Impact of mineral discoveries and productions on educational Intergenerational Mobility in Africa★

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Abstract

We study the potential role of mineral discoveries and productions on educational intergenerational mobility for more than 14 million individuals across 28 African countries and 2,890 districts. We find that mineral discoveries and productions positively affect educational IM for primary education in Africa for individuals exposed to the mineral sites and living in districts with discoveries. Specifically, upward primary IM increases by 2.7 percent following mineral discoveries and 6.7 percent following mineral productions. Downward primary IM decreases by 1.2 percent following both mineral discoveries and productions. However, no significant effects are found for secondary and tertiary educational IM. We also unveil four transmission channels through which the positive effects of mineral discoveries and productions on educational primary IM operate, including the income effect proxied by parents working in the mining sector, the structural transformation of the local economy, the returns to education, and the provision of infrastructures.

Keywords: Africa, Educational Intergenerational Mobility, Mineral discoveries and productions, Generalized Difference-in-differences, Natural experiment

JEL: C55, I21, I25, I26, N9, O10, Q32

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1 Introduction

Africa, a continent with many opportunities, has emerged out of decades of stagnant and unstable economic growth since mid-1990s. According to Young (2012), Sub-Saharan living standards have, for the past two decades, have been growing about 3.4 to 3.7 percent per annum, reflecting the African "growth miracle", i.e., increases of real consumption, the quality of housing, the health and life expectancy of children, the education of youth, and the allocation of female time in the household. The "growth miracle" has been accompanied by significant improvements in education. Specifically, in Sub-Saharan Africa (SSA), gross enrollment in primary education almost doubled from 54 percent in 1970 to 99 percent in recent years. For secondary and tertiary education, it has been more than three and six times higher in recent years compared to 1970, from 13 to 43 percent and 1.4 to 9.4 percent, respectively. Likewise, the percentage of students across the region who complete primary and lower secondary education rose by around 22 percentage points, from 46 to 69 percent and 22 to 44 percent, respectively (WorldBank, 2020). Indeed, many countries have come close to achieving their goals to provide an education to all citizens. These improvements have been observed for both rural and urban areas as well as females and males.[1] As a result, intergenerational mobility in education which measures children education relative to their parents has also significantly increased across African countries, above the levels in Latin America. But it remains lower in the region compared to Western countries, Asian countries, and Eastern Europe countries (Hertz et al., 2008; Azomahou and Yitbarek, 2020; Henn and Robinson, 2021). As shown by Henn and Robinson (2021), actual and perceived social and educational intergenerational mobility constitute one of the three Africa's latent assets that will drive its economic prosperity and bright future. It is critical for an equality of opportunities for all Africans.

Against this background, few researchers have investigated the determinants of educational intergenerational mobility in Africa. They conclude that critical determinants

[1] However, nearly one in three students and more than half students still do not complete primary school. In addition, the evidence on the ground also reveals a rise in inequality of education across African countries, income inequalities, uneven social and economic progress, poverty traps, episodes of many financial crises, suggesting that some further improvements are still needed.

include individuals characteristics (e.g., gender, race), access to credit markets, quality of education, globalization, FDI, urbanization, colonial investments in the transportation network, proximity to the coasts or capitals, huge investments in human capital following independence, and drastic changes in the educational systems (Nimubona and Vencatachellum, 2007; Alesina et al., 2019; Azomahou and Yitbarek, 2020; Baah and Eshun, 2020). However, this literature has overlooked the potential role of natural resources, specifically, of mineral discoveries and productions on educational IM. Our paper fills this gap, especially given the predominance of mineral resources across the African countries. Indeed, the African continent is home to an abundance of mineral resources that include gold, silver, diamonds, emerald, ruby, iron, copper, coal, bauxite, cobalt, uranium, platinum and more. It hosts 30 percent of the world's mineral reserves, 40 percent of the world's gold and up to 90 percent of some minerals like chromium and platinum. Moreover, these last decades, there have been regularly giant discoveries of natural resources worldwide and in Africa Seri (2021). According to Minex Consulting database, 969 moderate to super-giant mineral discoveries occurred in Africa between 1950 and 2019, and 396 of them (40 percent) since 2000. As a result, Africa represents a significant share of the global production and export of important minerals and metals. In Africa, exploitation of mineral resources makes a significant contribution to foreign exchange earnings through exports, government revenues, employment, and GDP. However, mineral resources can be at the same time a blessing or source of hope for the future and a curse or sources of difficulties and fragility. The proper use of mineral resources for a country's long-term economic and social development is not automatic. Indeed, growth in the mining sector does not necessary shift an economy towards better industry processing, services, i.e., structural transformation, education, health, job creations, and inclusive growth and development.

Considering this, the literature has analyzed the effects of natural resources on several variables at both the macro and local levels. Its conclusion is nuanced. At the macro level, most papers in this literature show that natural resources have been a curse than a blessing, as well illustrated by the Dutch Disease literature.[2] Others show positive effects on foreign direct investments in non-resource sectors (Toews and Vezina, 2017), or ambiguous effects on macroeconomic activity and financial conditions (Arezki et al., 2017; Seri, 2021). At local level, a positive effect of natural resources has emerged in more recent analysis focusing on African countries or other developing countries (see e.g., Fisher et al., 2009; Goderis and Malone, 2011; Hausermann et al., 2018; Zabsonré et al., 2018; Cavalcanti et al., 2019; von der Goltz and Barnwal, 2019; Cust and Mensah, 2020; Bhattacharyya and Mamo, 2021). More specifically on education, the literature is also inconclusive. Some papers find that natural resources exert a decrease of education in developing countries (see e.g., Leamer et al., 1999; Gylfason, 2001; Ahlerup et al., 2020). Other find that natural resources abundance or dependence is positively associated with human capital accumulation, notably through the increase of public spending in education (see e.g. Stijns (2006); Kim and Lin (2017) for cross-country analysis, and Pegg (2010) for the case of Botswana), and that the effects may diverge depending on whether our focus is the quantity or the quality of education, the levels of education or the characteristics of individuals Farzanegan and Thum (2020); Gradstein and Ishak (2020).

In this paper, we analyze the potential role of mineral discoveries and productions on educational IM in 28 African countries, 2,890 districts and for individuals aged between 16 and 50 and born between 1950s and 1990s. To do so, we mainly use data from IPUMS and Minex Consulting Datasets. To the best of our knowledge, this is the first paper that investigates this link while focusing on Africa. Outside of Africa, only Bütikofer et al. (2018) study the effects of oil discoveries on earnings intergenerational mobility in Norway. First, we provide a panorama of the trend, dynamics, and disparities of educational IM across countries, regions of the continent, and depending on the characteristics of the individuals, using the conditional absolute measure of IM following Alesina et al. (2019). Second, we empirically study the effects of mineral discoveries and productions on primary and secondary/tertiary educational IM by employing a generalized difference-in-differences method in a quasi-natural experiment. Our quasi-natural experiment relies

[2] See, e.g., Corden and Neary (1982); Sachs and Warner (1995, 2001); Kretzmann and Nooruddin (2005); Collier and Hoeffler (2005); Ross (2004, 2006); Tsui (2011); Van Der Ploeg (2011); Keen (2012); Lei and Michaels (2014); Van Der Ploeg and Poelhekke (2017); Smith and Wills (2018); Harding et al. (2020).

on the plausible exogeneity of mineral discoveries that revert specific characteristics, specifically the unpredicted time of discoveries, the unpredicted geographical location, the significant lag between the natural resources discoveries and beginning of production around five to six years (Horn, 2011; Khan et al., 2016; Arezki et al., 2017; Cavalcanti et al., 2019). We find that mineral discoveries and productions positively affect educational IM for primary education in Africa for individuals exposed to the mineral sites and living in districts with discoveries. Indeed, upward primary IM increases by 2.7 percent following mineral discoveries and 6.7 percent following mineral productions. Downward primary IM decreases by 1.2 percent following both mineral discoveries and productions. However, the results are non-significant for the secondary and tertiary education levels.[3] Our results are robust to several robustness checks. We also unveil four transmission channels through which the positive effects of mineral discoveries and productions on educational primary IM operate, including the income effect proxied by parents working in the mining sector, the structural transformation of the local economy, the returns to education, and the provision of infrastructures. First, the increase of income for parents working in the mining sector, due to the novel abundant opportunities, will allow them to invest more in their child's education attainment Becker and Tomes (1979). Second, the structural transformation of the local economy will lead to a shift of individuals from the agriculture sector to manufacturing and services sectors (as described by Cavalcanti et al. (2019), in the case of Brazil). Third, this new economic dynamism, creation of new jobs, will lead to an increasing demand for skilled workers. Thus, the higher returns or benefits to education in terms of wealth and income will motivate individuals to increase their educational attainment relative to their parents (Torche, 2014). Fourth, the provision of infrastructures in districts with discoveries through an increase in government spending in education, or more accessible access to basic needs such as electricity and clean water,

[3]To put our findings into perspective and extrapolate them to Africa, we show that the number of individuals born up to 15 years after mineral discoveries and who have completed at least primary education while their parents have not, increases by 662 thousand in Africa over the period 1950-2000. This figure stands at 581 thousand for individuals born up to 15 years after mineral productions. Similarly, the number of individuals born up to 15 years after mineral discoveries and who have not completed at least primary education while their parents have completed it, decreases by 371 thousand. This figure stands at 124 thousand for individuals born up to 15 years after mineral productions. These figures would have been even higher to millions of individuals if we would have considered all the individuals born after the discoveries and productions, and not only those born up to 15 years after the event.

is also a driver of the positive effect of mineral discoveries on educational IM.

