svorny (Svorny, 1987) investigated the effect of two particular medical licensure regulations (basic science certification and citizenship) on the consumption of physician services. She found that, controlling for a range of socioeconomic, population, and health system characteristics, more stringent licensure requirements in a US state were associated with lower numbers of physicians per population in the state, and concluded that "the interests of organized medicine dominated those of consumers in influencing the medical regulatory supply process" (Svorny, 1987). Adams, Ekelund and Jackson examined the effect of a range of variables capturing the stringency of midwife licensure and other midwifery regulations on the consumption of the services of certified nurse-midwives (CNM) (Adams 2003). They found that more stringent midwifery regulations in a US state led to lower consumption of midwifery services in the state and concluded that "supply-restricting effects dominated quality assurance in the U.S. market for CNM services" (A. F. Adams, Ekelund, & Jackson, 2003).

Both studies have technical limitations. Svorny (Svorny, 1987) assumed that her outcome variable, physician population density by US state, was a measure of the quantity of physician services consumed in the states. However, it is plausible that physicians in states with lower physician population densities provided on average more services per year than physicians in states with higher densities. The conclusion that licensure decreases equilibrium consumption of health services may thus be wrong. Adams, Ekelund and Jackson (A. F. Adams et al., 2003) controlled for endogeneity between their outcome variable (the quantity of midwife services) and the licensure and regulation variables using a number of instrumental variables. However, the instrumental variables (hospital charges for an uncomplicated vaginal delivery, number of CNM per-capita, physician deliveries as a percentage of total deliveries, total population in the state) may be invalid because they are likely to have affected the outcome variable through many pathways other than the licensure and regulation variables. The coefficients in the instrumental variable regressions may thus be biased.

[16] This identification of the net effect of licensure legislation on consumer benefits is possible because we assume that such legislation never leads to an outward shift in supply. If this assumption were not met, consumer welfare could decrease when equilibrium consumption increases.

In sum, analyses of the licensure effect on health worker income or the price of health services cannot determine whether licensure served the public interest. Analyses of the licensure effect on health service quality can theoretically rule out that licensure benefited the public, but past studies were not able to demonstrate that licensure was in the public interest (and it seems unlikely that future studies will) because of practical difficulties in measuring comprehensively all dimensions of health service quality that can be affected by licensure legislation. The most promising approach within the second category of studies is to evaluate the licensure effect on the quantity of health services. The results of the two studies that used this approach suggest that licensure reduced social welfare, but technical issues diminish the strength of this evidence.

b. Third category of licensure studies: political power

A third category of licensure studies has analyzed the relationship between the political power of health worker interest groups and the passage of licensure legislation and other occupational regulation. Variables used to proxy interest group power were found to be positively associated with passage of licensure legislation for physicians, nurses, dentists, and pharmacists (Stigler, 1971) and physician assistants and psychologists (Graddy, 1991b), as well as the stringency of licensure regulation for dentists (Becker, 1986) and the stringency of other occupational regulation for optometrists (Begun, Crowe, & Feldman, 1981). The authors of these studies interpreted their results as evidence that "interest group" explanations of licensure hold true. However, it is unclear whether the proxy variables they used really measured the political power of health worker interest groups. For instance, Stigler (Stigler, 1971) and Becker (Becker, 1986) used the percentage of an occupation living in urban areas as a measure of political power. As Stigler argued, an occupation that is more concentrated in cities will be more powerful: "When the occupation organizes a campaign to obtain favorable legislation, it incurs expenses in the solicitation of support, and these are higher for a diffused occupation than a concentrated one" (Stigler, 1971). However, the concentration of health workers in cities may not matter for the political power of occupations in countries where most members of the occupation have access to communication technologies, such as mail or telephone, so that political support can be organized independent of physical distance between health workers.

Graddy (Graddy, 1991b) assumed that the political power of health worker groups (physician assistants and psychologists) increases with the ratio of group members "belonging to the

major professional association" to the total number of employed persons, and Begun, Crowe, and Feldman (Begun et al., 1981) assumed that the political power of optometrists increases with the ratio of optometrists to their competitors (ophthalmologists and opticians). However, political power may decrease in these ratios beyond some point. Ceteris paribus, the ratios increased with group size. However, as group size increases, the cost of organizing political support among group members may rise, reducing the group's political power (Peltzman, 1976):

"It is not enough for the successful group to recognize its interests; it must organize to translate this interest into support for the politician who will implement it. This means not only mobilizing its own vote, but contributing resources to the support of the appropriate political party or policy: to finance campaigns, to persuade other voters to support or at least not oppose the policy or candidate, perhaps occasionally to bribe those in office. While there may be some economies of scale in this organization of support and neutralization of opposition, these must be limited. The larger the groups that seeks the transfer, the narrower the base of the opposition and the greater the per-capita stakes that determine the strength of opposition, so lobbying and campaigning costs will rise faster than group size. The cost of overcoming "free riders" will also rise faster than group size."

Note also that a number of variables hypothesized to proxy political power of interest groups in these studies were found not to be associated with licensure legislation and other regulation (for instance "the ratio of the occupation to the total labor force" in Stigler's 1971 study (Stigler, 1971) and "the percentage of optometrists who belong to their state optometry association" and "whether or not the state's optometry association has a legislative lobbyist" in the 1981 study by Begun, Crowe, and Feldman (Begun et al., 1981)). The absence of significant relationships between these variables and occupation regulation suggests that the variables either did not measure political power or that certain dimensions of political power did not influence occupational regulation.

Another problem with the above analysis belonging to the third category of licensure studies is that they did not control for reverse causality, so that their estimates of the effect of political power of interest groups on licensure legislation may be biased. It seems likely that in many cases the introduction of licensure or an increase in licensure stringency will reduce the costs of organizing political support and thus strengthen health workers' political power. Licensed health workers are usually centrally registered (for instance, with a professional

chamber or council) and can thus be easily contacted in a political campaign. In addition, licensure defines the scope of practice of different types of health worker groups, ensuring a certain level of homogeneity of interests within the groups. Furthermore, the more stringent the licensure requirements, the smaller the size of the group of licensed health workers and the easier the political organization of the group.

In sum, while the literature on the relationship between political power of health worker interest groups and licensure suggests that political power does determine licensure legislation – i.e., that "interest group" explanations of the existence of licensure hold true – the studies in this category suffer from a number of limitations. In particular, it is unclear whether the proxy variables for political power chosen in these studies are valid and the analyses failed to control for reverse causality in the relationship between political power and professional licensure.

