Long run impacts of labor migration on human capital accumulation: Evidence from Malawi

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Abstract: Circular labor migration is prevalent in many low-income countries. While some argue such labor migration creates opportunities for escaping poverty, the literature on the effects of this migration on sending communities is limited, especially in Africa. In this paper, we estimate the net effect of international migration on human capital formation of children from sending communities. International labor migration may raise investments in human capital directly through an income effect but may undermine such investments if child labor is a ready substitute for adult labor. Through the lens of a two-sided natural experiment in Malawi, we test whether the substitution effect outweighs the income effect and whether the local technology of production contributes to the result. In 1967, a new labor treaty between Malawi and South Africa opened the way for a 300% increase in the flow of Malawians to South African mines over seven years. A plane crash in April 1974 precipitated a four-year ban on this labor migration and the immediate return of all miners. We use administrative data on spatial differences in historical access to mine jobs to measure community-level exposure to this rapid expansion and contraction of external labor demand. Using 1977 and 1998 Census data, we compare long run education outcomes across high and low shock intensity areas for those age eligible for primary school during the shock years to older and younger age ineligible cohorts. Greater exposure to international labor migration contributed to a 1.4-1.8% increase in total years of education and a 2% increase in any primary schooling attainment among age eligible cohorts. We provide suggestive evidence that these positive education effects are driven by districts in which child labor was least substitutable for male labor.

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Introduction

One of the most powerful ways in which poor households can improve their standard of living is to send out an international labor migrant (Clemens 2011). Such migration, increasingly important in poor countries, often entails large remittance flows.[2] Despite these large capital and labor flows, there is no consensus in the economics literature on whether and how international labor migration affects human capital accumulation. Policy debates about the human capital externalities of labor migration tend to focus on whether migration encourages brain drain of the most skilled, or its alternative, brain gain, among left-behind adult members of the household who are incentivized to get more schooling (Gibson and McKenzie 2011). What is often overlooked is the direct impact of losing unskilled adult labor when adult and child labor can substitute in production in rural economies.

In theory, the migration of adults from rural economies can work to improve or undermine educational attainment of the next generation. If migrants send money home and households get wealthier, credit constraints may be relaxed and the demand for schooling may increase. On the other hand, the loss of male labor in agricultural production may require families and farms to substitute towards child labor, thereby raising the opportunity cost of going to school. Whether these substitution effects dominate the effects of rising migrant incomes or not is an empirical question. Moreover, the net effect is likely to depend on the technology of production of the local economy, specifically, the substitutability of child for adult labor.

This paper uses the context of international labor migration of unskilled male workers from Malawi to South Africa to address two related research questions: Does adult labor migration raise or lower total schooling attained by the next generation? And, do these impacts of labor migration depend on local technologies of production? We use a two-sided natural experiment in Malawi spanning an unexpected expansion and contraction of foreign labor demand to test whether the substitution effect outweighs the income effect (or vice versa) in a poor rural and predominantly agricultural economy.

Malawi has a long history of sending men to work on South African gold mines. In 1967, a newly signed labor treaty between Malawi and South Africa opened the way for a 300% increase in the flow of Malawians to South African mines. In the following seven years, upwards of 20% of the adult men were employed as contract mineworkers, staying away for two years at a time and sending sizeable earnings back to their rural homes. This access to foreign jobs and foreign capital came to an abrupt halt after a mining plane crashed in April 1974, killed a group of Malawian miners. This event precipitated a four-year ban on all labor migration to the mines, leading to the immediate return of over a hundred thousand

[2] Global remittance flows currently exceed flows of official development assistance to poor countries (Yang 2011).

men. We use both sides of this natural experiment to test whether income or substitution effects dominate in the demand for education and to understand more generally the role that local agricultural production technologies play in determining the net effect of this labor migration.

Our empirical strategy compares long-run education outcomes for cohorts age-eligible for primary school during the massive expansion in labor migration (1967-1973) and during the labor ban years (1974-1977) to age ineligible cohorts across areas with high versus low exposure to the labor demand shocks. We use 1998 and 1977 Census data to measure long run educational outcomes and marshal newly assembled administrative data on spatial differences in historical access to mine recruiting stations to create community-level measures of high and low shock exposure.

We use two different comparison cohorts who are not age-eligible for primary school at the time of the shock. The first, younger, comparison cohort is eligible for primary school from 1977 onwards, that is, after the end of the shock. The second, older, comparison cohort is eligible for primary school before the start of increased labor migration to South Africa, that is, before 1967. Because of selective mortality concerns among oldest cohorts in the 1998 Census data, we create a dataset containing the eligible and older ineligible cohorts by stitching together 1977 and 1998 Census data at the age group-district-sex level. We use the microdata from the 1998 Census for our main empirical analysis using a difference-in-differences strategy and validate our results using the aggregated hybrid dataset. .

As a specific test of whether local technology of production matters for how international labor migration affects education outcomes, we estimate difference-in-differences regressions for two different communities. The first group of communities is characterized by tea and tobacco plantations, where child labor is a good substitute for male labor (Eldring 2003, Chirwa 2005 and Otañez 2006). The second group of communities has none of these cash crop estates and is characterized by agricultural production that is less amenable to using child labor instead of male labor. We test whether the impacts of migration are different across areas with these different local production technologies.

The historical experience of labor migration from Malawi provides an interesting setting for our research questions. First, there is only a single selection problem to consider – only adult men (and not the entire household) were permitted to move (Gibson, McKenzie and Stillman 2011). Second, unlike many other studies of migration, migrants were required to return home after two years and required to have two thirds of their earnings diverted into deferred pay. Hence, we know that regardless of migrant motives for migrating and sending money home, flows of capital back to the rural areas were substantial. Third, rather than compare outcomes across households with and without migrants, we compare outcomes across communities with differential access to mine jobs. Being in a district with a mine recruiting station

substantially reduced the costs of migrating, as we explain in Section 2. These recruiting stations were established a good twenty to thirty years before the labor treaty and labor ban occurred. Although areas with and without access to these recruiting stations may differ on a number of dimensions, we can control for several important historical and geographic variables that are likely to affect station placement and education outcomes. We can also control for district fixed effects to account for remaining differences in unobservables.

Our main results suggest that greater exposure to international labor migration contributed to a 1.4-1.8% increase in total years of education and a 2% increase in any primary schooling attainment among age eligible cohorts. This accounts for about 6.6% of the total increase in enrollment rates between 1962 and 1978 (Heyneman 1980). These positive net effects are evident for the cohorts age-eligible for primary school during the expansion of labor demand as well as for cohorts age-eligible during the labor ban years. They are of similar size for both shocks, and for both younger and older comparison cohorts . And, although mine work dies up during the labor ban, the historical evidence shows that returning miners would have had up to three years' worth of earnings to draw down upon return. These positive education effects of exposure to the dramatic rise and fall of international labor migration in Malawi suggest that the effects of income on human capital accumulation of children outweigh the substitution effect of adult labor migration.

We, do, however, find suggestive evidence that substitution technologies in agricultural production contribute to our results. The positive impacts of labor migration on education are present only in the subsample of districts that do not have large agricultural estates. In other words, we estimate positive impacts for total years of schooling and share of the population with any primary school, but only in areas where child labor was a less good substitute for male labor. While more work is needed to flesh out these heterogeneous effects, the initial evidence indicates a role for local production technologies to determine the impacts of labor migration on sending communities.

This project is part of a broader research agenda on how international, circular labor migration has long-run effects on rural agricultural labor markets. Our paper relates to several literatures. At the broadest level, our finding that migration promotes educational attainment in the next generation is hopeful for the very poorest of countries, where the migration of one adult towards places of improved employment opportunities is often the best escape from poverty for an entire household. The empirical literature on the effects of international migration on education outcomes has been mixed (Yang 2008, Gibson et al 2011,

Cox-Edwards and Ureta 2003, McKenzie and Rapoport 2011)[3], often focused on middle income countries, and almost non-existent in the case of Africa. Our paper deepens the evidence for Africa, and broadens the discussion by pointing out that local production technologies matter for the human capital effects of migration. These positive effects are also not necessarily limited to international labor migration but may apply to any type of internal, circular migration, a widespread phenomenon in developing countries.