The rest of the paper is organized as follows. Section 2 reviews the literature and places this study among the existing papers. Section 3 discusses the data, explains the construction of the educational IM, and presents some stylized facts on educational IM in Africa by decade, gender, at district and country level. Section 4 provides stylized facts on both educational IM and mineral discoveries and productions. Section 5 describes the methodology. Section 6 presents our main findings. Section 7 explains the transmission channels. Section 8 and Section 9 discuss the robustness checks and the sensitivity of our findings, respectively. Section 10 concludes and offers potential policy implications.

2 Review of literature

Our paper closely relates to three strands of the literature, notably the literatures on natural resources and education, general effects of natural resources on several variables, and the determinants of intergenerational mobility.

2.1 Natural resources and education

The effects of natural resources on education are ambiguous. First, some papers find that natural resources exert a decrease of education in developing countries. Indeed, Leamer et al. (1999) find in Latin American resource-rich countries that the abundance of natural resources entails a delay of industrialization, and therefore lowers education levels since workers do not need high skills to work in the natural resources sector. Gylfason (2001) and Ahlerup et al. (2020) show that natural resources crowd out investments in education in resource-rich countries and reduce educational attainment. Second, while some papers find negative effects of natural resources on education, other papers rather point out to a positive effect. They find that natural resources abundance or dependence is positively associated with human capital accumulation, notably through the increase of public spending in education (see e.g., Stijns, 2006; Kim and Lin, 2017, for cross-country analysis) and Pegg (2010) for the case of Botswana). Third, some papers find that the effects of natural resources on education may diverge depending on whether our focus is the quantity or the quality of education or the levels of education or characteristics of individuals (age, gender). Indeed, Farzanegan and Thum (2020) show a positive effect of oil rents on the quantity of education measured by government spending in primary and secondary education, particularly in countries with sound quality of institutions. In contrast, they find a negative effect of oil rents on the quality of education, defined as "an increase in cognitive skills obtained from an additional year of schooling". They explain this negative effect by a low demand and supply for high-quality education.[4] Moreover, Gradstein and Ishak (2020), using IPUMS data on 18 African countries, find that oil price booms occurring in early childhood (ages 0-4) enhance educational attainment and other derived outcomes, but reduce them when occurring in the adolescence (ages 10-14), especially for girls

2.2 Effects of natural resources

At the macro level, most papers in this literature show that natural resources have been a curse than a blessing, as well illustrated by the Dutch Disease literature. They found that natural resources are generally associated with the deterioration of economic and institutional conditions, the occurrence of conflicts, an appreciation of real exchange rate, which induces a loss of competitiveness and a de-industrialization of the economy, as well as with weak fiscal policy stance and unsustainable debt accumulation (e.g., Corden and Neary, 1982; Sachs and Warner, 1995, 2001; Kretzmann and Nooruddin, 2005; Collier and Hoeffler, 2005; Ross, 2004, 2006; Van Der Ploeg, 2011; Keen, 2012; Van Der Ploeg and Poelhekke, 2017). Moreover, the macroeconomic effects of natural resource discoveries of oil, gas, and minerals on economic activity seem to be mixed. While some papers find negative impacts of giant discoveries on fiscal policy, debt, conflict, poverty, and inequality (Kretzmann and Nooruddin, 2005; Harding et al., 2020; Lei and Michaels, 2014; Tsui, 2011; Smith and Wills, 2018), others show positive effects on foreign direct investments in non-resource sectors Toews and Vezina (2017), or ambiguous effects on macroeconomic activity and financial conditions (Arezki et al., 2017; Seri, 2021).

At local level, a positive effect of natural resources has emerged in more recent anal-

[4] On the demand side, the phenomenon of Dutch disease in those countries, by leading to an increase in the size of the non-tradable sector, will require less skilled workers with no higher level of human capital. Moreover, the higher share of employees in the public sector, which job that not requires high-quality of education, entail a low demand for higher quality of education. On the supply side, the lower incentive to attract local qualified teachers and the lack of long-term opportunities for foreign or migrant teachers reduce the quality on education.

ysis focusing on African countries or other developing countries. They show that natural resources is associated with a reduction of inequality, poverty, and an increase of living standards, income, and welfare. Indeed, Goderis and Malone (2011) find that resource exploitation booms reduce income inequality in resource-rich countries. Fisher et al. (2009) show an evidence of the reduction of poverty in the mineworkers' population in Tanzanian artisanal mines of gold and diamond. Zabsonré et al. (2018) reveal in the case of Burkina Faso that gold exploitation led to better living standards, an increase per capita household expenditures, and a reduction of poverty in the mining areas. Marlet (2020), using mining exploitation in Ghana, finds that mining areas will increase migration flows up to 200 km from the treated district by reducing migration costs through the construction of roads and infrastructures. Moreover, they also induce an increase of income and improvement of welfare by 1.3 percent. In contrast, some papers find that mining activity can create some environmental issues by increasing pollution and metal toxicity (e.g., von der Goltz and Barnwal, 2019; Hausermann et al., 2018).

The literature also supports the benefits and positive role of natural resources discoveries on local economic development, governance and conflicts, provisions of public goods and welfare. Indeed, Cavalcanti et al. (2019) find evidence of a positive impact of oil and gas discoveries on local development and urbanization in Brazil. Cust and Mensah (2020) reveal that oil, gas, and mineral discoveries positively impact the citizen's expectations, which is materialized by a decrease in outward migration and an increase in fertility in the short term. Bhattacharyya and Mamo (2021) show that oil and mineral discoveries reduce the likelihood of conflict in 48 African countries, which is mainly driven by an improvement of economic development and efficient political distribution patronage in districts with discoveries. Then, these papers on the effects of natural resources show opposing effects depending on whether we focus on the macro or local level. It seems that natural resources have some benefits for the population located near the site of discovery or exploitation, which may not be the case for the population living far from the resources.

2.3 Intergenerational Mobility in education and its determinants

The trends and drivers of intergenerational mobility or persistence in education have been widely studied in the literature (see e.g., Corak, 2013; Chetty et al., 2014; Howell, 2019; Engzell and Tropf, 2019). Overall, the intergenerational mobility in education has increased over time, but some heterogeneities and disparities across regions remain. Indeed, Hertz et al. (2008) analyze trends in the intergenerational persistence of education over 50 years in 42 countries, including 19 developing countries and 3 SSA countries.[5] They find that the education IM has improved in almost all regions of the world.[6] The western developed countries have the higher educational IM than in any regions of the world, especially for the Nordic countries. They are followed by the Eastern bloc countries and Asian countries. However, the educational IM is the lowest in Latin American countries and African countries. This shows that educational IM has been less dynamic in developing countries as compared to emerging and developed countries.[7] Interestingly, Henn and Robinson (2021), using the 2015 World Bank Intergenerational Database, find that educational IM is higher in Africa than in South Asia, MENA, and Latin American countries. Particularly, countries like Botswana, Kenya, Mauritania, and Cape Verde display approximately the same educational IM as high-income countries.[8]

Only few papers exclusively focus on educational IM in Africa. They explain the dynamics of educational IM across the African continent, the disparities across countries, race, regions, and unveil some of their determinants. First, focusing on South Africa, Nimubona and Vencatachellum (2007) show that educational IM is higher for whites than blacks, and among blacks, higher for females than males, except for the poorest females. They find that access to credit market and quality of schools are the main determinants of lower educational IM for blacks. Focusing on Ghana, Baah and Eshun (2020) reveal that economic and educational IM is one of the lowest in the world. In addition, they find that globalization enhances IM, thereby recommending policies aiming at expanding globalization. Moreover, they find that FDI and expansionary fiscal policy improve IM

[5]A higher intergenerational persistence implies lower intergenerational mobility; a lower intergenerational persistence means higher intergenerational mobility.

[6]They also show that the regression coefficient representing the transmission of educational attainment from parent to child has decreased over the past 50 years, reflecting an improvement of mobility over time, while the IM's correlation coefficient has not changed.