To sum up, we identify three categories of licensure studies: first, studies examining the level of competitiveness in the market for health services; second, studies analyzing the effect of changes in licensure legislation on health worker incomes or quantity, price, or quality of health services; and third, studies investigating the influence of political power of interest groups on the passage of licensure legislation. While several studies suggest that "interest group" explanation of the existence of licensure hold true, the evidence is not conclusive. Most of the studies we reviewed merely show that health workers have benefited from licensure legislation (studies in the first and second category) or that health worker groups have had some influence on licensure legislation (studies in the third category), but fail to demonstrate that consumers suffered a welfare loss. Thus, these studies cannot rule out that licensure legislation served the public interest. The studies of licensure effect on quality or quantity of health services are an exception. A decrease in the quality of health services rules out an increase in consumer welfare and an increase (decrease) in the quantity of health services consumed implies an increase (decrease) in consumer welfare. However, the few studies that investigated the effect of licensure on the quality or quantity of health services suffer from technical limitations in measurement of variables and effect estimation, so the evidence – again – is not conclusive.

An important shortcoming of the literature on health worker licensure is that almost all published studies were conducted in the US, even though health worker licensure regulations exist in most developed and developing countries. The US health services market has

characteristics that are rarely found in other countries. Some of these characteristics are likely to influence the effect of licensure on market outcomes. For instance, in the US, health workers may already have strong incentives to provide high-quality health services because of the high costs associated with health care malpractice suits. The marginal effect that licensure can have on market outcomes may thus be lower in the US compared to settings where malpractice suits are less expensive. Future studies need to investigate causes and effects of licensure regulation in other countries.

Two further criticisms apply to studies in the first and the second category. First, the real effects of licensure may differ from the effects that legislators or interest groups intend to achieve. Changes in licensure regulation are infrequent events. Legislators and members of interest groups will thus have little opportunity to observe the effects of licensure laws and to learn from failures. Hence, inferences about the behavior of actors in the regulatory process based on observed effects of regulation (as done in many of the studies discussed above) may be invalid. A case in point is a study on the regulation of physiotherapists in the US. Sass and Nichols (Sass & Nichols, 1996) found "that physical therapists have devoted considerable effort to obtain passage of laws that ultimately result in lower wages". As an explanation of "this seemingly perverse result" the authors consider that physical therapists incorrectly believed that the professional regulation would increase their earnings (Sass & Nichols, 1996).

Second, analyses belonging to the first and the second category of licensure studies are concerned with structures and outcomes in the market for health services. Health services, however, are merely instruments to attain better health. It is therefore possible that consumers suffered a welfare loss in the market for health services, while overall consumer welfare increased. For instance, licensure regulation may have prevented incompetent health workers from providing a health service intended to reduce childhood mortality. The resulting inward shift in supply (due to the exclusion of health workers from the market) may have exceeded the outward shift in demand (due to the increase in average quality of the service), so that consumers suffered a welfare loss in the market for that health service. Nevertheless, more children may have survived (since the fewer children who did receive the service received a better service) and overall consumer welfare may thus have increased. In measuring the effect of licensure on social welfare, future studies should thus include the value of changes in population health outcomes due to licensure regulation.

IV. Third phase: The health worker as necessary resource

IV.1 Background

In the 1990s and 2000s, the lack of health workers became a major research focus in developed and developing countries. In contrast to the first phase (see above), health worker shortages in developed countries were local rather than nationwide, occurring in so-called medically underserved areas, which were most commonly rural or remote areas but included also certain areas in cities where predominantly poor people seek health care.[17] In 2002, Brooks and colleagues described health worker maldistribution and the resulting health worker shortages in underserved areas in the US (Brooks, Walsh, Mardon, Lewis, & Clawson, 2002):

"While 20% of the population of the United States resides in rural areas, less than 11% of physicians practice in rural communities. Despite the fact that the supply of physicians has increased over the last 20 years, the percentage of physicians practicing primary care specialties has declined. Although the overall number of physicians practicing in rural areas has increased, the proportion relative to urban areas continues to decline. In sum, it continues to be difficult to attract and retain physicians in rural areas, particularly primary care physicians."

Six years later, Rabinowitz and colleagues repeated, in essence, Brooks' problem statement (Rabinowitz, Diamond, Markham, & Wortman, 2008):

"The persistent shortage of physicians in rural areas continues to have a major impact on access to care for those living in small communities. Although one of every five Americans (20%) lives in a rural area, only 9% of physicians practice there. The scope of this problem is substantial, because more than 20 million of the 60 million people residing in rural areas live in federally designated Health Professional Shortage Areas (HSPAs). This rural physician shortage has existed for more than 80 years, despite the fact that, in general, people living in rural areas have a greater need for medical care, being older, sicker, and poorer than their nonrural peers. Of greater concern, the future rural physician workforce is likely to decline

[17] A medically underserved area is an area where the number of health workers falls below a target. As described in section II., such targets can be based on need, demand, or supply criteria (such as service targets or population ratios). Commonly, a mix of criteria is used in the definition of underserved areas (Bärnighausen & Bloom, 2009b).

even further, with only 3% of recent medical students planning to practice in small towns and rural areas."

In developing countries, evidence emerged that the population density of health workers affected both population health outcomes (such as child mortality (Anand & Bärnighausen, 2004)) and health systems outcomes (such as childhood vaccination coverage (Anand & Bärnighausen, 2007)), emphasizing the need to increase health worker education and retention in developing countries (Joint Learning Initiative, 2004; WHO, 2006b). In addition, with the adoption of the MDGs by national governments and international organizations, health became a major focus of development policies. In particular, the fourth MDG ("reduce child mortality"), the fifth MDG ("improve maternal health"), and the sixth MDG ("combat HIV/AIDS, malaria and other diseases") emphasized population health improvements as primary goals of development (United Nations, 2009). While these goals do not depend on health services delivery alone, they are unlikely to be achieved without substantial increases in service coverage in developing countries. The indicators used to monitor the progress towards the health MDGs include health service targets, e.g., the proportion of one-year old children immunized against measles (for the fourth MDG), the proportion of births attended by skilled health personnel (for the fifth MDG), and the proportion of population with advanced HIV infection with access to antiretroviral drugs (for the sixth MDG) (United Nations, 2009). It soon became apparent that such health service targets could not be achieved without substantially increasing the health workforce in developing countries (Joint Learning Initiative, 2004; WHO, 2006b, 2008).[18] Access to antiretroviral treatment (ART) is a case in point. A number of studies modeling the need for health workers to provide universal access to antiretroviral treatment (ART) showed that at current health worker education and migration rates in developing countries it is very unlikely that sufficient health workers will be available to treat most patients needing ART in the foreseeable future (Bärnighausen & Bloom, 2009a; Bärnighausen, Bloom, & Humair, 2007). Even at current levels of relatively low ART coverage, many developing countries are struggling to find the health workers necessary to further expand coverage (Clark, 2006; IOM, 2007; Kober & Van Damme, 2004; MSF, 2007; Ooms, Van Damme, & Temmerman, 2007).

[18] Of course, increases in the efficiency of health care delivery, e.g. through changes in health worker team composition and task shifting from more to less highly educated health workers , could decrease the gap between current health worker numbers and the numbers required to achieve the health MDGs. However, it is very unlikely that efficiency increases can eliminate the gap (WHO, 2008).