Second, while we do not yet have direct evidence on the amount of time that children spend working, our results contribute to the child labor literature (Edmonds 2009). This literature generally finds that child labor declines and educational outcomes improve in the wake of transitory income shocks (Edmonds and Schady, the Nicaragua coffee boom paper). However, these income shocks are almost never caused by an adult member of the household moving away. We provide new evidence that even when men do move away, replacement income in the form of remittances can still improve education outcomes.

Third, we open a new area of research in the economic history of *apartheid*. Much of this literature focuses on the South African experience of *apartheid* and does not consider the impacts of the structures of *apartheid* on South Africa's many northern neighbors.[4] Given the extent of involvement of the Chamber of Mines in recruiting large numbers of men from Malawi, Zambia, Zimbabwe, Tanzania, Angola, Lesotho, Swaziland and Botswana over a number of years, it is perhaps surprising that there is such a gap in the literature. We assemble newly collected disaggregated data and provide new evidence of the long-run impacts of mine migration to South Africa that may be relevant in all of these other countries.

Finally, although we discuss Malawi's historical experience in this paper, our results have relevance for current migration policy. There are many countries with substantial outflows of foreign labor migrants and inflows of remittances. To understand the potential intergenerational impacts of this migration on education, it is important to know more about the characteristics of local labor markets of sending communities and specifically whether children are good or poor substitutes for their male (or female) migrant family members. Furthermore, abrupt cessations of foreign guest worker programs may have

[3] Cox-Edwards and Ureta (2003) and Yang (2008) both find positive impacts of migrant remittances on education spending and education outcomes. McKenzie and Rapoport (2011) estimate the impact of Mexican migration to the US on educational attainment of teen children left behind using historical migration as an instrument for current migration. They find that migration of a parent significantly reduces the total amount of schooling attained and provide evidence that boys drop out of school in order to migrate (along the lines of a "brain drain" effect) while girls who drop out do more housework. The mechanism they have in mind is that migration possibilities for teens reduce the expected future return to school because such returns are lower in the US than in Mexico. There is no explicit discussion of child labor substituting for adult labor in the Mexican context.

[4] Lucas 1985 and Lucas 1987 are exceptions, but these papers focus on national aggregate effects of the system of mine migration.

unintended negative consequences for human capital outcomes in contexts where the income effects of adult labor migration outweigh the substitution effects on child labor.

The paper begins with a brief discussion of the conceptual framework linking labor migration of adults to educational attainment of children. The next section reviews the history of mine migration to Malawi that are salient to our empirical strategy and to the interpretation of results. Section 3 describes the empirical strategy and discusses threats to validity. Sections 4 and 5 present data and results. Section 6 concludes.

1. Conceptual framework: Migration and Human Capital Accumulation

Labor migration of adult males may affect human capital attainment of children through two main channels: an income and a substitution effect. If households receive cash from migrant workers through voluntary remittances or involuntary deferred pay, they may be able to afford school fees and related expenses. Spending on education should rise if education is a normal good, and because remittances relax liquidity constraints. This positive income effect should increase enrolment and eventual educational attainment.[5] At the same time, migrant earnings could cause households to substitute away from domestic production of goods and services and towards market goods, reducing their demand for household labor. This part of the effect of extra income lowers the opportunity cost of schooling, and leads to greater enrolment and, potentially, attainment.

If income effects of having a labor migrant are particularly large, it may take some time for the positive effects of income to reverse when migration ceases. How much time depends on how much migrants have accumulated while abroad as well as on how much income they can replace upon return. In the next section, we describe how the system of mine migration from Malawi almost certainly enabled miners to return with sizeable savings, the equivalent of about three years of earnings from domestic labor.

Mass outmigration of men from rural areas could alternatively lead to excess demand for labor on the family farm and in the agricultural sector more broadly, raising the opportunity cost of going to school. Households losing migrant men may be more likely to pull children from school to substitute for male labor. And, after labor migration is shut down, we would expect households to substitute immediately back to male labor and away from child labor (with positive effects for education) upon return. Both of these substitution effects should be stronger when children are better substitutes for male labor in production.

[5] Income effects may be negative if migrant workers cease to contribute to household earnings after leaving. In our context, money is involuntarily remitted through a deferred pay scheme, so we do not consider this option.

Of course, both income and substitution effects may be at work at the same time, and in the same households for children of different ages, or in the same communities. Which effect dominates is an empirical matter. More generally, the net effect of these two forces is likely to be influenced by the degree of substitution of child for emigrant labor. In this paper, we exploit the rapid expansion and contraction of foreign labor demand to investigate whether the net effect of male labor migration on the educational outcomes of the next generation is positive or negative, and whether local agricultural production technologies helps to explain these results.

2. Labor migration from Malawi: Context

i. A brief history of labor migration to South Africa

As early as the 1900s, Malawians travelled to South Africa and Rhodesia to work as contract miners and farmworkers. We concentrate on the period between 1950 and 1990, during which time most labor migrants ended up working on the South African gold mines.[6] These mines relied on the centralized recruitment of labor resources from foreign countries coordinated through the Witwatersrand Native Labour Agency (WNLA, or Wenela), and the Native Recruitment Corporation (NRC, in 1977 the two combined to form The Employment Bureau of Africa or TEBA).[7]

Figure 1 shows WNLA data on the number of Malawian men employed on South African mines each year between 1950 and 1990. Over this forty year span, migrant labor rose from just over 10,000 men per year to a high of 120,000 men per year, and back down to almost zero. To put these numbers in perspective, at the peak of labor migration, around 20% of the adult male population was missing from the country and by 1977, 35% of the adult male population had ever worked abroad. Most of these contract mineworkers were engaged for two years at a time, after which they had to return home. Workers could reengage for subsequent two year contracts after spending some time at home (Wilson 1972, pg 68 and Lucas 1985). This labor migration was therefore highly prevalent, circular, and reasonably long-term.

The figure illustrates two clear periods of significant change in recruiting patterns. Employment on South African mines increased dramatically in the seven years between 1967 and 1973. This was the result of a new international labor recruiting agreement between WNLA and the Malawian government put in place in August 1967, in which labor quotas for South African mine recruiting were scrapped. Prior to this agreement, the Nyasaland government imposed strict quotas on mine recruiting, largely at the behest of

[6] Labor migration to Rhodesia was also substantial in the early part of the century, but this source of labor demand began to decline by the early 1960s (Clarke 1977, pg. 31).

[7] Wilson (1972) and Lucas (1985) provide accounts of how WNLA and the NRC operated as labor monopsonists in the colonies, keeping wages in the industry low by hiring workers from Mozambique, Northern and Southern Rhodesia, Nyasaland, Lesotho, Swaziland, Tanzania, Angola, Botswana as well as South Africa.

colonial estate owners (Paton 1995, pg 46). After independence, President Banda worked quickly to sign an agreement with WNLA that allowed unlimited recruiting along with mandatory deferred pay for workers (more on this below). There is a sense that workers did not anticipate the 1967 agreement (Paton 1995, pg 47). Between 1967 and 1973, mine employment grew by almost 300%, and the government enjoyed substantial foreign exchange earnings from deferred pay and remittances.