[7]See also in the same vein, comparisons across developed countries by Engzell and Tropf (2019)

[8]See other papers on developed countries (Black and Devereux, 2010; Corak, 2006; Chetty et al., 2014) and developing countries (Azam and Bhatt, 2015; Daude and Robano, 2015; Neidhöfer et al., 2018) for further discussions on the dynamics, disparities across countries and regions, and determinants of educational IM.

while unemployment has an exactly opposite effect on it. Second, other papers conduct cross-country analysis using several countries in Africa. Indeed, Alesina et al. (2019) employ measures of absolute mobility to estimate intergenerational education mobility since independence using census data on 26 African countries. They find that colonial investments in the transportation network and missionary activities were associated with upward mobility. Intergenerational mobility was also higher in regions close to the coast and national capitals as well as in rugged areas without malaria. Upward mobility is higher and downward mobility is lower in regions that were more developed at independence, with higher urbanization and employment in services and manufacturing. In addition, Azomahou and Yitbarek (2020) analyze the educational IM across 9 Sub-Saharan African countries over 50 years, using two measures of intergenerational educational persistence. They reveal that intergenerational education persistence has reduced among the birth cohorts in all countries, particularly after the 1960s due to huge investments in human capital following independence and drastic changes in the educational systems. Even in the light of declining intergenerational education persistence in the region, countries such as Ghana, Guinea, Nigeria, and Uganda experienced higher intergenerational mobility while Comoros and Madagascar had the lowest. Also, intergenerational persistence in education was found to be stronger from mothers to their children, and daughters' education is more correlated with her parents' education than that of sons.

Despite their very insightful contributions to understand the determinants of educational IM, the previous papers have overlooked the effects of natural shocks or experiments such as mineral discoveries and productions on educational IM, especially in Africa. There are only few papers that look into the effects of the Great depression and oil discoveries on income or earnings intergenerational mobility, in the US and Norway, respectively (Feigenbaum, 2015; Bütikofer et al., 2018). Our paper fills this gap by studying educational IM in 28 African countries for individuals aged between 16 and 50, and born between 1950 and 2000. Therefore, it contributes to the literature in several ways. First, it provides a panorama of the trend, dynamics and disparities of educational IM across countries, regions of the continent, and depending on the characteristics of the individuals. Second, it empirically studies the effects of mineral discoveries and productions on primary and secondary/tertiary educational IM. Finally, it explains these effects by the income, structural transformation, returns to education, and infrastructures channels.

3 Data sources and construction of the IM index

Our data come from mainly two sources. We use data on education and individual characteristics from Integrated Public Use Microdata Series (IPUMS) and data on mineral discoveries and productions from Minex Consulting Dataset.

3.1 Data sources

3.1.1 IPUMS data

IPUMS (Integrated Public Use Microdata Series) covers 82 national censuses surveys in 28 countries: Benin, Botswana, Burkina Faso, Cameroon, Egypt, Ethiopia, Ghana, Guinea, Kenya, Lesotho, Liberia, Malawi, Mali, Mauritius, Morocco, Mozambique, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, South Sudan, Sudan, Tanzania, Togo, Uganda, Zambia, Zimbabwe. This dataset covers more than 130 million of individuals. IPUMS data provides information on education, occupation, household members, the relationship between household members, household size, demographic characteristics, current residence, marital status, birth year, gender, the rural or urban living areas, at the district and province level. Regarding education, IPUMS reports data on the years of schooling and the completion of primary, secondary, tertiary education levels. For our analysis, we use the educational levels for both parents and children rather than years of schooling given their higher coverage, similarly to Alesina et al. (2019).

Our final sample is given by the availability of district and residency information, education and individuals characteristics (gender, age) data as well as whether individuals live with their relatives and biological or step- parents. We also focus on the individuals aged between 16 and 50, and born between 1950 and 2000.[9] It covers more than 14 millions individuals across 2,890 districts from 61 surveys. We have harmonized the boundaries of

[9] We assume that primary level of education is most of the time completed for individuals above 16 years and secondary level for individuals above 25 years.

districts following Alesina et al. (2019) to deal with administrative boundaries changes.[10] Table A.22 and Table A.23 describe the data for each census and country.

3.1.2 Mineral discoveries data

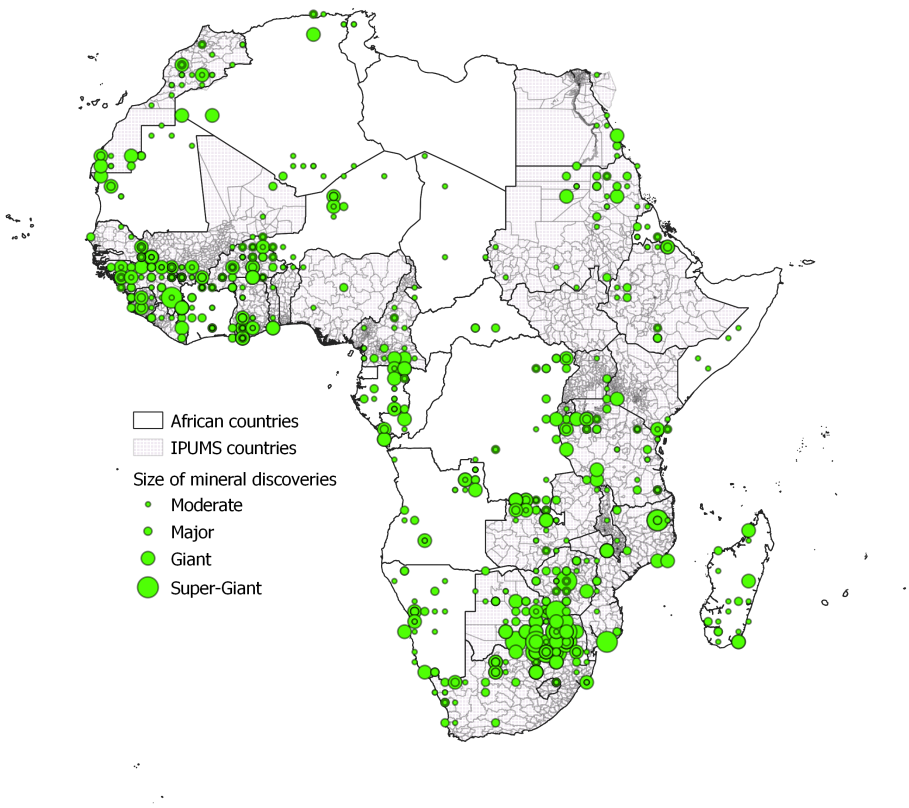
Data on mineral discoveries and production in Africa are from Minex Consulting Dataset (2019). This dataset provides geolocalized information on discoveries, their size (moderate, major, giant, super-giant), the status of the mine (closed, feas, operating, underdeveloped), and the type of minerals. According to Bhattacharyya and Mamo (2021), mineral discoveries are defined as giant if they generate an amount of at least USD 0.5 billion of annual revenue for 20 years or more. They are qualified as major if they generate an annual revenue stream superior or equal to USD$50 million over a shorter lifetime than in the case of giant discoveries. These discoveries may serve as quasi-natural experience; as they have several interesting features that allow to capture their causal effects on several macro and micro variables (see e.g., Arezki et al., 2017; Khan et al., 2016; Bhattacharyya and Mamo, 2021). These features are presented in the empirical strategy section (Section 5).

After merging this dataset with the IPUMS data, we identify 331 districts out of the total of 2890 in which mineral sites were discovered or entered in production. Figure C.10 displays the evolution of the number of discoveries over time in all African countries. 969 mineral discoveries occurred in Africa between 1950 and 2019, and 573 of them (60 percent) between 1950 and 2000. As previously said, we focus on individuals born between 1950 and 2000 so that the minimum age of 16 years needed to complete the primary education is respected. Moreover, we show that 406 mineral discoveries occurred in the 28 countries covered by our analysis and during our period of study 1950–2000 (i.e., 71 percent of the 573 mineral discoveries that occurred in 1950–2000). We therefore cover a large share of mineral discoveries and can extrapolate our findings to the whole African countries. In addition, Figure 1 maps the location of these discoveries across Africa by

[10] We drop Burkina Faso (1985), Kenya (1979), Liberia (1974), Togo (1960, 1970) since they do not cover all local regions or do not have any identifier to match children to parents. Moreover, we have harmonized the countries boundaries and district names for countries such as Botswana, Burkina Faso, Ethiopia, Ghana, Guinea, Lesotho, Malawi, Mauritius, Morocco, Nigeria, South Africa, and Uganda. For Nigeria, data come from households' survey rather than census surveys, therefore the number of observations is small as compared to other countries.

the size of mineral discoveries. We show that mineral discoveries have been concentrated in Southern Africa (48.3 percent) and Western and Central Africa (34.2 percent). A relatively few discoveries occurred in Eastern Africa (11.9 percent) and Northern Africa (5.7 percent). About the size, mineral discoveries have been in majority moderate (45.3 percent), followed by major (29.8 percent), giant (21.7 percent) and super-giant giant (3.2 percent). Moderate and major discoveries were mainly found in Western and Central Africa while giant and super-giant were located in Southern Africa. The minerals found were mostly gold (34 percent), bulk metals (18.4 percent), and precious minerals (15.8 percent) and base metals (15 percent). Table C.25 and Table C.26 present these findings and the types of mineral in details.