The shift in perspective from regarding health workers as economic agents to viewing them as a resource necessary to improve population health in underserved areas of developed and developing countries led to research on means to increase health worker supplies to such areas. In the following, we review two major topics in this third phase of research on the health workforce: first, programs aimed at attracting health workers to underserved areas in developed countries; and, second, health worker emigration from developing to developed countries (Aiken, Buchan, Sochalski, Nichols, & Powell, 2004). While the supply of health workers to underserved areas and regions is not only a function of health worker movements, but also of education rates (Bärnighausen & Bloom, 2009a), studies on health worker education are few (Eckhert, 2002) and thus do not warrant a review.

IV.2 Developed countries: interventions to increase the supply of health workers to underserved areas

Programs to increase the supply of health workers to underserved areas can affect health workers in different stages of their careers. Before the start of training to become a health worker, selective admission strategies attempt to increase the number health workers who will practice in underserved area by selecting those individuals into health care training who – given observable characteristics – are most likely to work in underserved areas after graduation. During training, curricula specific to health needs in underserved areas and exposure to practice in such areas attempt to increase graduates' likelihood of choosing underserved practice by specifically preparing them for this type of service. Lastly, financial-incentive programs offer scholarships (during training) or loan repayments (after training) in return for service in underserved areas (Bärnighausen & Bloom, 2008). Table 3 shows an overview of studies extracted from three recent systematic reviews of four types of programs (selective admission to medical school, medical school training for practice in underserved areas, residency training for practice in underserved areas (Brooks et al., 2002; Rabinowitz et al., 2008), and finanicial-incentive programs for return of service in underserved areas (Bärnighausen & Bloom, 2009b)), supplemented by studies identified through additional literature searches by the authors of this chapter using the PubMed and Econlit databases.

We excluded from the overview in Table 3 studies that merely described program results and included only those studies that compared outcomes in program participants with outcomes in non-participants. All included studies measured an outcome in either one of two categories: provision of care – if the study compared all health workers enrolled in a program to all health workers – or retention – if the study compared only those enrolled and non-enrolled

health workers who at some point took up practice in an underserved area. Two types of retention outcomes can be distinguished: retention in the *same* underserved area (i.e., a health worker leaving a particular underserved area to work in another underserved area counts as *non-retention*) and retention in *any* underserved (i.e., a health worker leaving a particular underserved area to work in another underserved area counts as *retention*).

Our extraction and literature searches identified only one study reporting the effect of selective admission to medical school without additional medical school training to prepare students for practice in underserved areas (Basco, Buchbinder, Duggan, & Wilson, 1998). The study found – unsurprisingly – that students attending medical schools with selective admission targeting future generalists were significantly more interested in primary care and in rural practice than students attending medical schools that did not have such a selective admission policy. Other studies investigated programs that trained (future) health workers specifically for practice in underserved areas either during medical school (without or without an explicit selective admission policies) or during residency. These studies found that participants in these programs were significantly more likely than non-participants to practice in underserved areas (Bowman & Penrod, 1998; Brazeau, Potts, & Hickner, 1990; Fryer, Stine, Krugman, & Miyoshi, 1994; Rabinowitz, 1993; Rabinowitz, Diamond, Markham, & Hazelwood, 1999b; Rabinowitz, Diamond, Markham, & Paynter, 2001; Smucny, Beatty, Grant, Dennison, & Wolff, 2005), to intend to practice in underserved areas (Rosenthal, 2000), and to remain in the *same* underserved area (Pathman, Steiner, Jones, & Konrad, 1999; Rabinowitz, Diamond, Markham, & Rabinowitz, 2005) – with only one exception, which did not find any significant difference between participants and non-participants (Rabinowitz, Diamond, Hojat, & Hazelwood, 1999a).

Five of seven studies investigating the effect of participation in financial-incentive programs on retention in the *same* underserved found that participants were significantly less likely to remain in the same underserved area (G. M. Holmes, 2004; Pathman, Konrad, King, Taylor, & Koch, 2004; Pathman, Konrad, & Ricketts, 1992, 1994a, b), while one study did not report a significance level but found substantially lower retention among participants (Singer, Davidson, Graham, & Davidson, 1998), and another study did not find a significant difference (Jackson, Shannon, Pathman, Mason, & Nemitz, 2003).

On the other hand, 10 of the 12 studies investigating the effect of financial-incentive programs on provision of care or retention in *any* underserved area found that participants

were more likely to provide care to underserved populations (Brooks, Mardon, & Clawson, 2003; Inoue, Matsumoto, & Sawada, 2007; Matsumoto, Inoue, & Kajii, 2008; Pathman, Konrad, King, Spaulding, & Taylor, 2000; Probst, Samuels, Shaw, Hart, & Daly, 2003; Rabinowitz, Diamond, Veloski, & Gayle, 2000; Rittenhouse, Fryer, Phillips, Miyoshi, Nielsen, Goodman et al., 2008; Xu, Fields, Laine, Veloski, Barzansky, & Martini, 1997a; Xu, Veloski, Hojat, Politzer, Rabinowitz, & Rattner, 1997b) and to continue to practice in some underserved area (G. M. Holmes, 2004; Pathman et al., 2000) . These differences were shown to be statistically significant in eight of the ten studies (Brooks et al., 2003; G. M. Holmes, 2004; Pathman et al., 2000; Probst et al., 2003; Rabinowitz et al., 2000; Rittenhouse et al., 2008; Xu et al., 1997a; Xu et al., 1997b), while two studies did not provide the results of significance tests (Inoue et al., 2007; Matsumoto et al., 2008) and two other studies reported that participants were significantly less likely than non-participants to remain in some underserved area (Matsumoto et al., 2008; Pathman et al., 1992).

In all of the above studies, the (future) health workers chose to participate in a program. It is thus difficult to distinguish whether the finding that program participants are more (or less) likely to provide care in underserved areas or to remain in an underserved area is a true effect of program participation or merely a selection effect. Selection issues are particularly apparent in the evaluation of programs with selective admission policies. All of the studies evaluating such programs compare participating health care students to their non-participating peers. However, such peers are unlikely to be a good counterfactual, because they will on average be less likely than the participants to have the characteristic required for participation in the program, e.g., rural upbringing or self-declared interest in primary health care. As the selection criterion was likely chosen because it was observed to be positively associated with practice in underserved areas, we would expect that observed differences in the likelihood to practice in underserved areas between participating and non-participating health care students can be (partially) explained by selective admission.

Indeed, the one study that does not find any significant difference in the provision of care in underserved areas between participants and non-participants in a program with selective admission (and medical school training for rural practice) controlled for rural upbringing in the analysis (Rabinowitz et al., 1999a) – while the program “recruits and selectively admits medical school applicants who have grown up in a rural area and intend to practice family medicine in rural and underserved areas” (Rabinowitz et al., 1999b).

Another study of the same program concludes that "the admission component of the PSAP [Physician Shortage Area Program] is the most important reason for its success" (Rabinowitz et al., 2001). Implicit in such a conclusion is the assumption that a large proportion of participants would not have studied to become health workers, had they not enrolled in the program. If this assumption were not met, the program would not have increased the supply of health workers to underserved areas and could thus not be called a "success".