This expansion in labor demand was brought to an abrupt halt in April 1974, when a WNLA plane transporting miners back to Malawi crashed, and 74 miners were killed.[8] In response, President Banda rescinded the labor agreement, banned future recruiting by WNLA and recalled all Malawian migrant workers home (Lucas 1985; Chirwa 1996).[9] Although Banda had wanted to expand the estate sector, and had reason to recall the mine workers, the timing of this recall, initiated in response to the plane crash, was clearly unexpected.[10] In the four years between 1974 and 1977, mine employment fell dramatically. In 1977, WNLA recruiters were permitted to restart operations in Malawi but employment levels for Malawians never returned to 1970 levels as the South African mines had turned their strategy of recruitment inwards, substituting local labor for what they saw as unreliable foreign supplies (Crush 1986; Crush et al 1991, pg 129).

The unanticipated rise in external labor demand from 1967 to 1973 and sharp fall from 1974 to 1977 constitute the two sides of our natural experiment. The periods before 1967 and after 1977 represent relatively stable periods of labor demand from the foreign mining sector. In the empirical methods section, we describe how the periods before and after the labor demand shocks constitute our comparison periods.

ii. Economic conditions in the macro economy 1950 to 1990

The most important aspect of the Malawian economy during this period that is relevant for our empirical analysis is rapid economic growth in the estate sector. After independence in 1964, Banda strongly supported the development of the estate sector which specialized in producing tea, tobacco and sugar for export. Between 1964 and 1979, the country averaged 6% growth per annum (Hirschmann 1990, Kadzamira 2003) largely because of this strategy. This means that for much of the period during which external demand for mine labor expands and contracts, the local economy is also growing.

[8] *The Observer-Reporter*, April 5 1974 "77 Persons Killed in Plane Crash" http://news.google.com/newspapers?nid=2519&dat=19740405&id=q85dAAAAIBAJ&sjid=f14NAAAAIBAJ&pg=3041,1287591

[9] Banda claimed "I have killed *Wenela*" (Chirwa 1996)

[10] Certainly the South African Chamber of Mines Annual Report of 1973 did not note any concerns with regard to existing labor recruiting practices (Chamber of Mines Annual Report 1973; Paton 1995, pg 54).

The decision to work on South African mines was likely influenced by the changes in local work opportunities in Malawi generated by this economic growth. To the extent that this economic growth was felt everywhere, it should bias us against finding any differential effects of the surge and decline in migrant labor across space. Any of the improved incomes from growth in the estate sector that promote school enrollment should show up in positive trends in educational attainment across all areas, and this is indeed something we see in our data.

A larger concern is that the economic growth of the 1960s and 1970s might be felt differently across the country. These concerns motivate some of the geographic fixed effects included in our analysis. We postpone further discussion of potential threats to validity of our empirical strategy to the next section.

iii. Getting migrant workers to South Africa

Different areas in Malawi experienced the time series variation in mine employment in Figure 1 to different degrees. This was because the logistics of getting access to a mining job were neither simple nor costless. The procedure for getting from Malawi to South Africa involved several steps. A man needed to obtain official verification of no outstanding tax obligations from the local chief; then he needed to get similar approval from the local tax authority; following which he had to travel to a WNLA recruiting station. At the station, he had to pass a medical examination (mainly regarding a minimum weight requirement) and get 'attested' (approved for travel), after which he delivered the attestation documents back to the local district officer for processing of his foreign travel documents. The final step involved going back to the WNLA station to await transportation to a main WNLA depot for transfer to South Africa.

The costs associated with signing up for mine work were therefore not negligible. They also varied depending on distance to the nearest WNLA recruiting station. We collected and digitized administrative data on the location of these WNLA stations as of 1937 and show their prevalence across the country in Figure 2. The red hatched areas in the figure represent the communities (Traditional Authorities, or TAs) that had a WNLA station; the white areas show TAs without a WNLA station; and the thick black borders represent district boundaries. Each of the three regions had some access to a WNLA station.

An important part of our identification strategy rests on comparing outcomes across different cohorts from communities facing substantially different costs of signing up for mine work depending on the presence of a local WNLA station. Table 1 provides evidence that the presence of a WNLA station in a district and the number of WNLA stations in a district both predict higher labor outmigration but not trends in outmigration prior to the 1967 labor treaty. The first four columns show results from a

regression of the log of the number of men who report ever working abroad in the 1977 Census on different measures of access to WNLA stations, region fixed effects, and historical population density. All of these measures of exposure predict higher stocks of labor migrants in 1977. The second set of columns show the same results for a flow measure of migration: the log of the number of men issued foreign travel certificates between 1958 and 1963 at the district level. Again, proximity to a WNLA station positively predicts these outcomes.

When we regress the change in the flow of foreign travel documents issued between 1958 and 1960, and between 1963 and 1967 on the WNLA station variables, there is no longer any predictive power in the access to mine work variables. Changes in the flow of labor migrants prior to 1967 appear balanced across areas with and without WNLA stations. This result is consistent with the idea that the new labor treaty did not follow increases in labor flows to South Africa. We discuss where WNLA stations were located, and how these areas look like non-WNLA areas, in the data section.

iv. Getting migrant money back to Malawi

Labor migration to South Africa enabled Malawians to earn substantially more than they could at home. Average annual earnings on local estates were only 94.4 Kwacha in 1968 rising to 112 Kwacha in 1973 and to 126.80 Kwacha in 1974 (Pryor and Chipeta 1990). In contrast, average miner earnings were 183 Kwacha in 1966 (Wilson 1972, pg 46) rising to 375 Kwacha in 1974 (Crush et al 1991, pg. 19). Mine earnings were therefore always significantly higher than they would have been relative to the next best alternative: working on an estate farm in Malawi.

Because of the system of deferred pay set up and implemented by WNLA, we know that a substantial portion of these earnings found their way back to country. The labor agreement in 1967 gave WNLA permission to withhold two thirds of mine worker wages until their return to Malawi. This guaranteed that at least two thirds of earnings were automatically earmarked for return to sending communities, over and above any voluntary remittances sent by miners.[11] In 1967, the value of deferred pay from South African (686 259 Kwacha) was almost equal to the value of voluntary remittances (601,529 Kwacha) (Malawi Ministry of Labour 1963-1967). Mine-worker earnings therefore constituted a significant source of foreign exchange revenue for Malawi.

[11] The deferred pay arrangement was supported by the Malawi government, as it significantly increased the chances of the miners returning home.

While the flows of this foreign capital dried up after the labor ban in 1974, the initiation of the labor ban entailed a lump sum payout of deferred pay earnings for returning miners.[12] To If we conservatively assume that voluntary remittances are zero, then the total amount of income that a family could receive from a miner returning from a two-year contract would be 342.71 Kwacha in the years 1969-1973. In comparison, annual earnings for an estate worker were 112 in 1973 (Pryor and Chipeta 1990) Hence, miners would have returned to Malawi with the equivalent of at least three years' worth of earnings in 1974.

v. Education and child labor in Malawi 1950 to 1990

Levels of human capital accumulation in Malawi are generally low, although have increased over time. During the colonial era (1881-1963) education in Malawi was provided by missionaries who emphasized vocational training rather than literacy. In 1945, less than 6% of the population was literate. At independence in 1964, fewer than 35% of school-aged pupils were enrolled in school. Between 1959 and 1978, total student enrollment in primary school increased by 30% despite a lack of investment in primary school construction (Heyneman 1980; there were just over 2,000 primary schools for over 600,000 enrollees in 1974, and only 18 high schools in the country, Malawi Ministry of Education 1977)). By the early 1990s, primary school enrolment was up to 50% of the relevant age range (Unicef: http://www.childinfo.org/files/ESAR_Malawi.pdf).

Cost was an important constraints to going to school. Unlike many African countries that instituted free primary education at independence, school fees for primary school education were in place in Malawi until 1994. Average annual school fees were the same across the country, and around 2.75 Kwacha for lower primary and 5.75 Kwacha for upper primary school. Parents were also responsible for other expenditures on textbooks, exercise books, writing materials and school uniforms (Heyneman 1980). That school fees were a substantial impediment to enrollment is evidenced by the 50% increase in student enrollment in the following the enactment of universal free primary education (World Bank and Unicef 2009).