Figure 1: Location of mineral discoveries by size for all African countries, 1950-2019



3.2 Construction of the educational IM

In this paper, we use the absolute educational IM measures as in Alesina et al. (2019).[11] We define both an upward and downward educational IM for the primary and secondary/tertiary education levels. First, upward primary educational IM is defined as the probability for a child born from uneducated parents or parents with less than primary education completed to achieve at least primary education. Downward primary educational IM is defined as the probability for a child born from parents with at least primary education completed be uneducated or have less than primary education completed. Second, given the few number of observations for tertiary education, we combined secondary and tertiary education. In that regard, upward secondary/tertiary educational IM is defined as the probability for a child born from parents with primary education background at maximum to achieve at least secondary education. Downward secondary/tertiary educational IM is defined as the probability for a child born from parents with at least secondary education background to achieve primary education or be uneducated. To identify the references for each child, we use the average of education attainment for their biological or step- parents, rounded to the nearest integer. In the robustness section (Section 9), we rather use the minimum or maximum of their education. We also consider the immediate older generation and broaden the definition of parental authority to include uncles/aunts (in law), parents-in-law, grand-parents, and grand-uncles/aunts in the reference group.

Practically, first, for each individual (parents and children), we compute two educational attainment variables P_{jith} and ST_{jith} measuring the primary and secondary/tertiary educational attainment, respectively. Specifically, P_{jith} takes that value of one if the individual j born in district i and year h, and surveyed in year t has completed at least the primary education, and zero otherwise. Similarly, ST_{jith} takes that value of one if the individual j born in district i and year h, and surveyed in year t has completed at least the

[11] For the use of relative educational IM measures, see Hertz et al. (2008); Black and Devereux (2010); Chetty et al. (2014); Bütikofer et al. (2018); Azomahou and Yitbarek (2020). They require the use of continuous type variables such years of schooling or rank based on years of schooling. We rather use data on educational attainment and construct absolute measures of education IM, as they are more available than years of schooling, and therefore increase the coverage of our analysis and reduce the attrition bias. Moreover, as shown by Alesina et al. (2019), data on educational attainment are less subject to measurements errors and allow to identify a common reference group for children (e.g., parents without primary education completed), as compared to years of schooling.

secondary education. Second, for each child j, we therefore computed two averages (or the minimum or maximum in the robustness) measures of parents' educational attainment, PP_{jith} and PST_{jith} , as the average of P_{jith} and ST_{jith} rounded to the nearest integer, respectively, for the two biological or step-parents if both cohabit with the child, or if only the father or mother if the child lives with only one of its parents. Third, we compare the educational attainment of each child j cohabiting with at least one parent to the average educational attainment of the parents and obtain our absolute measures of educational as follows:[12]

i) Upward primary IM: $IMUP_{jith} = \begin{cases} 1 \text{ if } P_{jith} = 1 \text{ and } PP_{jith} = 0 \\ 0 \text{ if } P_{jith} = 0 \text{ and } PP_{jith} = 0 \end{cases}$

ii) Downward primary IM: $IMDP_{jith} = \begin{cases} 1 \text{ if } P_{jith} = 0 \text{ and } PP_{jith} = 1 \\ 0 \text{ if } P_{jith} = 1 \text{ and } PP_{jith} = 1 \end{cases}$

iii) Upward secondary/tertiary IM: $IMUST_{jith} = \begin{cases} 1 \text{ if } ST_{jith} = 1 \text{ and } PST_{jith} = 0 \\ 0 \text{ if } ST_{jith} = 0 \text{ and } PST_{jith} = 0 \end{cases}$

iv) Downward secondary/tertiary IM: $IMUST_{jith} = \begin{cases} 1 \text{ if } ST_{jith} = 0 \text{ and } PST_{jith} = 1 \\ 0 \text{ if } ST_{jith} = 1 \text{ and } PST_{jith} = 1 \end{cases}$

3.3 Stylized facts on educational IM in Africa

In this section, we briefly describe the trends of education IM in Africa as well as their disparities across countries, gender, and residency. To do so, we estimate conditional educational IM, netting country/districts, cohort and census effects. Specifically, we estimate a model where our dummies of educational IM are regressed on country or district fixed effects α_i, cohort fixed effects γ_t, and census-year fixed effects δ_t. The model is as follows:

$$IM_{jit} = \alpha_i + \gamma_t + \delta_t + \varepsilon_{jit} \tag{1}$$

[12]By replacing biological or step- parents in the last sentences with immediate older generation, we obtain our alternative measures of absolute educational IM including other relatives on top of the biological or step- parents. We will use these alternative definitions of IM in the robustness section Section 9.

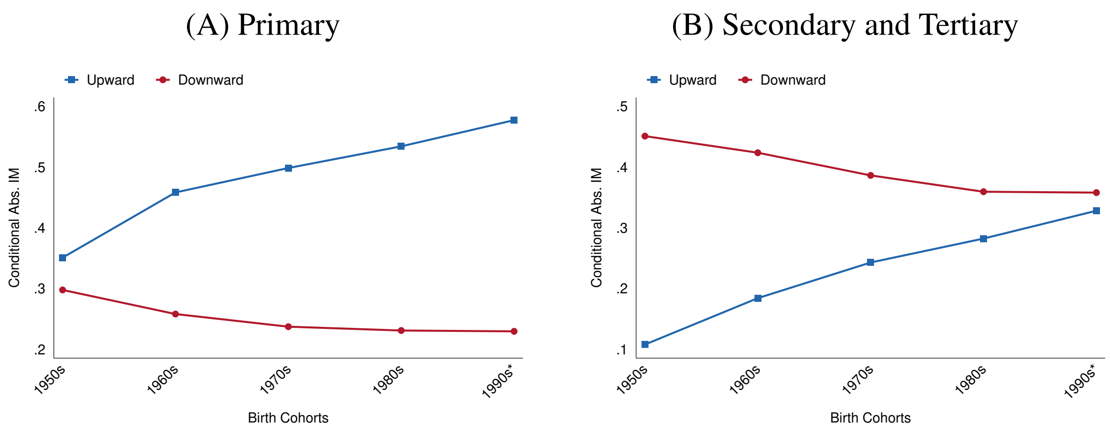
Thus, country or district fixed effects α_i reflect the conditional likelihood of each type of educational IM at the country or district levels, netting the cohort and census effects. Cohort fixed effects γ_t reflect the conditional likelihood of each type of education IM, netting the country/district and census effects. We do so to better compare the educational IM across individuals, cohorts, districts, and over time, especially by purging the differences between countries/districts, cohorts, and census-year specific effects. In addition, we estimate conditional educational IM by country and gender, country and individuals' residency (urban and rural), by cohort and gender, cohort and residency, and cohort and discovery by introducing country and gender fixed effects, country and residency fixed effects, cohort and gender fixed effects, cohort and residency fixed effects, and cohort and discovery fixed effects, respectively.[13]

3.3.1 Trends of IM by decade

Overall, we observe that primary and secondary/tertiary educational IM have significantly improved in Africa over time, independently of gender and residency (urban/rural areas). The average trends of primary and secondary/tertiary educational IM are displayed in Figure 2 for both upward and downward mobility, respectively, and for five cohorts between 1950 and 2000. We show that upward primary IM has steadily increased across cohorts, from 35.1 percent for the 1950s cohort to 57.7 percent for the 1990s cohort. Similarly, downward primary IM has steadily decreased, but at a slower pace, from 29.8 to 23 percent between the 1950s and 1990s cohorts, respectively. Moreover, secondary and tertiary educational IM have experienced similar trends. Upward secondary and tertiary educational IM has steadily increased from 10.8 to 32.9 percent and downward secondary and tertiary educational IM has steadily decreased from 45.1 to 35.8 percent between the 1950s and 1990s cohorts, respectively. In contrast to primary level, downward IM has always been elevated than upward IM for secondary and tertiary levels, but the gap has closed over time. Secondary and tertiary upward (downward) educational IM is lower (higher) for both old and recent cohorts, thereby implying a lower (higher) upward (downward) mobility at higher levels of education.