Of the 16 studies of program effect in Table 3, 14 controlled for additional variables in the comparison between participants and non-participants, such as sex, age, ethnicity, marital status, medical specialty (Bowman & Penrod, 1998; G. M. Holmes, 2004; Pathman et al., 2000; Pathman et al., 2004; Pathman et al., 1992, 1994b; Probst et al., 2003; Rabinowitz et al., 1999a; Rabinowitz et al., 1999b; Rabinowitz et al., 2001; Rabinowitz et al., 2000; Rittenhouse et al., 2008; Xu et al., 1997a; Xu et al., 1997b). However, even those studies that control for factors likely to be closely related to care provision and retention in underserved areas (such as growing up in an underserved area (Rabinowitz et al., 1999a; Rabinowitz et al., 2000; Xu et al., 1997a; Xu et al., 1997b) or "strong interest" prior to medical school to practice as a doctor in an underserved area (Rabinowitz et al., 2000; Xu et al., 1997b)) cannot rule out that participants selected into the program on unobserved characteristics related to the preference of working in underserved areas.

Only one study of program effect attempted to control for selection on unobserved variables by using a selection model (G. M. Holmes, 2004). In order to identify the program effect, the study used four medical school characteristics: "historical proportion of graduates specializing in primary care", "quality of the school", a "tuition index", and a "public school indicator". The use of these identifying variables assumes that they influenced selection into the program but did not affect the provision of care in underserved areas other than through their effect on program participation. However, the type of medical school that students attend is likely to be related not only to the decision to enroll in financial-incentive programs, but also – independent of program participation – to the decision to work in underserved areas. For instance, students with strong preferences to work in underserved areas may be more likely than their peers with weaker preferences for such care to select medical schools with a high "historical proportion" of graduates pursuing careers in primary care, because such schools are likely to focus on medical education relevant for underserved areas. This selection may determine work location decisions, independent of any effect the medical

school characteristic may have on participation in the programs. Thus the characteristics may not be valid variables to identify program effects.

In sum, studies evaluating programs aimed at increasing the supply of health workers to underserved area find that participants are more likely to provide care for underserved population and to remain in underserved areas in the long run (even if not in the same underserved area where they were initially placed). However, because the studies to date have not convincingly controlled for selection effects, the evidence to date does not allow the inference that the programs have caused increases in health worker supply to underserved areas.

Table 3: Studies of programs aimed at increasing the supply of health workers to underserved areas

Study	Program type	Program	Outcomes	Results
(Basco et al., 1998)	Selective admission to medical school	All US medical schools "with premedical recruitment activities that targeted future generalists"	Self-reported interest in primary care and rural practice	Students attending medical schools with selective recruitment targeting future generalists were significantly more interested in primary care and in rural practice than students attending other schools.
(Rabinowitz et al., 2001)	Selective admission to medical school Medical school training for practice in underserved areas Financial incentives	Physician Shortage Area Program (PSAP) of Jefferson Medical College (selective admission and medical school training for practice in underserved areas) Rural preceptorship NHSC (financial incentives)	Provision of care in any underserved area	PSAP participation significantly increased the likelihood of a graduate of Jefferson Medical College graduates to practice rural primary care (adjusted odds ratio (aOR) 2.5, $p < 0.001$) net of rural preceptorship during medical school, NHSC participation, sex, expected peak income, rural family practice clerkship. Holding the other factors equal rural preceptorship and NHSC participation significantly increased the likelihood of rural primary practice (aORs 2.4 and 2.6, respectively, both $p < 0.001$).

Study	Program type	Program	Outcomes	Results
(Rabinowitz et al., 1999a)	Selective admission to medical school Medical school training for practice in underserved areas	PSAP	Provision of care in any underserved area	PSAP participation was not significantly related to practice in rural area, when controlling for “size of community raised”, “size of community undergraduate college”, “father’s education”, “specialty plans as a Freshman”, “senior debt”.
(Rabinowitz et al., 2005)	Selective admission to medical school Medical school training for practice in underserved areas	PSAP	Retention in the same underserved area	“After 11–16 years, 68% (26/38) of the PSAP graduates were still practicing family medicine in the same rural area, compared with 46% (25/54) of their non-PSAP peers ($p = .03$).”
(Rabinowitz, 1993)	Selective admission to medical school Medical school training for practice in underserved areas	PSAP	Provision of care in any underserved area	“PSAP graduates from the classes of 1978 through 1986 were approximately four times as likely as non-PSAP graduates to practice family medicine (55 percent vs. 13 percent), to practice in a rural area (39 percent vs. 11 percent), and to practice in underserved areas (33 percent vs. 8 percent). They were approximately 10 times more likely to combine a career in family medicine with practice in a rural (26 percent vs. 3 percent) or underserved (23 percent vs. 2 percent) area.”

Study	Program type	Program	Outcomes	Results
(Rabinowitz et al., 1999b)	Selective admission to medical school Medical school training for practice in underserved areas	PSAP	Provision of care in any underserved area	"PSAP graduates were much more likely than their non-PSAP classmates at JMC [Jefferson Medical College] to practice in a rural area of the United States (34% vs 11%; RR, 3.0), to practice in an underserved area (30% vs 9%; RR, 3.2), to practice family medicine (52% vs 13%; RR, 4.0), and to have combined a career in family practice with practice in a rural area (21% vs 2%; RR, 8.5)."
(Smucny et al., 2005)	Medical school training for practice in underserved areas	Rural Medical Education Program (RMED) of the State University of New York (SUNY)	Provision of care in any underserved area	"A greater percentage of former RMED students practiced in rural locations [22/86 (26%)] than did non-RMED students [95/1,307 (7%)]" ($p < 0.0001$).
(Brazeau et al., 1990)	Medical school training for practice in underserved areas	Upper Peninsula Medical Education Program at Michigan State University	Provision of care in any underserved area Specialty choice of medical school graduates	Program graduates "chose rural practice and primary care specialties, especially family practice, more often than did their downstate colleagues" (whose medical school did not emphasize training for practice in underserved areas).
(Fryer et al., 1994)	Medical school training for practice in underserved areas	Statewide Education Activities for Rural Colorado's Health (SEARCH) at the University of Colorado Medical School (UCSOM)	Provision of care in any underserved area Specialty choice of medical school graduates	UCSOM graduates who had participated in SEARCH were more likely to have chosen a primary care specialty (46.9% vs. 30.6%) and to establish practices in rural counties (16.4% vs. 9.6%) than graduates who had not participated.