Although school fees were high throughout the country, noticeable regional differences in access to and investment in schooling show up as early as the 1940s. Mean educational attainment for the oldest cohorts in the 1977 Census is 0.7 years for the Northern region and 0.5 years in the Central and Southern Regions. The fraction of the population with any primary schooling was 18% in the North, and 15% and 13% in the Central and Southern Regions respectively. In 1966, over 40% of children ages 5 to 19 were enrolled in school in the North, which was double the enrollment rates in the Central and Southern

[12] We are working on finding remittance and deferred pay flows by year through the 1974-1977 period.

Regions. These differences emanated from the presence of missionary schools concentrated in the Northern Region.[13]

In the absence of technical change in agriculture during this time (Foster and Rosenzweig 1996), there would have been little reason to get much education beyond what was required for functional literacy (about 4 years of education). Positive returns to education in agriculture are typically found for this level of education (Appleton 2000). For this reason, we focus on measuring the impacts on total years of schooling attained and on the share of adults with any primary school enrolment (rather than secondary schooling or higher education; these are irrelevant outcomes in rural Malawi during this period).

In addition to having historically low levels of education, Malawi also has relatively high levels of child labor. The share of children aged 10 to 14 involved in work in Malawi in 1977 (from the only Census that records employment by age group and district) is about 17% of boys and girls. The definition of working is fairly broad, since it includes working for pay for someone else, working without pay on family farms, and working in the household. There is substantial district-level variation in the share of these 10 to 14 year olds employed: some districts have only 2% of children working, while others report employment rates of 38%.

One of the main factors distinguishing between these high and low child labor districts is the presence of agricultural estates. In districts that have tobacco and tea estates, child labor is about 21% while in non-estate districts, child labor is only 14% (results not shown). One of the reasons for these differences is likely because the returns to child labor are higher on agricultural estates. We will investigate how this spatial variation in the technology of agricultural production contributes to the main impact of mining labor demand on educational outcomes.

3. Empirical strategy

Our approach to understanding the impact of migration on educational attainment of those left behind is to test for the sign of the net effect of Malawian labor migration to South Africa between 1967 and 1977. We test between the following two hypotheses:

- *H1: The effect of income dominates the substitution effect:* When male labor leaves and remittances are sent, school enrolment and attainment rise if goods are normal. When male labor returns with accumulated remittances, enrolment and attainment may continue to be higher for a time. The net effect will be higher educational attainment in cohorts eligible for primary school in

[13] Heyneman (1980) describes how in some areas of the Northern Region, literacy rates were three times higher the national average, and over 90% of 6 year olds entered primary standard one.

1967-1973 and in cohorts eligible for primary school in 1974-1977, relative to older and younger cohorts

- *H2: The substitution effect dominates the effect of income*: When male labor leaves, schooling falls as children replace fathers at work. When male labor returns, the demand for child labor declines, and enrolment and attainment rise, at least for those young enough to return to school. The net effect is that education outcomes should decline for cohorts eligible for primary school in 1967-1974 and improve for cohorts eligible for primary school in 1974-1977, relative to older and younger cohorts.

We estimate the gap in total schooling between adults who were age eligible for primary school between 1967 and 1977 and from areas that had a WNLA recruiting station (WNLA areas) and similarly aged adults from areas with no WNLA stations (non-WNLA areas). Since areas with and without WNLA recruiting stations might differ on a number of dimensions (e.g. WNLA areas might be wealthier, or have more schools, or more land for cultivation), we construct a counterfactual difference as the same gap in schooling attainment cohorts ineligible for primary school in each of these areas. The main difference-in-differences regression model to be estimated is:

$$y_{asjd}=\beta_0+\beta_1 Eligible67\text{-}73_{asjd} + +\beta_2 Eligible74\text{-}77_{asjd} + \beta_3 WNLA_{jd} + \beta_4 Eligible67\text{-}73_{asjd}*WNLA_{jd}$$

$$+\beta_5 Eligible74\text{-}77_{asjd}*WNLA_{jd} + G_d'\pi + X_{as}'\gamma + \lambda_d + \varepsilon_{asjd} \qquad (1)$$

where y_{asjd} is the share with any primary school and total years of schooling attained by an age-sex group (*as*) from the local community (called the Traditional Authority or TA) *j* in district *d*.[14] G_d is a vector of historical and geographic district level variables, X_{as} is a vector of demographics and λ_d is a district fixed effect. For our main result, we estimate (1) using observations at the TA level, the lowest geographic unit for which we have information about WNLA stations. Because of data constraints, we estimate (1) using data aggregated to the district level for some results. Robust standard errors are clustered either at the TA level or district level since there are many observations of different ages and gender located within the same TA and district location.

The main variables of interest in this regression are *Eligible67-73*, *Eligible74-77*, *WNLA* and the interaction, or difference-in-differences terms, *Eligible67-73*WNLA* and *Eligible73-77*WNLA*. *WNLA* is an indicator for whether the community contained a mine recruiting station established by 1937 or not, or a count variable capturing the number of WNLA stations in the district. β_3 gives us an estimate of the

[14] Other education variables to be added include the share with completed secondary schooling and the share of adults who are bilingual (English and Chichewa).

schooling gap between WNLA areas and non-WNLA areas. We might expect this gap to be positive if recruiting stations are located in relatively wealthier areas to target healthier workers, or negative if they are located in areas with high demand for child labor. *Eligible67-73* and *Eligible74-77* are binary variables denoting whether an adult was age eligible for primary school during the 1967-1973 or 1974-1977 period. We define age-eligible as being between the ages of 6 and 12, since we consider the first four years of primary school to be the relevant choice margins for this population. β_1 and β_2 describe the difference in mean schooling attainment between age eligible and age ineligible cohorts in non-WNLA areas. These could be positive or negative, since non-eligible cohorts are comprised of both older and younger individuals and we know that educational attainment is increasing over time.

The interaction terms estimate the differential difference in education gaps between eligible and non-eligible cohorts in WNLA versus non-WNLA areas. As explained above, the signs of these interaction terms are ambiguous and driven by the combination of income and substitution effects. If the substitution effect outweighs the effect of income, we expect $\beta_4<0$ and $\beta_5>0$; while if the income effect dominates, β_4 and β_5 should both be positive.

To construct appropriate comparison cohorts (i.e. those not eligible for primary schooling in either of the two periods) we consider cohorts age-eligible for primary school in the post-1977 period and those eligible in the pre-1967 period. Both of these periods represented a much more stable period of mining labor demand. Appendix Table 1 shows how we construct these cohorts from Census data and their respective ages in 1967, 1974, 1977 and in 1998.

Starting with the 1998 Census, we construct a sample of adults with completed educational attainment aged 20 to 44. In this sample, the 20 to 26 year olds were only eligible for primary school after 1977 and they constitute our younger comparison cohort. The 27 to 36 year olds would have been between ages 6 and 12 at some point during the 1974-1977 labor ban, while the 37 to 44 year olds would have been 15 and above at the time of this shock. Note that in each of the eligible age groups, some individuals would have been exposed to the shock in every year between age 6 and 12, while others would have only been exposed in the first or last part of their 6 to 12 age range.

Because of concerns about mortality selection at upper ages in Malawi (life expectancy was only 46 years in the late 1990s) we cannot use the 1998 Census to construct the older comparison cohort, those eligible for primary school prior to 1967. Instead, we use the 1977 Census to construct this cohort. Appendix Table 1 shows our sample of adults from the 1977 Census is aged 20 to 44. The sample consists of some adults (ages 20 to 22 in 1977) who would have been ages 10 to 12 and hence eligible for primary school during the 1967-1973 labor expansion. Those older than 23 in 1977 were all 13 and older by 1967 and

hence unlikely to have had their educational attainment affected by the mining employment shocks.[15] We explain how we combine the 1998 and 1977 Census data for estimation in the next section.