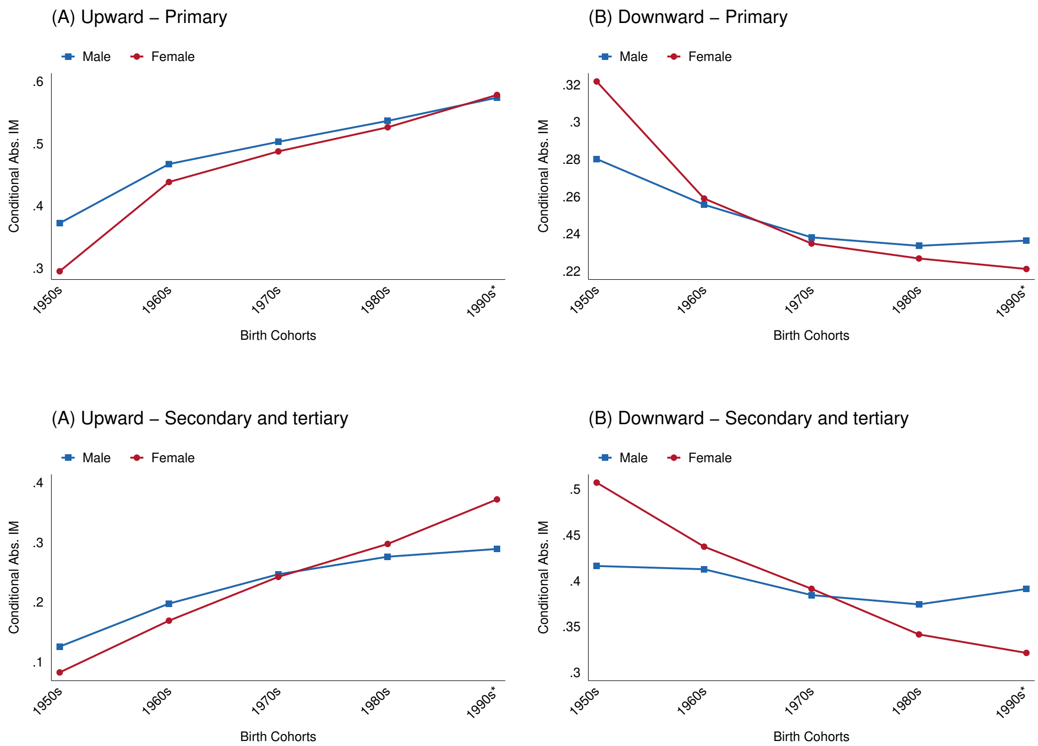
[13]We present the dynamics of country-level educational IM by district with and without discoveries in Section 4 where we discuss the stylized facts on both educational IM and mineral discoveries and productions.

Figure 2: Country-level educational IM by birth cohorts



We next look at these trends by gender. They are shown in Figure 3. The general trends for upward and downward primary education IM have been witnessed for both males and females. Specifically, we show that the gender gap in favor of males has closed over time, with sometimes females doing better than males in most recent cohorts.

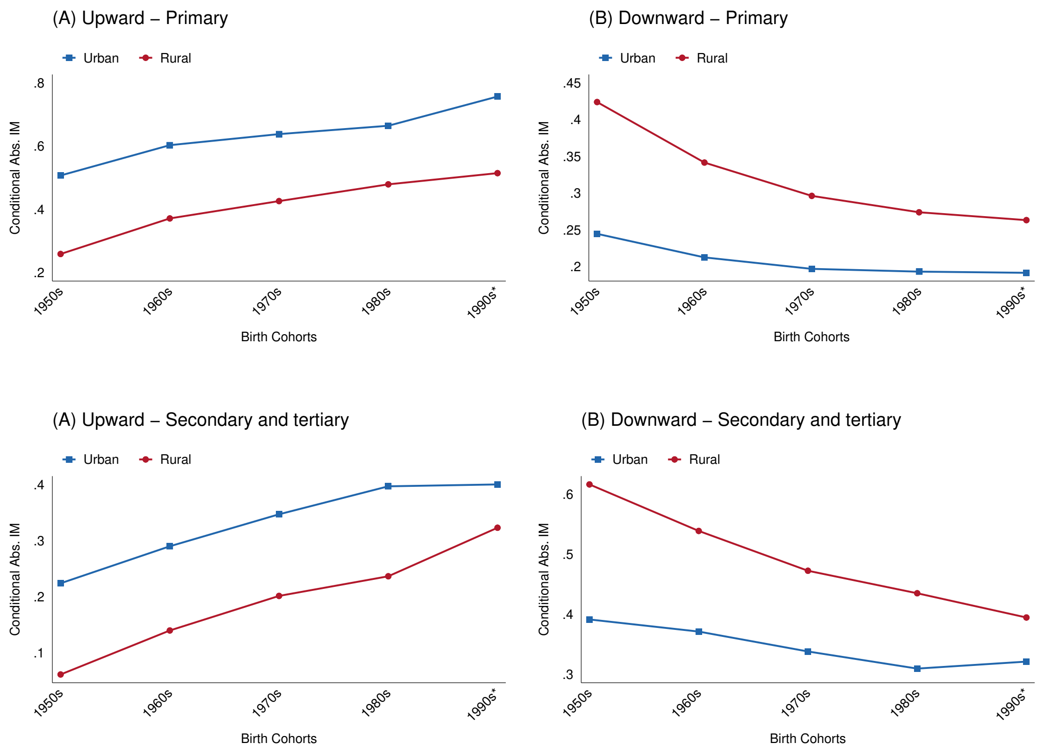
Figure 3: Country-level educational IM by birth cohorts and gender



Finally, we explore the trends by residency. The trends are presented in Figure 4.

We find that the general trends are also confirmed for both individuals living in urban and rural areas. More specifically, we show that educational IM has always been better in urban than rural areas. Although the residency gap has diminished over time, it has remained important even for more recent cohorts.

Figure 4: Country-level educational IM by birth cohorts and gender

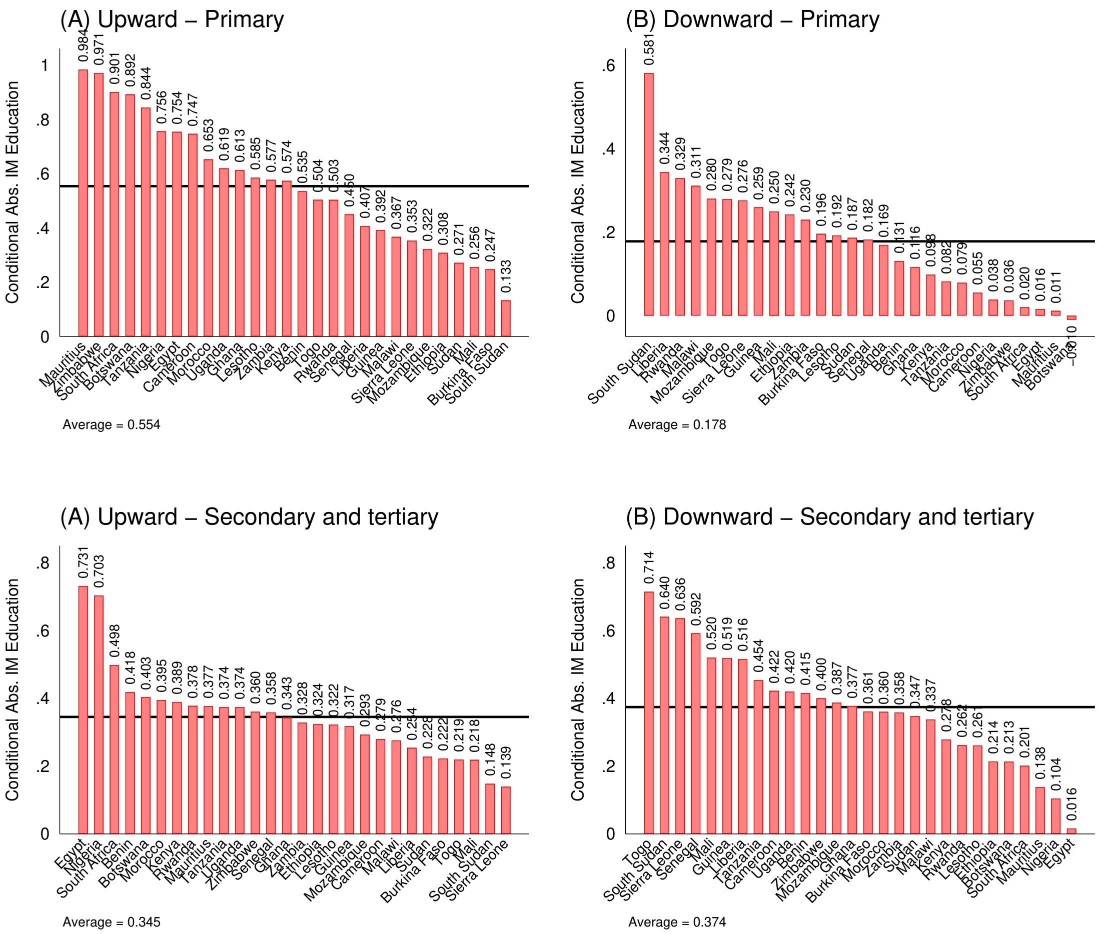


3.3.2 Educational IM at country and district level

a) Country-level educational IM

We display in Figure 5, the country-level educational IM. It shows that educational IM is uneven across countries, and that upward and downward IM are negatively correlated, i.e., countries with the higher upward IM tend to have the lowest downward IM too. These findings hold for both primary and secondary/tertiary education levels. More specifically, upward primary IM ranges from 98 percent in Mauritius to 13 percent in South Sudan, and downward primary IM from 58 percent in South Sudan to close to zero for Egygt, Mauritius and Bostwana. Upward secondary/tertiary IM ranges from more than 70 percent in Egypt and Nigeria to close to 14 percent in Sierra Leone and Sudan, and downward IM from 71 percent in Togo to 1 percent in Egpyt.