Study	Program type	Program	Outcomes	Results
(Pathman et al., 1999)	Medical school training for rural practice Residency training for rural practice	All US medical schools or residency programs with rural rotations	Self-reported preparedness for rural practice Self-reported preparedness for small-town living Retention in the same underserved area	"Residency rural rotations predicted greater preparedness for rural practice ($p = .004$) and small-town living ($p = .03$) and longer retention (hazard ratio, 0.43, $p = .003$). Extended medical school rural rotations predicted only greater preparedness for rural practice ($p = .03$)." "The physicians' sense of preparedness for small-town living predicted their retention duration (hazard ratio, 0.74, $p < .0001$), whereas their preparedness for rural medical practice did not predict their retention duration after controlling for preparedness for small-town living (hazard ratio, 0.92; $p = .27$)."
(Rosenthal, 2000)	Residency training for practice in underserved areas	Family medicine residencies with "rural training tracks"	Self-reported intent to practice in underserved areas	Graduates of family medicine residencies with rural training tracks were more likely to report that they intended to practice in rural communities than graduates of "small urban FP [family practice] residencies", "midsize urban FP residencies", and "all FP residencies" (76% vs. 39% vs. 18% vs. 24%).
(Bowman & Penrod, 1998)	Residency training for practice in underserved areas	All US family residency programs that focus on training for rural practice	Provision of care in any underserved area	A one-month increase in the length of time of required rural training increased the proportion of graduates of a residency program practicing in rural areas by 0.82 percent ($p < 0.0001$) net of "percentage of minority residents at program", "full rural mission at program", "partial rural mission at program", "percentage of population of the state that is nonmetropolitan", "emphasis on rural or OB [obstetrics] fellowship", "director is rural contact person", "other graduate training programs used at site", "months of obstetrical training", percentage of female residents at program", "population of program site (city or metropolitan)", "percentage of faculty with rural practice experience", "sponsoring hospital of program is public". Holding the other factors constant, having a rural mission statement increased the proportion of graduates practicing in rural areas by 12% ($p < 0.0001$).

Study	Program type	Program	Outcomes	Results
(Inoue et al., 2007)	Financial incentives	Jichi Medical University, Japan	Provision of care in any underserved area	Participants and former participants were more likely to work in a rural area of Japan than non-participants.
(Matsumoto et al., 2008)	Financial incentives	Jichi Medical University, Japan	Provision of care in any underserved area	Former participants were about four times more likely to work in rural areas than non-participants (12.8% vs. 3.3% in 1994 and 10.7% vs. 2.6% in 2004).
(Pathman et al., 1992)	Financial incentives	National Health Service Corps	Retention in the same underserved area Retention in any underserved area	Participants were significantly more likely to leave their practice of original placement than non-participants (adjusted hazard ratio (aHR) 1.98, $p = 0.0002$), when controlling for training in internal medicine and stated importance of living in a small community). Participants were significantly more likely to leave practice in underserved areas than-non participants (aHR 1.56, $p = 0.02$), when controlling for training in internal medicine and stated importance of living in a small community).
(Pathman et al., 1994a)	Financial incentives	National Health Service Corps	Retention in the same underserved area Retention in any underserved area	Compared to non-participants, former participants were about three times less likely to remain in the same practice (13% vs. 44%, $p < 0.001$) and about half as likely to remain in a non-metropolitan area (24% vs. 52%, $p < 0.001$).
(Pathman et al., 1994b)	Financial incentives	National Health Service Corps	Retention in the same underserved area	Five years after starting work at a practice site, participants were significantly less likely to have remained at the site of first practice than non-participants (aOR 0.41, $p = 0.01$), when controlling for physician discipline (allopath vs. osteopath), physician specialty, initial plans to remain in the underserved area, percentage of minority patients in the practice, county population, type of county, per-capita income in the county, and physician population density in the county.

Study	Program type	Program	Outcomes	Results
(Xu et al., 1997b)	Financial incentives	National Health Service Corps	Provision of care in any underserved area	Former participants were significantly more likely to practice in an underserved area ten years after graduating from medical school than non-participants (aOR = 3.7, $p < 0.0001$, when controlling for age, sex, ethnicity, having grown up in an underserved area, family income as a child, strong interest in working in underserved areas prior to medical school, debt, medical school experience in an underserved area, and residency experience in an underserved area).
(Xu et al., 1997a)	Financial incentives	National Health Service Corps	Provision of care to poor patients	30% of former participants' patients, but only 19% of non-participants' patients, were poor.
(Singer et al., 1998)	Financial incentives	National Health Service Corps	Retention in the same community health center	After five years of work in a community health centre, 36% of participants, but only 17% of non-participants, still worked in the same centre.
(Rabinowitz et al., 2000)	Financial incentives	National Health Service Corps	Provision of care in any underserved area	"Participation in the NHSC is the only experiential factor related to caring for the underserved" (aOR 2.2, 95% CI 1.6-3.0, when controlling for sex, ethnicity, family income when growing up, childhood in inner-city/rural area, strong interest in underserved practice prior to medical school, clinical experience with the underserved during medical school).

Study	Program type	Program	Outcomes	Results
(Brooks et al., 2003)	Financial incentives	National Health Service Corps	Provision of care in any underserved area	13% of rural primary care physicians, but only 3% of suburban and 3% of urban primary care physicians, had participated in the program.
(Probst et al., 2003)	Financial incentives	National Health Service Corps	Provision of care in any underserved area	Former participants were significantly more likely to be highly engaged in Medicaid[19] inpatient practice than non-participants (aOR = 1.93 (95% CI 1.18-3.13), when controlling for physician's sex, ethnicity, medical specialty, period of graduation from medical school, medical education in South Carolina, graduation from a non-US medical school).
(G. M. Holmes, 2004)	Financial incentives	National Health Service Corps	Retention in the same underserved area Provision of care in any underserved area	Participants were less likely to remain in their first practice location than non-participants (beta coefficients between -0.248 and -0.272 across three graduation cohorts (all $p < 0.01$), when controlling for age, sex, and ethnicity). Participants were more likely to serve in any underserved area than non-participants (beta coefficients between 0.528 and -0.745 across three graduation cohorts (all $p < 0.01$), when controlling for age, sex, and ethnicity).
(Rittenhouse et al., 2008)	Financial incentives	National Health Service Corps	Provision of care in any community health center	Participants were significantly more likely to work in a community health centre than non-participants (aOR = 6.99, $p < 0.001$, when controlling for sex, year of residency completion, private vs. public medical school, attendance of a medical school receiving Title VII funding[20]).

[19] Medicaid is a means-tested health program funded by the US federal government and the states. It covers health care expenditures of some categories of low-income individuals, including children, parents, pregnant women, and children with disabilities (Centers for Medicare & Medicaid Services, 2009).

[20] In the US, "Title VII grants are intended to strengthen the primary care educational infrastructure at medical schools and residency programs and to encourage physicians-in-training to pursue careers working with underserved populations" (Rittenhouse et al., 2008).

Study	Program type	Program	Outcomes	Results
(Pathman et al., 2000)	Financial incentives	National Health Service Corps Indian Health Service Corps State scholarships State loan repayment programs Practice and hospital-sponsored financial incentives	Provision of care in any underserved area	In comparison to non-participants, participants in financial-incentive programs were significantly more likely to practice in rural areas (33.3% vs. 6.5%, $p < 0.001$) and to care for underserved populations (54.1% vs. 29.4%, $p < 0.001$).
(Jackson et al., 2003)	Financial incentives	West Virginia Community Scholarship Program West Virginia Health Sciences Scholarship Program West Virginia Recruitment and Retention Community Program West Virginia State Loan Repayment Program	Retention in the same underserved area	Retention in the first practice site was not significantly different between program participants and non-participants.