Identification of the difference-in-differences parameters in (1), β_4 and β_5, requires that schooling attainment gaps between ineligible cohorts in WNLA and non-WNLA areas represent a valid counterfactual for the gap between eligible cohorts across WNLA and non-WNLA areas. While levels of education may be different across WNLA and non-WNLA areas, we need the cohort trends in education before 1967 and after 1977 to be the same in both areas. We also rule out any contemporaneous shocks to primary schooling that only occur in WNLA or in non-WNLA areas between 1967 and 1977 and which could confound the interpretation of our results (for example, local shocks to agricultural production between 1967 and 1977 that change household incomes and thus the demand for primary schooling).

WNLA stations are not randomly allocated across space. To get some idea about the factors driving selective placement, Table 2 presents correlations between historical and geographic variables and the location of WNLA stations at the TA and the district level. We use an indicator for WNLA station in the TA as the outcome in the first five columns and the number of WNLA stations in the district as the outcome in the remaining four columns. Interestingly, log population density measured in 1945 has no significant predictive power for whether a TA or district have any recruiting stations (results are the same if we use 1931 population density). Instead, the fraction of men who work in private estates in 1945 is negatively related to placement of the recruiting stations, while having a higher male/female sex ratio is positively related to placement of these stations and being in the Northern region positively predicts WNLA station placement (there are more agricultural estates in the Southern Region). These relationships are robust, and make sense. Recruiting stations are less likely to be seen in places with more male labor working on large European farms and more likely to occur in areas with a higher sex ratio, or, with more potential mineworkers (columns 3-5). These correlations are similar at the district level, althought not statistically significant.

With this selective placement in mind, equation (1) has several controls that allow us to limit concerns about contemporaneous shocks driving the results. By including district level controls for historical population density and geography, region fixed effects, and eventually district fixed effects, we compare schooling gaps between WNLA and non-WNLA areas (i.e. in different TAs) with the same historical population densities, or within the *same* district. Since geography, agricultural conditions, weather and

[15] Because the 1977 educational attainment data are only reported in five-year age categories by sex and district, we create a slightly fuzzier measure of *Eligible67-73* that is one for the age group 20 to 24 in 1977, and otherwise zero.

population density vary much more down the length of the country and across regions and districts than within a district, we eliminate many potentially confounding factors with these controls.

A potential threat to validity arises because WNLA station areas may have experienced different local labor market conditions from non-WNLA station areas during the 1967 to 1977 period. These different local labor market conditions may have had simultaneous effects on human capital investment. As discussed in the historical background section, the local agricultural estate sector was growing during the years that mining employment was expanding and then contracting. This growth was not evenly distributed across the country. Since WNLA stations tend to be located in areas with less historical estate employment, we assume that the positive effects on Malawi's economic boom from the mid-1960s to the late 1970s had larger impacts on non-WNLA areas.

How does this affect interpretation of results in (1)? If non-WNLA areas experienced increases in employment due to the expansion of the agricultural estate sector at the same time that WNLA areas experienced an expansion and contraction of external labor demand, we might expect our results to be biased in ambiguous ways. Growing employment in the non-WNLA areas would lead to rising incomes, and since men do not leave Malawi to take up these jobs, there is no substitution effect pulling children out of school as there is in WNLA areas.[16] In WNLA areas, if the income effect is larger than the substitution effect, increasing employment in non-WNLA areas would bias our results downwards (make them less positive). If instead the substitution effect outweigh the income effect in WNLA areas, we might estimate larger negative effects of access to mining work in South Africa. We are working to include controls for district and region-specific trends in educational outcomes to address some of these concerns. Nonetheless, the characterization of potential biases implies that if we estimate positive impacts of international labor migration from (1), these are likely to be underestimates of the true results.

One way that we use information about estate locations is to test for heterogeneity in responses to the mine labor expansion and contraction. As discussed in Section 2, we know that child labor is a particularly good substitute for male labor on agricultural plantations in Malawi. We estimate (1) for the subset of districts that have large tea and tobacco estates as well as for the subset of districts without. If the removal of male labor through international migration does create pressure to substitute towards child labor at all, we should see smaller net effects of access to South African mine work on educational attainment in estate districts than in non-estate districts. That is, the impacts of international labor migration will depend on the local technology of production and substitutability of child for adult labor.

[16] Or,even if men are vacating own farm jobs for work on agricultural estates, we would expect the substitution effect to be much smaller when these agricultural jobs are still in home districts.

4. Data and descriptive statistics

i. Data and sample

The main source of data we use to measure differences in human capital attainment is the 100% sample of the 1998 Malawi Census microdata covering individuals all three regions (North, Central and Southern Malawi), 27 districts and 227 TAs (communities) of Malawi. A TA contains roughly 44,000 people, while districts are larger, consisting of many villages and with an average population size of 370,000 people. We restrict the main sample to men and women aged 20 to 44 in 1998 and exclude adults living in any of the four towns of Malawi (Blantyre, Lilongwe, Zomba, and Mzuzu) since they would likely have had additional economic opportunities outside of mine work and farm work.[17] WNLA status of an area varies at the TA level (most locally), so we collapse all variables to age, location and gender level and estimate OLS regressions weighted by population counts in each cell.

To create older comparison cohorts, we use the 1977 Census data that reports educational attainment by age group (5 year age groups), sex and district. These data are therefore only available at a more aggregate geographic level than the 1998 Census data. To join the two datasets together and exploit the information for older cohorts captured from the 1977 Census, we further collapse the 1998 data to age group-sex-district level. All regressions on this district level sample are also estimated using population weights.

For all analyses, we use self-reported age in years to determine whether an individual was part of the exposed or non-exposed cohorts. Appendix Figure 1 presents histograms of reported ages by WNLA station status of the area from the 1998 Census. While there are some spikes on the decadal ages (20, 30 and 40), there are no other obvious age heaps on ages ending in 5. Also, since we are not creating an eligibility variable using a specific year of exposure, any misclassification of ages on the beginning or end sections of the eligible cohorts is likely to bias us against finding any significant differences between eligible and ineligible groups, within or across WNLA and non-WNLA areas.

An important concern is whether we can accurately identify where the adult grew up and was likely to be in school. Differential internal migration across regions, districts and TAs could be problematic for our identification strategy because we might differentially assign an adult to be from a TA in 1998 that has an historical WNLA station when in fact, they grew up in a non-WNLA district. If more educated adults are more likely to move from WNLA areas to non-WNLA areas, or less educated adults are more likely to move in the reverse direction, we might be concerned that comparisons of adult outcomes across WNLA and non-WNLA are confounded by this migration choice. Note that for this to be a major problem for our

[17] This exclusion affects only XX% of the adult sample.

difference-in-differences comparison the differential migration would have to take place only among those cohorts that were age eligible for primary school between 1967 and 1977.

The 1998 Census data does not contain any information on internal migration that we can use to look at this issue. However, others have estimated low rates of internal migration across regions: Segal (1985) uses 1977 Census data to estimate that only about 1.8% of the population moves across regions in the year before the Census. We regressed Segal's (1985) district-level measure of migration intensity (number of migrants per 1,000 people) on the number of WNLA stations in the district, region fixed effects, the log of population density in 1945 and an indicator for high malaria area. The coefficient on WNLA stations was statistically insignificant and small relative to the outcome mean (*p*-value 0.176; coefficient 7.11; mean of migration intensity 109 and standard deviation 33.6). This gives us some indication that differences in internal migration rates across districts are not likely to be correlated with WNLA status of the district.