Figure 5: Ranking: Country-level educational IM



b) Country-level educational IM by gender

We also present the country-level gender gap in educational IM in Figure D.11 and Figure D.12. First, we show that gender gap for primary IM is negatively (positively) correlated to upward (downward) educational IM, i.e., males tend to bo better than females in countries with lowest values of upward IM and highest values of downward IM. More specifically, upward primary IM is higher for males than females in Togo (14.9 percent), Liberia (11.6 percent), Sierra Leone, Zambia, Uganda (around 8–9 percent). It is rather higher for females than males in Lesotho (25.9 percent), Bostwana (15.5 percent), Nigeria (5 percent), and South Africa (4.2 percent). Similarly, downward primary IM is higher for females than males in Togo (9.8 percent), Liberia (7 percent), Guinea (6.2 percent), and Sierra Leone, Benin, and South Sudan (4–6 percent). It is rather higher for males than females in Lesotho (18.1 percent), and Botswana, Burkina Faso (5.4

percent). Second, gender gap for secondary/tertiary IM is less correlated with upward and downward educational IM. Upward secondary/tertiary IM is higher for males than females in Rwanda, Egypt, Liberia (8–9 percent), Uganda, Malawi and Zambia (6–6.5 percent). It is rather higher for females and males in South Africa, Morocco (4.5–5 percent), Sudan, Lesotho (3.9 percent), Mauritius (3 percent), Nigeria (2.5 percent), and Burkina Faso (2 percent). Moreover, downward secondary/tertiary IM is higher for females than males in Botswana (14.2 percent), Malawi (11.3 percent), Togo, Sierra Leone (around 9 percent), Ghana, and Benin (around 8 percent). It is rather higher for males than females in Morocco (7.2 percent), Mauritius (6.8 percent), South Africa (5.8 percent), Zimbabwe, Burkina Faso (around 4.5 percent), Sudan, Lesotho and Mozambique (3 percent).

c) Country-level educational IM by residency

We also report the country level residency gap in educational IM in Figure D.13 and Figure D.14. First, we show that upward (downward) IM are higher (lower) for individuals living in urban than rural areas, for both primary and secondary/tertiary levels, and for all countries. Second, similarly to gender gap, residency gap in primary IM are negatively (positively) correlated to upward (downward) IM, i.e., individuals living in urban areas tend to do far better than those in rural areas in countries with lowest values of upward IM and highest values of downward IM. Indeed, countries with the highest values of upward primary IM for individuals living in urban than rural areas are Ethiopia (57.6 percent), Sudan (44.8 percent), Burkina Faso (42.3 percent), Guinea (40 percent), Sierra Leone (34.6 percent), and Mali (32.4 percent). The countries with the lowest residency gap for upward primary IM (always in favor of individuals living in urban areas) are Mauritius (5 percent), South Africa (7.6 percent), Nigeria (10.5 percent), South Sudan (12.1 percent), Tanzania (13.4 percent), Egypt and Kenya (14.3 percent). Similarly, the countries with the lowest values of downward primary IM for individuals living in urban than rural areas are Ethiopia (50.8 percent), Burkina Faso (43.3 percent), Sierra Leone (34.4 percent), Mozambique (31.4 percent), Guinea (29.9 percent), and Mali (28.1 percent). The countries with the lowest residency gap for downward primary IM are Mauritius (0.9 percent), Nigeria, South Africa (close to 3 percent), Egypt (4.7 percent), and Kenya (6.3 percent). Third, we find that the residency gap for upward secondary/tertiary

IM is higher in Ethiopia (32.9 percent), Malawi, Morocco (21.8 percent), Guinea, Sudan (21.2 percent) and Zimbabwe (20 percent), while it is lower in South Sudan Sierra Leone (5–5.5 percent), Botswana (5.9 percent), Mauritius (7.3 percent), and Mozambique (7.9 percent). We also show that the residency gap for downward secondary/tertiary IM is higher in Burkina Faso (51.9 percent), Ethiopia (40.9 percent), Morocco (34.9 percent), Mozambique (31.7 percent), Togo (29.2 percent), and Guinea (28.9 percent), while it is lower in South Sudan, Nigeria (7.7 percent), Egypt (9.1 percent), South Africa, and Mauritius (9.8 percent).

d) Mapping of district-level educational IM across Africa

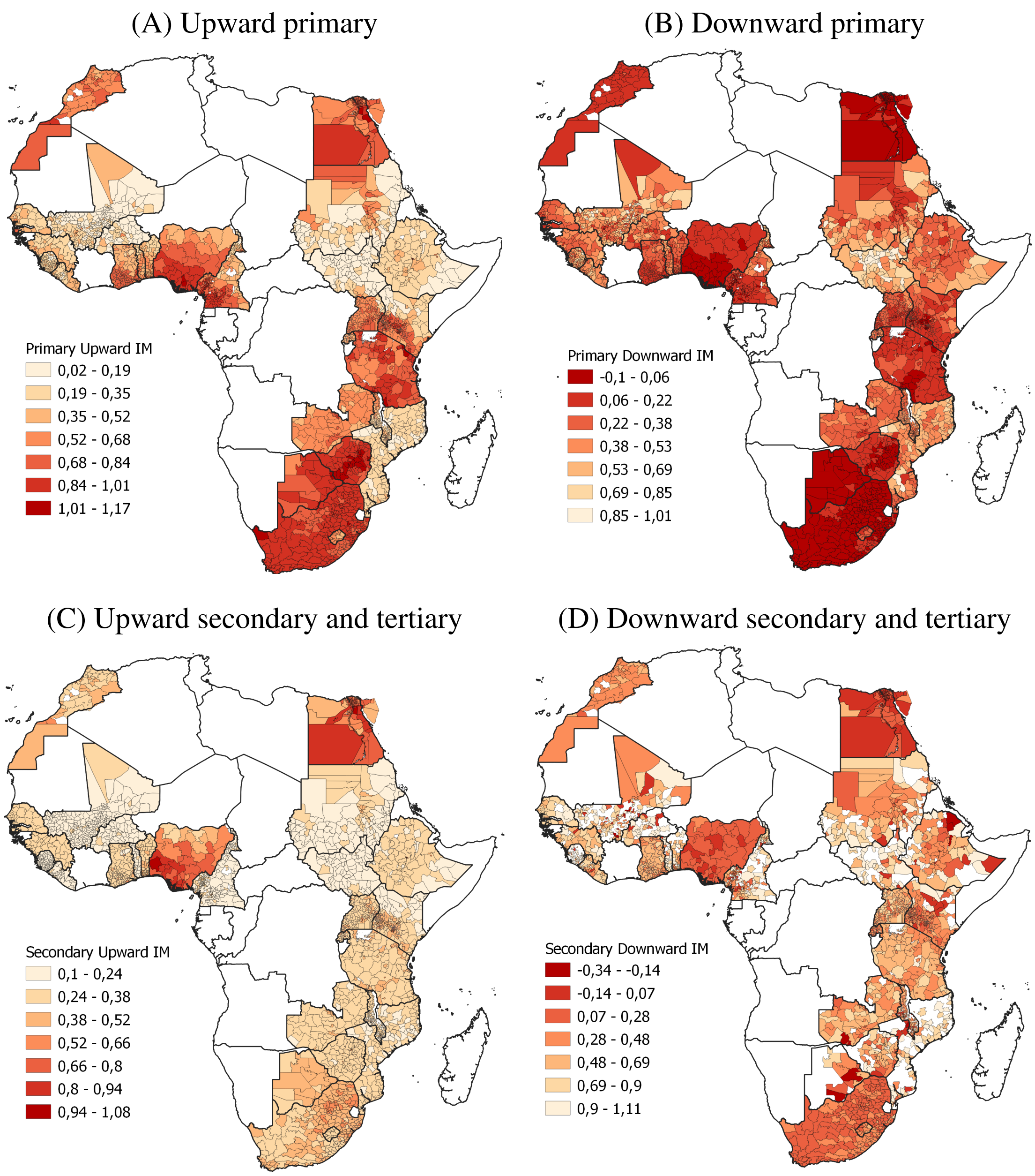
Finally, we map educational IM across 2,890 districts in Africa in Figure 6.[14] Table E.27 and Table E.28 also report the summary statistics of district-level educational IM by country for primary and secondary/tertiary levels, respectively. They show large within country variation as well as variation across districts of different countries.[15] Overall, we find that within country disparities are larger in countries with lower levels of educational mobility with some exceptions. First, we show that upward primary IM is more unequal in South Sudan, Sudan, Ethiopia, Burkina Faso, Mali, Mozambique, and Sierra Leone (countries with lower upward primary IM) and less unequal in Mauritius, South Africa, Zimbabwe, Botswana, Lesotho, and Tanzania (many countries with higher upward primary IM). In addition, downward primary IM is more unequal in Botswana, Mauritius, Egypt, Cameroon, Zimbabwe, Nigeria, Kenya, and South Africa and less unequal in South Sudan, Rwanda, Liberia, Lesotho, Guinea, and Togo. Overall, upward primary IM varies less across regions than downward primary IM (coefficient of variation is 1.6 times higher for the latter than the former). Second, we find that upward secondary/tertiary IM varies more across districts in Ethiopia, Sudan, Malawi, Cameroon, Zimbabwe, and Liberia (many countries with lower upward secondary/tertiary IM). It varies less across districts in Botswana, Mali, Lesotho, Senegal, Benin, Zambia, Egypt, and South Africa