Study	Program type	Program	Outcomes	Results
(Pathman et al., 2004)	Financial incentives	State scholarship programs State loan programs with service option State loan repayment programs State direct financial-incentive programs for medial residents State direct financial-incentive programs for fully trained health professionals	Retention in the same underserved area	Participants were not significantly more likely to remain at their site of first practice than non-participants (aHR 0.75, p = 0.080, when controlling for age, sex, medical specialty, and marital status).

IV.3 Developing countries: health worker emigration

In the past decade, health worker migration from developing to developed countries has been a common topic of editorials (Bundred & Levitt, 2000; Chen & Boufford, 2005; Mullan, 2007; Pang, Lansang, & Haines, 2002), policy reports (International Pharmaceutical Federation (FIP), 2006; Joint Learning Initiative, 2004; WHO, 2006b), and scientific publications. Below, we summarize the research on international health worker migration regarding measurement (i.e., studies estimating the size of migration flows from developing to developed countries or the stock of health workers who have migrated), causes (i.e., studies investigating migration reasons), welfare impact (i.e., studies investigating how health worker migration affects social welfare in source or recipient countries), and programs and policies (i.e., publications discussing potential interventions to reduce migration or minimize any negative consequences of international health worker migration).

Numerous studies have described international migration flows or stocks of in- or out-migrated health workers for individual migration source countries (e.g., India , Zimbabwe (Chikanda, 2005), Ghana (Dovlo & Nyonator, 1999), India (Kaushik, Jaiswal, Shah, & Mahal, 2008), Malawi (Zijlstra & Broadhead, 2007), Philippines (Institute of Health Policy and Development Studies, 2005)) or from individual recipient countries (e.g., UK (Buchan, 2002; Buchan, Baldwin, & Mundo, 2008), USA (Akl, Maroun, Major, Chahoud, & Schunemann, 2007; Akl, Mustafa, Bdair, & Schunemann, 2007; Brush, Sochalski, & Berger, 2004), Italy (Chaloff, 2008), Canada (Dumont, Zurn, Church, & Le Thi, 2008), New Zealand (Zurn & Dumont, 2008)). While data on health worker migration published in these studies is useful to demonstrate the magnitude of health worker migration from developing to developed countries, it is insufficient for many research purposes. For one, the country-level data cannot be pooled for multi-country analyses, because different studies used different methods to estimate the size of migration flows and stocks. In addition, most of the studies covered only short periods of time. Finally, some studies measured only migration of health workers who graduated from specific institutions or regions in a country (e.g., (Zijlstra & Broadhead, 2007)).

Four different studies have published datasets of *stock*s of emigrated health workers from a number of countries (Clemens & Pettersson, 2008; Hagopian, Thompson, Fordyce, Johnson, &

Hart, 2004; Mullan, 2005; OECD, 2005; WHO, 2006b).[21] All of the four datasets used numbers of health workers reported in recipient countries in order to estimate the magnitude of emigration from source countries. The stock estimates differ substantially across the datasets (see Table 4). These discrepancies are due to several factors, demonstrating some of the difficulties in estimating international health worker migration flows.

First, the four datasets used different sources of information on the numbers of foreign physicians in recipient countries. WHO/OECD (OECD, 2005; WHO, 2006b) and Clemens and Petterson (Clemens & Pettersson, 2008) used national census data, while Mullan (Mullan, 2005) and Hagopian and colleagues (Hagopian et al., 2004) used data from health workers' professional organizations.

Second, in order to estimate emigration stocks the different studies counted health workers in different sets of recipient countries – WHO/OECD counted health workers in the UK, US, Australia, Canada, Finland, France, Germany, Portugal; Clemens and Pettersson in the UK, US, Australia, Canada, France, Portugal, Spain, Belgium, South Africa; Mullan in the UK, US, Australia and Canada; and Hagopian and colleagues in the UK and US.

Third, the different datasets used different definitions of migrant health workers. WHO, Mullan, and Hagopian and colleagues defined a migrant health worker as one who was trained in another country, while Clemens and Pettersson defined a migrant health worker as one born in another country. This distinction is important, because some of the countries with the worldwide lowest population densities of health workers (such as Lesotho and Swaziland (WHO, 2009)) do not have their own medical school and thus depend on physicians trained in other countries – in particular their own citizens – to staff their hospitals and clinics (Clemens & Pettersson, 2008). According to the definition of a migrant health worker as one who was trained in another country, these countries can never have any emigrated physicians and any physician working in these countries will always be an immigrant. Last, the four datasets estimate stocks of emigrated health workers for different years (Table 4).

[21] The data reported in WHO 2006 (WHO, 2006b) is extracted from OECD 2005 (OECD, 2005).