To construct the TA and district-level measures of the costs of getting access to mine work in South Africa, we collect data from administrative records on the location of WNLA recruiting stations prior to 1937. For the TA-level analysis, we use an indicator for whether the TA has any WNLA station or not (shown in Figure 2). In the district level analysis, we use the number of WNLA stations in the district (results are similar if we use an indicator for at least one WNLA station in the district or the share of TAs in the district with any WNLA station). Importantly, there are recruiting stations across the length of the country – hence we can make comparisons across exposed and non-exposed cohorts within regions (including region fixed effects) and also within districts (including district fixed effects). This allows us to create better counterfactuals by controlling for differences in outcomes that might arise because economic alternatives to mining differ across large districts and larger regions

ii. Summary statistics

Table 3 presents summary statistics for baseline variables captured at the district level in Panel A, for outcome and control variables at the TA-age-sex level in Panel B, and for outcome and control variables at the district-5 year age group-sex level in Panel C. We present means for the full sample and for areas with and without WNLA stations along with the *p* value of the difference in means.

Panel A shows that about 60% of districts have at least one WNLA station and the average number of stations per district is just under 3. In non-WNLA areas, just over 30% of men report ever working abroad by 1977, while 37% of men in the WNLA areas report working abroad. There are some differences across WNLA and non-WNLA areas. WNLA districts have a lower population density in 1945 and a lower

male/female sex ratio in 1945. While men are equally likely to earn wages from any source across both areas, it does look like there was more unemployment in WNLA areas just prior to 1967, and a smaller fraction of men working in private estates in 1945. Controlling for district fixed effects will be important for these reasons.

From Panel B, about 20% of TAs in the country have a WNLA station. Eligible and ineligible cohorts are balanced across WNLA and non-WNLA areas, and completed years of schooling among the adult sample is also balanced. The mean level of education among adults aged 20 to 44 in 1998 is exceptionally low, at 4.36 years (just over that required for functional literacy), and only two thirds of this adult sample has ever been to primary school. The sample is not balanced across region. Within WNLA areas, more of the sample comes from the Central areas than from the Southern areas, and this pattern reverses in the non-WNLA areas. This is consistent with the fact that estates were historically prevalent in the South, and prior to 1937 labor recruiters chose to locate away from these areas.

In Panel C, we see that among children age-eligible for school in 1977 (the end of the labor ban), enrollment and grade for age attainment is significantly higher in WNLA areas than in non-WNLA areas. This is the first indication we have that among eligible cohorts, exposure to mining employment of fathers may have led to increases in educational attainment. Using the combined 1977 and 1998 adult sample, completed years of education are still very low: adults have under 2 years of completed education.

4. Results

i. Difference-in-differences estimates using younger cohorts as comparison: TA-level analysis

Table 4 presents the main result of the paper. We show means, standard deviations and the cell counts for each of two outcomes measured in the 1998 Census data at the TA-level: total years of schooling in 1998, and any primary school attained.[18] These statistics are provided for each variable across WNLA and non-WNLA areas for cohorts eligible for primary school between 1967 and 1973 (row 1), for cohorts eligible for primary school between 1974 and 1977 (row 2), and for the younger comparison cohort eligible for primary school after 1977 (row 3). Differences in means across WNLA and non-WNLA areas are reported, along with difference-in-differences comparisons in the lower part of the table.

The first thing to notice is that educational attainment is uniformly higher (and statistically significantly different) in WNLA areas than in non-WNLA areas for all cohorts. Second, education is rising over time in both areas, from a mean of between 3.1 and 3.5 years for the oldest cohorts, to a mean of 4.3 to 4.6 years for the youngest cohorts. Controlling for the education gap between WNLA and non-WNLA areas

[18] Results are similar for share of completed primary school and bilingualism.

among the youngest comparison cohorts, we estimate that cohorts eligible for schooling during the expansion of mine employment in Malawi gained 0.08 more years of education. Similarly, WNLA cohorts eligible for schooling during the labor ban also gained 0.08 more years of schooling relative to non-WNLA cohorts. The difference-in-differences estimates for share of cohort attaining any primary school gives message similar result: WNLA cohorts eligible for school between 1967 and 1977 were between 1.3 and 1.6 percentage points more likely to have ever attended school relative to non-WNLA cohorts, and controlling for differences in enrollment rates across WNLA and non-WNLA areas in the youngest comparison group.

Three of these four estimates are significantly different from zero at conventional levels even without including any of the variables that we know are relevant for educational attainment. Table 5 presents the difference-in-differences regression results for the same outcome variables, adding controls for sex, age and age squared, region fixed effects and the log of district-level population in 1945 in columns (2) and (5) and adding district fixed effects in columns (3) and (6).

The results are very similar to those in Table 4. The differences in total years of schooling attained across WNLA and non-WNLA areas (on average) are now no longer significant. For both outcomes, the mean differences across WNLA and non-WNLA areas become small and insignificant once district fixed effects are included. National trends in educational attainment show up in the highly significant and large coefficients on the eligibility dummies that are robust to including additional controls and district fixed effects. The difference-in-differences estimates are both positive and similar sized for cohorts eligible during the labor expansion and contraction, although most precisely estimated for the cohorts eligible during the labor ban. To put these estimates in perspective: cohorts eligible for school in WNLA areas during the expansion and contraction of mining employment gained an additional 0.07 years of education and were about 1 to 1.5 percentage points more likely to have ever been in primary school. This represents a 1.6% gain in total years of education and a 1.4 to 2.2% gain in the share with any primary school.

ii. Validating the main result using older cohorts as comparison: District-level analysis

Table 6 presents results from the combined 1977 and 1998 Census data aggregated to the district-5 year age group-sex level. In this sample, the comparison cohorts are all older and eligible for primary school prior to 1967. The youngest cohorts in the 1977 Census (ages 20 to 24) and all of the 1998 Census cohorts

(ages 25 to 44) are part of those eligible during the mining labor expansion or the labor ban.[19] The measure of access to mining jobs in these regressions is the number of WNLA stations in the district, assuming that a larger number of stations further reduces the cost of getting to a recruiting station and signing up for a job. The mean number of WNLA stations in the district is 1.95.

The increasing trends in education over time are now observed in the large positive and significant coefficients on eligibility indicators, while the coefficients on the WNLA variables are still positive. Once we add controls, and district fixed effects to each regression, we estimate positive values for β_4 and β_5. These coefficients are usually significant at the 10% level - power is an issue since we have far fewer observations at this district-level of analysis than in the prior TA-level analysis. The results are also fairly robust to including district fixed effects.

Table 6 indicates that WNLA cohorts eligible for primary schooling between 1967 and 1977 get more total years of education and are more likely to have entered primary school than non-WNLA cohorts, controlling for differences between these areas in older comparison cohorts. In districts with one additional WNLA station, attainment is about 0.042 years higher among cohorts eligible during the labor expansion, and about 0.09 years higher during the labor contraction. The share with any primary schooling among these WNLA cohorts rises by between 0.5 and 1.7 percentage points. These point estimates are reassuringly similar to those estimated in Table 5 using on the 1998 data and the younger cohorts as comparison. Relative to the mean values of outcomes in this sample, the point estimates represent between 1.8 and 4.5% more education, and between 1.3 and 4.5 percent higher enrollment in primary school.

Figure 3 presents the main educational attainment results of the paper graphically. The figure plots the age group coefficients obtained from regressions like those estimated in Table 6 but using individual age group dummies instead of cohort eligibility dummies. These regressions are estimated using data from all cohorts (older comparison cohorts, both sets of eligible cohorts, and younger comparison cohorts). We plot one line for the age group coefficients (added to sample mean of education) from non-WNLA areas, and another for age group coefficients from WNLA areas.

The graph shows the strong trends in education levels over time in both areas. For the oldest cohorts, mean education is around 1.5 years; for the youngest cohorts in 1998, mean education is closer to 5 years of education. The vertical lines in the graph roughly demarcate cohorts who are eligible for primary

[19] Recall that we cannot perform an exact mapping from age to cohort eligibility as in the TA level analysis, since the 1977 Census data are only reported in 5 year age groups. We make the 1998 data comparable by collapsing data to 5 year age groups, so the assignment to eligibility cohorts is fuzzier than in the previous analysis.

schooling during the expansion of mine employment (cohorts age 35-49 in 1998) and those who are eligible for primary schooling during the labor ban (cohorts age 25-34 in 1998). The graph shows that both areas had very similar trends in education among cohorts eligible for primary school prior to 1967 and for those eligible after 1977.