[14]For some districts, educational IM are either negative, close to zero, higher than one, or close to one, due to a small number of observations at district level. Moreover, we show that while country-level and district-level estimates of educational IM may differ, they are strongly correlated and provide a quite similar ordering of countries by educational IM.

[15]Dark colors mean a positive effect (Higher Upward IM and Lower Downward IM), while lighter colors mean a negative effect (Lower Upward IM and Higher Downward IM).

(many countries with higher or milder upward secondary/tertiary IM). Moreover, downward secondary/tertiary IM varies more across districts in Botswana, Egypt, Ethiopia, Malawi, Mauritius, Nigeria (paradoxically, many countries with lower downward secondary/tertiary IM). It varies less across districts in Senegal, Ghana, Morocco, Tanzania, Sierra Leone, Uganda, and Togo (paradoxically, many countries with higher or milder downward secondary/tertiary IM). We further check whether these within and between disparities of educational IM could be explained by mineral discoveries and productions.

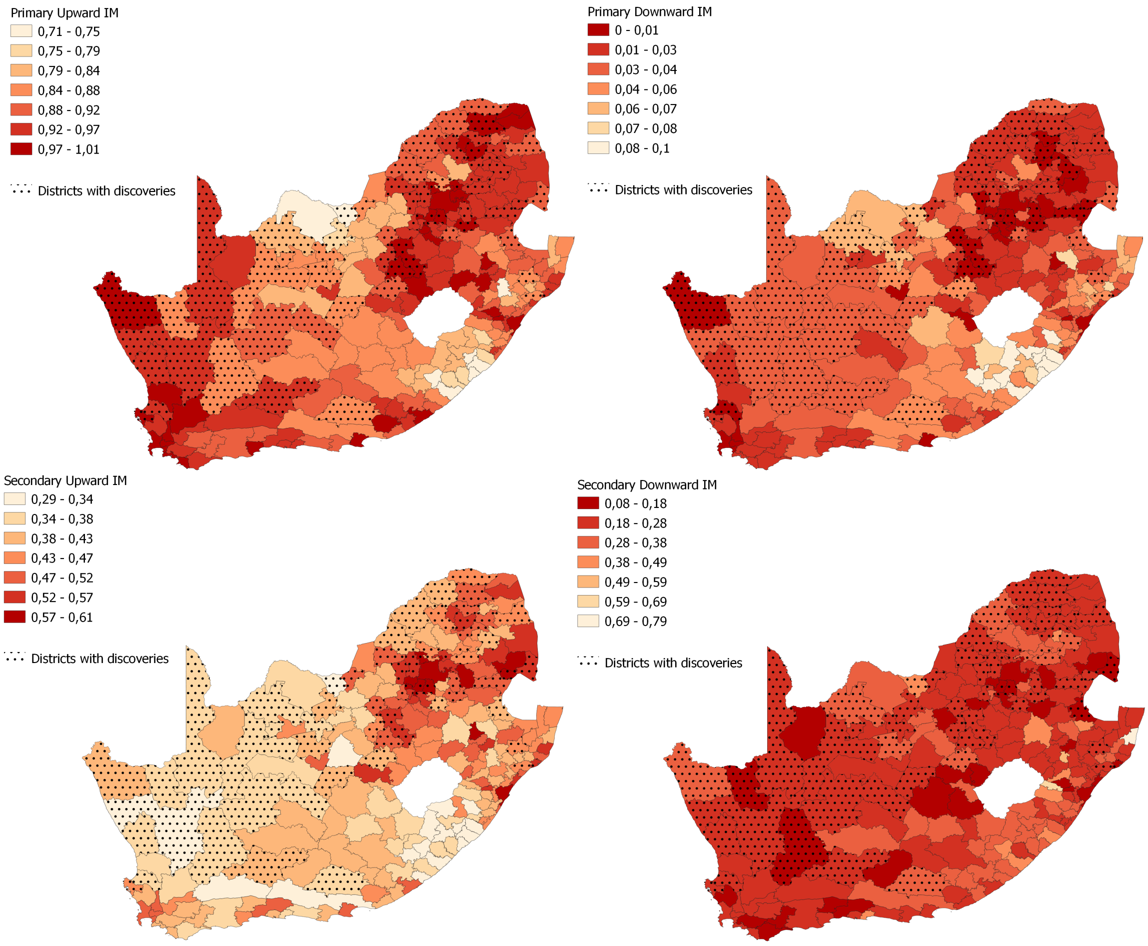
Figure 6: District-level educational IM



4 Stylized facts on educational IM and mineral discoveries and productions

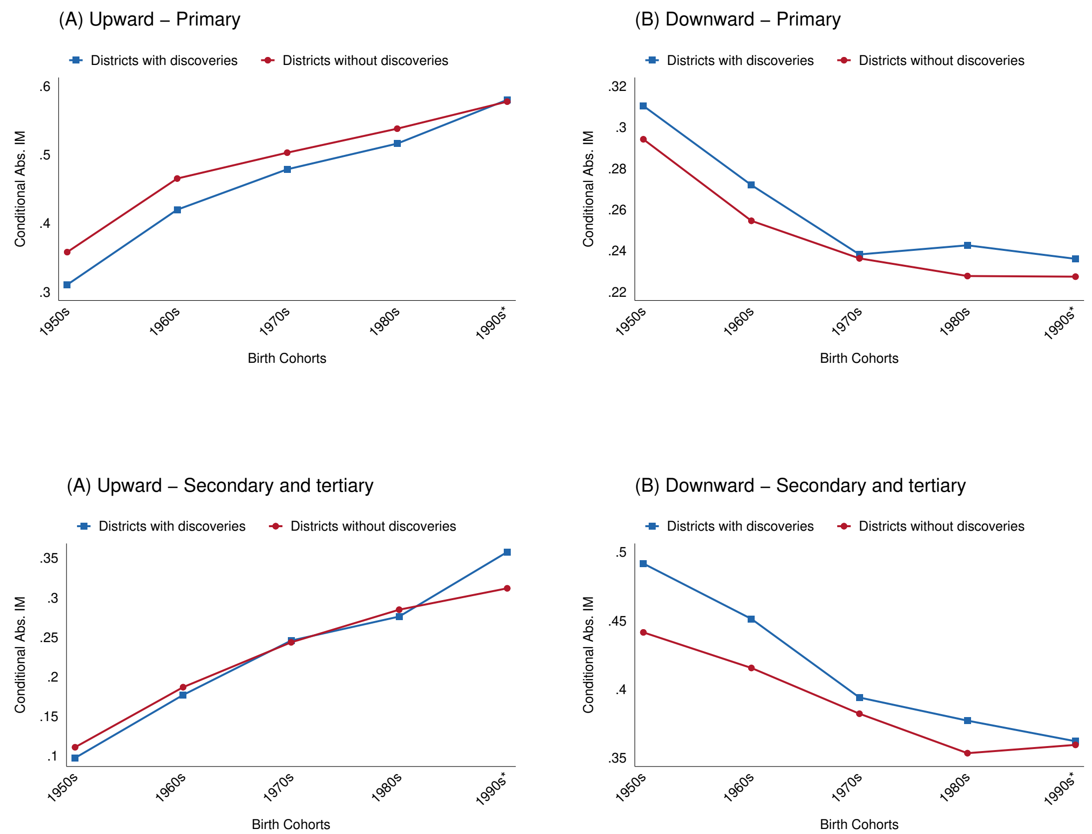
As a foretaste of the effects of mineral resource discoveries and productions on intergenerational educational IM, we present in this section some stylized facts on both conditional education IM and mineral discoveries and productions. We first show the mean differences of district-level conditional IM between districts with and without discoveries over the period of study (see Table E.29 and Table E.30). We find that upward (downward) IM for primary education is, on average, higher (lower) in districts with discoveries than in districts without discoveries by around 4 percentage points. The opposite result holds for secondary education; upward (downward) IM is on average lower (higher) in districts with discoveries than districts without discoveries by around 4–6 percentage points. Second, we also show the summary statistics of IM by districts with and without discoveries for each country in Table E.29 and Table E.30. Upward IM is on average higher in districts with discoveries than districts without discoveries in 12 and 7 countries out of 26 countries (with both districts with and without discoveries) for primary and secondary levels, respectively. Downward IM is, on average, lower in districts with discoveries than districts without discoveries in 11 and 9 countries out of 26 for primary and secondary levels, respectively (see also Figure E.19). South Africa, the country with the highest number of discoveries in our sample (108 total discoveries), illustrates well the case of countries where educational IM is higher in districts with discoveries/productions (see Figure 7). The educational IM by districts with and without discoveries are reported in Figure E.19, and in Table E.29 and Table E.30. In the 60 districts where mineral sites were found, upward IM was 92 and 46 percent for primary and secondary/tertiary levels, respectively, higher by around 3 percent than in the 156 districts without any discoveries. Similarly, downward IM was 2 and 25 percent in districts with discoveries for primary and secondary/tertiary levels, respectively, lower by around 2 percent than in districts without discoveries.