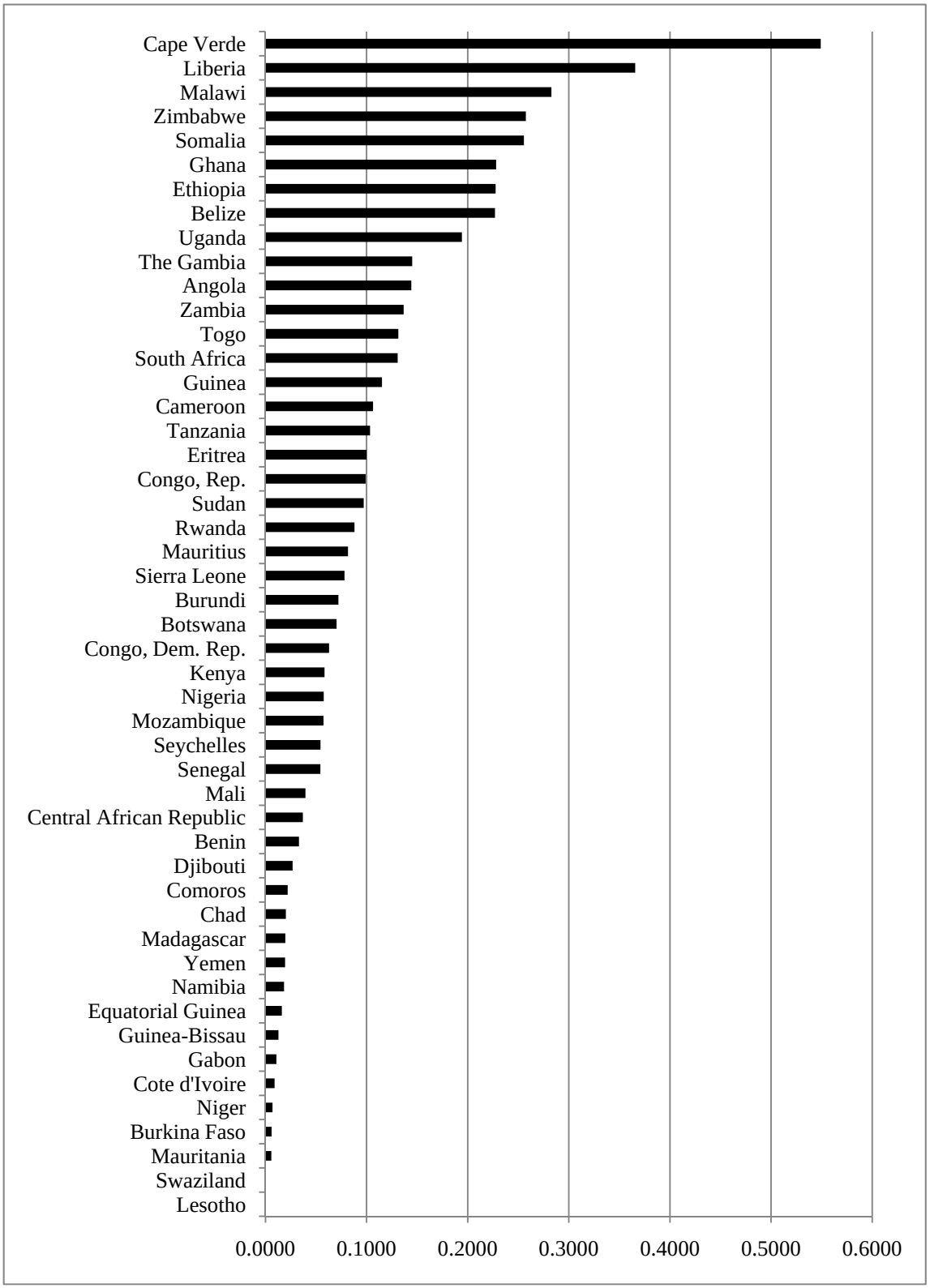
Table 4: Estimates of stocks of physicians who emigrated from selected sub-Saharan African countries

		Study			
		WHO 2006 , OECD 2005	Clemens and Pettersson 2008	Mullan 2005	Hagopian et al. 2004
	Year of data	2002	2000	2004	2002
Country	South Africa	12136	7363	3734	3788
	Nigeria	4261	4856	3921	2281
	Ghana	926	1639	NR	515
	Ethiopia	335	553	NR	266
	Uganda	316	1837	NR	175
	Zimbabwe	237	1602	NR	101
	Angola	168	2102	NR	NR
	Cameroon	109	845	NR	NR
	Tanzania	46	1356	NR	NR
	Mozambique	22	1334	NR	NR

NR = not reported

One comprehensive dataset provides physician emigration *rates* for all countries worldwide for each year in the period 1991-2004 (Docquier & Bhargava, 2006, 2007). Figure 3 shows annual emigration rates (in % per year) for the year 2004 for all countries in sub-Saharan Africa covered in the dataset. According to the dataset, in 2004 emigration rates exceeded 10% in seventeen countries in the region and 20% in eight countries. Such panel on health worker emigration rates is extremely useful for a wide range of analyses, including on the causes and consequences of health worker migration. However, the dataset has a number of limitations. For one, the definition of migrant physician used for different recipient countries in the dataset differed across recipient countries (a physicians born in another country, a physician with citizenship in another country, and a physician trained in another country) (Clemens & Pettersson, 2008). Moreover, the data on physicians who immigrated to a recipient country was available for all fourteen years from 1991 through 2004 for only 4 of the 16 recipient countries across which physician numbers were summed to estimate emigration flows from source countries. For all other recipient countries, the authors intra- or extrapolated some country-year values of emigrated physicians.

Figure 3: Estimates of health worker emigration rates in sub-Saharan African countries, 2004



The relatively recent arrival of the above datasets and the fact that each suffers from some limitations may explain why the literature on causes of health worker migration is largely descriptive and the literature on the welfare impact of the migration is small. Studies on the causes of health worker migration investigated reasons for migration decisions through surveys of health workers in both source and recipient countries. In these surveys, health workers consistently listed higher earnings in other countries as one of the most important reasons for migration plans or past migration (Awases, Gbary, Nyoni, & Chatora, 2004; Chikanda, 2005; Luck, Fernandes, & Ferrinho, 2000; Mackintosh, 2003; Martineau, Decker, & Bundred, 2002; Nguyen, Ropers, Nderitu, Zuyderduin, Luboga, & Hagopian, 2008). However, health workers also named a number of other factors as influencing their migration decisions, including job security, flexible leave policies (Mackintosh, 2003), opportunities for education and training (Awases et al., 2004; Mackintosh, 2003; Oman, Moulds, & Usher, 2009), opportunities for promotion (Bach, 2004; Buchan, Parkin, & Sochalski, 2003; Muula & Maseko, 2006), the management of health services (Bach, 2004; Chikanda, 2005; Kingma, 2006; Luck et al., 2000), workplace safety (in particular the risk of work-related HIV infection (Bossert et al., 2007; Institute of Health Policy and Development Studies, 2005; Muula & Maseko, 2006; Palmer, 2006)), family welfare (Chikanda, 2005; Oman et al., 2009), and country stability (Chikanda, 2005; Nguyen et al., 2008; Oman et al., 2009). Non-financial factors appear to be nearly as important as earnings differentials in motivating migration, but the patterns of important non-financial factors differ across countries (Awases et al., 2004).

Despite a well-developed economics literature on the welfare impact of migration (e.g., (Borjas, 1995; Goldfarb, Havrylyshyn, & Magnum, 1984; Grubel & Scott, 1966; Kwok & Leland, 1982)), only a few studies have examined the particular impact of international health worker migration on social welfare in source and recipient countries. Studies in Kenya (Kirigia, Gbary, Muthuri, Nyoni, & Seddoh, 2006) and Malawi (Muula, Panulo, & Maseko, 2006) estimated the financial loss due emigration of a health workers as the total costs of educating such a health worker (including tuition, study materials, accommodation , and living expenses during primary, secondary and tertiary education). The estimated losses of returns on investment were about half a million year-2005 US$ for a doctor in Kenya, more than 300 thousand year-2005 US$ for a nurse in Kenya (Kirigia et al., 2006), and between approximately 240 thousand year-2005 US$ (when an interest rate of 7% per annum is used) and 26 million year-2005 US$ (when an interest

rate of 25% is used) (Muula et al., 2006). While these financial losses seem large, two studies of remittances from emigrated health workers found that the remittances (of Filipino physicians (Goldfarb et al., 1984) and Tongan and Samoan nurses (Connell & Brown, 2004)) exceeded the initial investment in their human capital, suggesting that in some countries it may pay to train health workers for export.

Another study estimated the social net present value of a financial incentive that pays fully for a student's education as a health worker in return for a few years of service in an ART program in sub-Saharan Africa. The study found that these financial incentives are highly cost-beneficial if they are effective in reducing health worker emigration. For instance, if the only effect of the financial incentive were to reduce annual health worker emigration from 12% to 5% for five years, the net present value of financing the education of a team of health workers sufficient to treat 500 ART patients would be more than 200 thousand year-2000 US$ (Bärnighausen & Bloom, 2009a).