Around about the age group 40-44 years, mean education of adults in WNLA districts starts to increase more rapidly than for those from non-WNLA districts. This higher level of educational attainment is maintained throughout the labor ban cohorts, and interestingly, does not continue rising but stays steady for the 1974-1977 cohorts. This is consistent with there being a lingering effect of income after the labor ban is initiated. Among younger cohorts, the education gap looks like it starts to close again post-1977, although it is hard to discern from the graph whether this is because the non-WNLA areas close the gap, or because WNLA areas start to fall behind.

The results of Tables 4, 5 and 6 and Figure 3 indicate that the net effect on education of Malawian children of exposure of adult males to new access to mine work in South Africa was positive, and roughly the same for both types of eligible cohorts. This evidence suggests that in the wake of men leaving to work in South Africa, the demands of child labor did not crowd out the demand for schooling and that in fact, the income effects associated with mining employment outweighed any substitution effects. The fact that we find positive effects for cohorts eligible during the labor ban indicates that these income effects lingered for some years after men returned from the mines.[20] We next discuss the magnitudes of the changes in income between 1967 and 1977 that contribute to these educational gains.

iii. Magnitudes

We have shown using a difference-in-differences research design with two distinct comparison groups that exposure to mining employment in a foreign country raised total educational attainment by 1.4-1.8% and raised the share of adults who had ever been to primary school by around 2%. These shocks to mine employment therefore account for about 6.6% of the total increase in enrollment rates between 1962 and 1978 (Heyneman 1980).

Given the size of the earnings associated with mine employment in South Africa discussed in Section 1, it seems reasonable that investments in human capital would have risen to this extent and also reasonable that the income effect would outweigh the substitution effect for child labor. This finding is consistent

[20] We show this lingering effect by showing that among children aged 6 to 15 in 1977 (at the end of the labor ban), enrollment in school and grade for age attainment is higher for children exposed to the labor ban at school entry age and in WNLA areas. Results not shown. Thus, although fathers lost their mining jobs and returned home, the income from saved remittances and involuntary deferred pay enabled children to continue in school during these years.

with Lu and Treiman (2011) who find that the income effect dominates the substitution effect for households wit migrant workers in South Africa.[21]

While an initial consideration of the labor ban might lead us to conclude that education should have fallen for those cohorts eligible for schooling between 1974 and 1977, the fact that returning miners would have received an equivalent of three years' worth of local income all at once when they lost their jobs means that the income effect of international labor migration lasts a long time. The size of the income shocks experienced by miners needs to be understood relative to local economic opportunities. In the early years of labor expansion, mine wages were around 183 Kwacha per year, while the minimum estate wage was 94.4 Kwacha. By 1974, wages on the estates had risen, but nowhere near the level of wages on the mines. An estate farm worker in 1974 could earn about 126 Kwacha per year, while on the mines, such a worker would have earned deferred pay of roughly three times that amount (312-390 Kwacha per year). Thus, returning miners would never have been able to replace their lost mining income fully, despite the fact that the estate sector was growing rapidly until the late 1970s.[22]

iv. Heterogeneity with respect to local agricultural production technologies: Do net effects depend on substitutability of child for adult labor?

Unfortunately, we have no direct evidence capturing how child labor may have changed between 1950 and 1990. In lieu of this, we investigate whether the education impacts that we estimate are heterogeneous in ways that would suggest at least some substitution of child for male labor during the labor expansion and contraction. We estimate versions of (1) using the 1998 TA-level data for two groups of districts: those with large tobacco and tea plantations and those without.[23]

Table 7 shows the estimates of β_4 and β_5 for each of these subgroups and each education outcome. The major point to notice is that all of the positive education impacts are estimated in the sample of districts without large agricultural estates. In these districts, cohorts eligible for primary schooling between 1967 and 1977 have between 0.9 and 0.14 more years of education and are between 1.2 and 1.9 percentage points more likely to be in school. These effects are large, and often statistically significant. Moreover, the effect sizes (differences between the eligible cohort coefficients) are consistent with there being a larger impact among cohorts eligible during the labor expansion than during the labor contraction (although these differences are not statistically significant).

[21] Lu and Treiman (2011) find that the odds of attending school are 1.3 times higher for children from households with a migrant worker.
[22] Paton (1995, pg 56) notes that while migrants returning from South Africa did move to the estate sector, they were generally too well off to seek immediate employment.
[23] We take the definition of these districts from Christiansen (1983).

In contrast, the coefficients estimated for estate districts are never statistically significantly different than zero. In fact, for the years of education outcome, point estimates are negative, and larger for cohorts eligible during the labor expansion. We are cautious in interpreting these negative coefficients as strong evidence that international labor migration led to increased child labor in estate districts.[24] However, we do consider the positive net effects estimated for the no estate districts as reasonably good evidence that where child labor was not a good substitute for male labor, the effect of international labor migration and concomitant remittance flows was to increase investments in schooling.

5. Conclusions and future work

We have used two waves of complete Census data from 1977 and 1998 to show that the massive and unanticipated expansion and sudden contraction of employment of Malawian men on South African mines over a ten-year period had lasting effects on the human capital attainment of following generations. This new evidence from Africa shows that the income effects of labor migration on the demand for education seem to outweigh the substitution effects of this migration on the demand for child time in the labor market. Depending on the technology of production– specifically, whether adult and child labor are good substitutes or not – international migration of adults can have long-lasting positive effects on human capital accumulation across generations.

While the historical context of labor migration from Malawi is quite specific, our results have broad relevance for development economists interested in migration. International migration is often considered to offer one of the most immediate ways out of poverty and our paper provides direct evidence on one of the mechanisms through which this migration can positively impact the lives of those left behind in sending communities, even in contexts where child labor is highly prevalent.

Our ongoing work will develop improved and more disaggregated measurements of the location of historical agricultural estates to further probe how the technologies of production in local labor markets determine how human capital investment choices respond to international labor migration. The analysis of women's work in the wake of mass exit and re-entry of male labor along with substantial remittance flows is an another important avenue for future research.

[24] We are developing data on the physical location of estates across the country to better probe this mechanism.

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Figure 1: Annual recruitment of Malawian miners to South African mines, 1950-1994

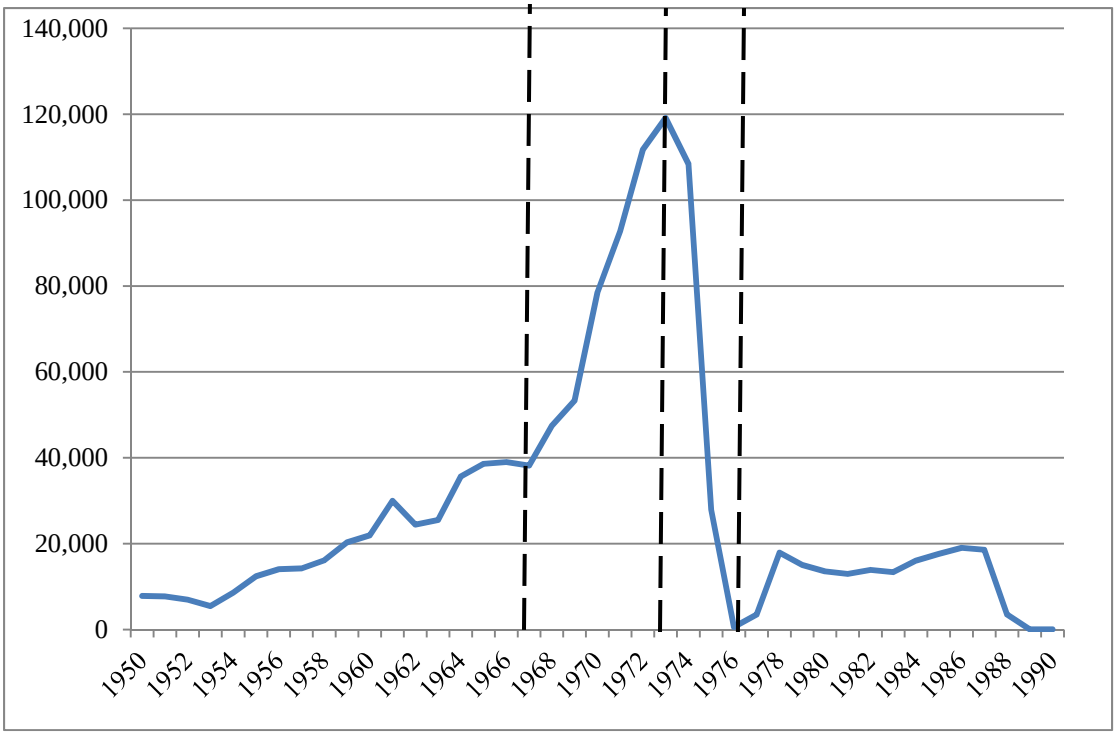

Figure 2 shows number of Malawian workers recruited to work on mines in South Africa in each year, 1950-1994. The three dotted lines represent (from left to right) the initiation of the new recruiting agreement in August 1967, the moratorium on migration to South Africa after the April 1973 Malawian plane crash and the legal resumption of mine migration to South Africa in 1978.

Figure 2 The spatial distribution of mine recruiting stations across Malawi

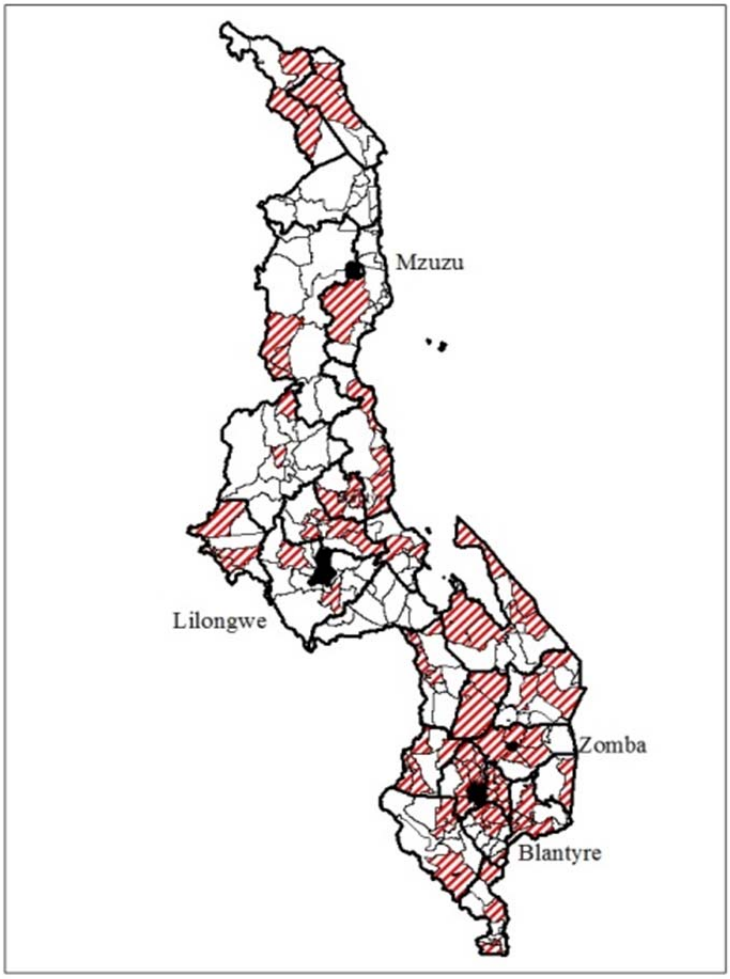

Figure 2 shows district boundaries (thick black lines), traditional authority boundaries (thinner black lines) and the distribution of WNLA recruiting stations (red hatched areas) across the country. Malawi's four cities (black shaded areas) are excluded from the analyses.

Figure 3: Mean education by age group and WNLA status of district

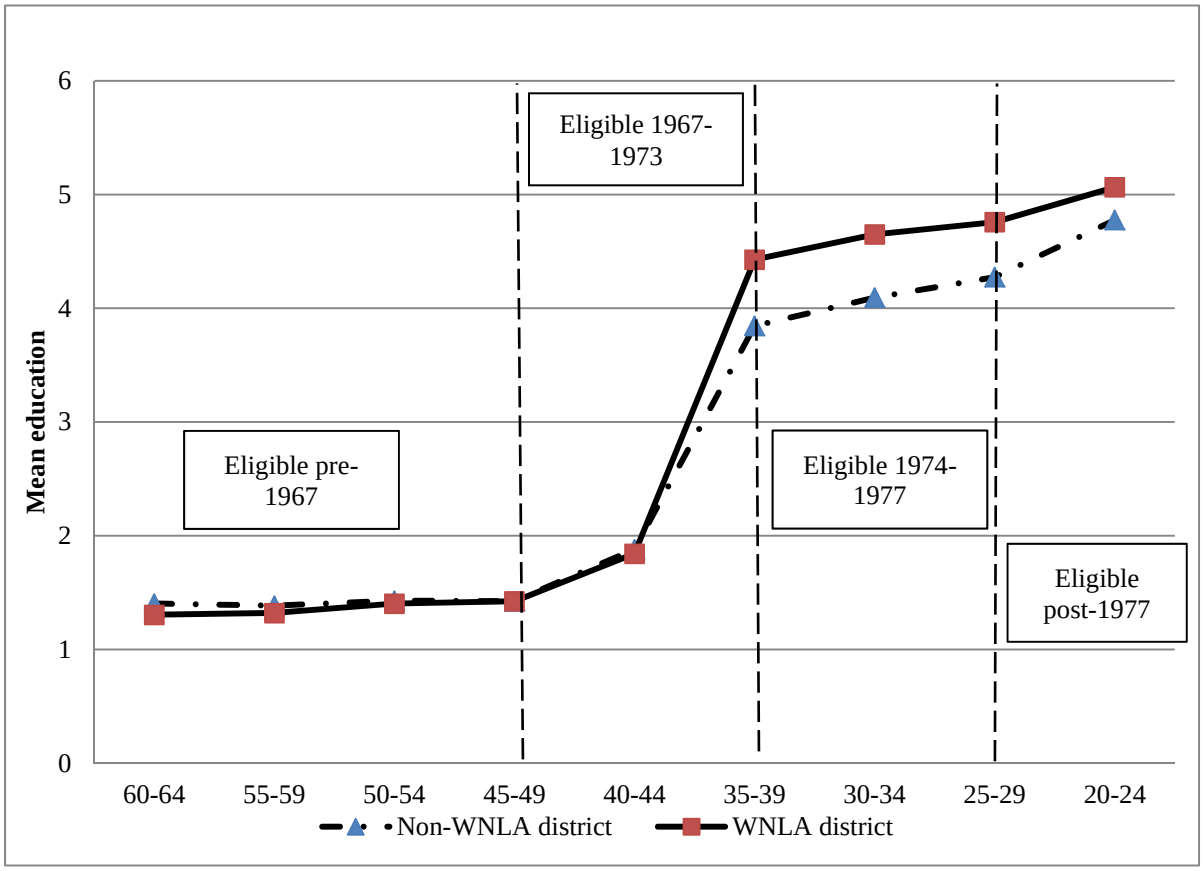

Figure 3 shows age group coefficients from a regression of total years of education on 9 age group dummies and their interaction with a WNLA station indicator and all other control variables (as in Table 5)