A final set of publications on health worker migration has discusses potential programs and policies to reduce emigration of health workers from developing countries or to mitigate negative consequences of migration. Table 5 summarizes the proposed interventions. Some the programs and policies have already been implemented in developing countries (such as compulsory service (Reid, 2001) or financial-incentive programs (Ross, 2007) in South Africa or non-financial incentives in Zambia (Koot & Martineau, 2005)) or been adopted by developed countries (such as the UK's "ethical recruitment policy" (Carlisle, 2004)). However, studies evaluating the effect of the implemented programs and policies on health worker migration – similar to those evaluating programs to increase the supply of health workers to underserved areas in developed countries – are as of yet lacking.

In sum, although the recent focus of development policy on population health has sparked research on health worker migration from developing to developed countries, the majority of studies are descriptive in nature, in part, because comprehensive data on international migration flows of health workers has not been available. Future initiatives need to emphasize further improvements in data on international health worker migration. Once validated data are available, researchers can draw on the extensive literature and theories of migration in economics

and other disciplines to further investigate the causes and consequences of health worker migration and to evaluate existing interventions to reduce migration rates.

Table 5: Programs and policies to reduce health worker migration from developing countries or to mitigate any negative consequences of such migration

Program or policy	Definition	References
Microlevel approaches		
Selective admission	Select students for health worker education who are likely to remain in the country of training	(Lehmann, Dieleman, & Martineau, 2008)
Training for practice in developing countries	Focus health care education on the health care needs of developing countries	(Lehmann et al., 2008)
Increased health worker training in developed countries	Increase the national health worker education rate in countries that currently receive large numbers of health workers from developing countries	(Ahmad, 2005)
Compulsory service	Require all health workers to serve for some time in their country of training	(Metz, 1991; Reid, 2001)
Financial incentives	Offer financial incentives for return of service in the country of training	(Bärnighausen & Bloom, 2009b; Ross, 2007)
Non-financial incentives	Improve the working and living conditions of health workers in developing countries	(Lehmann et al., 2008; Stilwell, Diallo, Zurn, Vujicic, Adams, & Dal Poz, 2004)
Macrolevel approaches		
Visa restrictions	Potential recipient countries agree not to issue visas to health workers from certain potential source countries or to issue only temporary visas	(Ahmad, 2005; Stilwell et al., 2004)
"Ethical recruitment"	Potential recipient countries allow recruitment of health workers only if the source country consents to such recruitment	(Ahmad, 2005; Buchan & Sochalski, 2004; Labonte, Packer, Klassen, Kazanjian, Apland, Adalikwu et al., 2006)
Compensation payments	Recipient countries make payments to certain migration source countries for every health workers they receive from the source countries	(Ahmad, 2005; Buchan & Sochalski, 2004; Labonte et al., 2006)

V. Conclusions

In this paper, we have reviewed research on the health workforce since the 1960s. We have structured the review into three perspectives corresponding roughly to three chronological phases. During the first phase – which is associated with the perspective "health workforce planning" – shortages of health workers in developed countries triggered research on manpower planning methods to aid policy makers in ensuring adequate supplies of health workers (1960s through 1970s). Four main approaches to project future health worker requirements were developed, viz., approaches based on health need, demand for health care, health care service targets, and health worker-to-population ratios. We discuss the advantages and disadvantages of each of the four approaches and show that modified versions of the approaches, in particular the service targets approach, are experiencing a renaissance in current studies estimating health worker requirements to meet population health goals, such as the health MDGs, in developing countries.

During the second phase – which is associated with the perspective "the health worker as economic actor" – a perceived "cost explosion" in many health systems in developed countries shifted the research focus to the study of the influence of health workers' behavior on allocative and technical efficiency in health systems (1980s through 1990s). We review the literature on one particular research topic during this phase, health worker licensure, which investigated whether licensure regulation was introduced to benefit health worker "interest groups" or to serve the "public interest". We describe three categories of studies testing "interest group" against "public interest" explanations of the existence of health worker licensure. Studies in the first category, "market structure", measured the level of competitiveness in the health care market, taking competitive structures as evidence against and monopolistic structures as evidence for "interest group" explanations; studies in the second category, "licensure effects", examined the influence of licensure on health worker incomes, and the price, quality, and quantity of health services; studies in the third category, "political power", analyzed the relationship between the political power of health worker interest groups and the passage of licensure legislation. While the findings of several studies suggest that "interest group" explanation of the existence of licensure hold true, the evidence is not conclusive because of technical limitations and conceptual problems in the analytical approaches.

During the third phase – which is associated with the perspective "the health worker as necessary resource" – local health worker shortages in developed countries and regional shortages in developing countries sparked research investigating the effectiveness of interventions to increase the supply of health workers to so-called underserved areas of developed countries and health worker migration from developing to developed countries (1990s through 2000s). Several studies showed that participants in programs aimed at increasing the number of health workers in underserved areas (such as selective admission to health worker education or financial-incentives for return of service) were more likely to provide care in such areas than their peers who did not participate. However, the studies could not conclude that the programs caused an increase in the supply of health workers to underserved areas, because they cannot rule out that selection rather than program effects was responsible for the differences in the behavior between program participants and non-participants. International health worker migration has recently emerged as a research topic (including studies on the causes and consequences of such migration), but has been hampered by the lack of validated data on health worker migration flows and stocks of migrated health workers.

Of course, the three research perspectives on the global health workforce are merely stylized descriptions of main research thrusts and do not imply that such foci were necessarily the best use of research resources during the different phases. Moreover, the three perspectives are not mutually exclusive. For instance, some of the studies undertaken from a perspective of the health worker as a necessary resource use health workforce planning approaches to estimate the size of the gap between available and needed health workers – even if the starting point of these studies is an observed health worker constraint in the delivery of certain priority health interventions. Other studies that are motivated by a perceived or measured lack of health workers clearly view health workers as economic actors that consider financial and non-financial incentives in their location decisions.

Opportunities for future research on the health workforce abound. While they are likely to include new approaches to the study, our review suggests that the transfer of existing approaches from developed to developing countries could lead to important insights. For instance, studies on health worker licensure were mostly carried out in the US. It seems likely that the strength of health worker "interest groups" relative to the power of the public differs across stages of

socioeconomic development and by type of health system. Evidence on the causes and effects of health worker licensure in different developing countries is thus likely to contribute substantially to the licensure debate. Another example where transfer of research topics and methods could lead to important insights is programs to influence health workers' location decisions. Programs similar to those aimed at increasing the supply of health workers to underserved areas in developed countries have been implemented in many developing countries. Unlike their developed-country counterparts, however, they have yet to be evaluated in their impact on health worker movements from well-served to underserved areas and from developing to developed countries, suggesting the need for a coherent economic model of medical migration..

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