Figure 7: District-level educational IM in South Africa



However, these previous stylized facts hide differences in the dynamics of IM in districts with and without discoveries, and particularly progress that has happened in districts with discoveries (see Figure 8). We show that country-level conditional IM for both primary and secondary levels has substantially increased over time, with more recent cohorts more likely to do better than their parents in terms of education, and this independently of gender, residency, and discovery of mineral fields. More importantly, the growth of educational IM between districts with and without discoveries have sometimes differed. Indeed, while upward IM for primary and secondary/tertiary education was lower in districts with discoveries among the old cohorts (1950s-1960s), it has significantly increased and closed the gap in these districts for more recent cohorts (1980s-1990s) to stand above the one in districts without discoveries. Similarly, downward IM for primary and secondary/tertiary education was higher in districts with discoveries for old cohorts, and it has closed the gap over time and for more recent cohorts with the one in districts without discoveries. Therefore, IM has been significantly more dynamic in districts with discoveries. Mineral discoveries and productions seem to have contributed to change the geography of the land of opportunities across African regions.

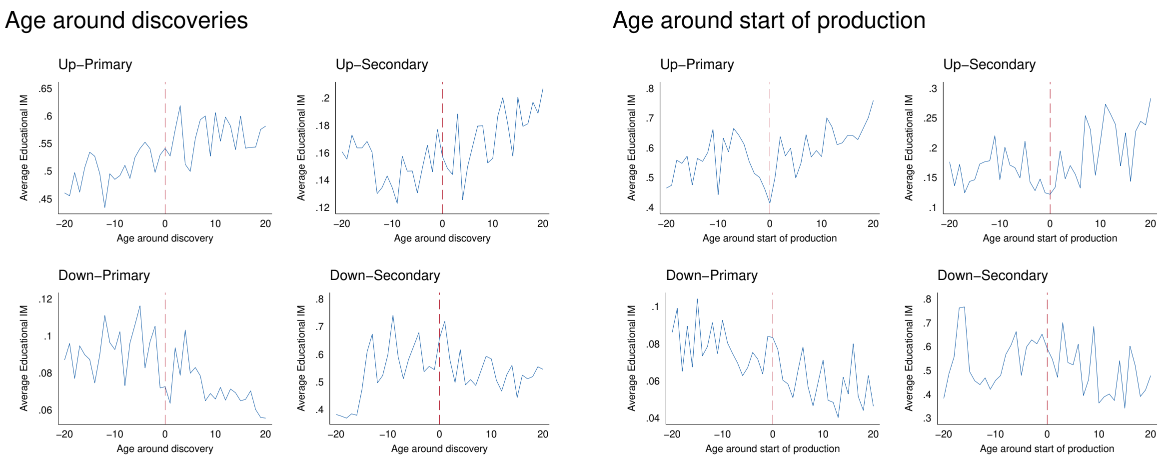
Figure 8: District-level educational IM



In addition, we show that the improvements of IM have occurred for both females and males, with females doing better than males in districts with discoveries (see Figure D.15 and Figure D.16). The gender gap of upward primary IM in favor of males has closed early in districts with discoveries (for 1970s cohort) than districts without discoveries (for 1990s cohort). The gender gap of secondary and tertiary IM in favor of males quickly turns to be in favor of females in districts with discoveries (for cohorts 1960s–1990s), which happened 20 years later in districts without discoveries (for cohorts 1980s-1990s). Likewise, downward IM for primary and secondary/tertiary was higher for females than males in districts without discoveries contrary to districts with discoveries. Still, the gap has closed or widened for recent cohorts in districts without and with discoveries, respectively, with females performing better than males. We also find that IM improvements have occurred both in urban and rural areas in all districts (see Figure D.17 and Figure D.18). However, the gap between urban and rural areas has remained significant despite greater improvements in rural areas. There are, however, no significant differences in the dynamics of IM for rural and urban districts with and without discoveries.

Finally, we look at the dynamics of IM for individuals born around the first discovery and beginning of production. They are presented in Figure 9. These dynamics show that the timing of mineral discoveries and productions may constitute structural breaks in IM dynamics for individuals born before and after the discovery or production. Indeed, we show that the likelihood of upward IM for primary and secondary education has significantly increased after the mineral discoveries and productions for individuals born after the discovery or production. Similarly, the likelihood of downward IM for primary and secondary education has decreased after the mineral discoveries and productions for individuals born after the discovery or production, while it is has sometimes increased for individuals born in years running up to discovery or production. While we cannot plot the dynamics of the counterfactuals, we show that IM has favorably and significantly accelerated after the discovery and beginning of production of mineral resources.

Figure 9: Country-level educational IM by birth cohorts



5 Empirical methodology

To estimate the potential effects of the discoveries and productions of mineral resources on educational IM, we adopt an experimental approach and exploit the exogeneity of natural resource discoveries. First, it is plausible that the timing of mineral resource discoveries is exogenous due to the uncertainty related to exploration success. While the technology used for exploration has improved over time, it is still highly improbable to predict the timing and success likelihood of finding a mineral field in a particular region (Khan et al., 2016; Arezki et al., 2017; Cavalcanti et al., 2019; Seri, 2021). Moreover, the location of mineral resources discoveries is purely exogenous as it depends on the geography, the structure of the soil and underground soil, and other factors dating from the foundations of the earth. Therefore, while some regions may be endowed with mineral resources, it is improbable to find any resources in others. This allows differentiating between districts with and without mineral discoveries. Second, mineral discoveries provide a significant source of revenues and represent a major economic shock that can affect the trajectory of the development in countries and districts they are found. They can also change the habit of individuals and their expectations about their own and children's future. Third, as shown by Arezki et al. (2017) and Horn (2011), there is a significant lag between the discoveries of natural resources and the beginning of their production, around five to six years. This allows us to study the effects of both mineral discoveries and productions on educational IM, separately. These features stand at the heart of our identification strategy and allow capturing a causal effect of mineral discoveries and productions on educational IM in African countries. Throughout the paper, we analyze both the effects of the first discoveries and productions on upward and downward mobility, and later in the robustness of multiple and successive discoveries and productions.

We employ a generalized difference-in-differences (GDID) strategy in a quasi-natural experiment and estimate treatment effects by comparing the change in educational IM between a treatment group (people with exposure to the mineral discoveries and productions) and a control group, across pre-discovery/production and post-discovery/production. By doing so, our goal is to identify how the Educational IM has evolved following discovery/production for a group of people with exposition compared to a group of people born in the same district and around the discovery or production but not exposed to it, while controlling for the dynamics of educational IM in other districts without any discovery/production.

To capture the pure effect of the discovery/production, we first focus in our baseline on a period spanning 30 years around it, i.e., we consider in the regressions, individuals born 15 years before and after the discovery or production. In the robustness, we expand this window and consider larger window periods of 40, 50, 60 years around the discovery or production. We define different expositions to the discovery or production as well as various control groups. First, focusing on a window of 30 years, we consider all the individuals born the year of the discovery or production to up to 15 years after it to be in the treatment group. In an alternative specification, we assume that individuals born 5 years before the discovery or production will still be exposed to it as they start their education around the date of the discovery or production; therefore, the treatment group comprises individuals born five years before the discovery or production to up to 15 years after. Second, in the first specification, we consider as control groups (i) individuals born in districts with a discovery or production and between 15 years before to one year before the discovery or production, and (ii) individuals born in districts without any discovery or production over the period of study. Similarly, the second specification takes in control groups, (i) individuals born in districts with a discovery or production and born between 15 years to 5 years before the discovery or production, and (ii) individuals born in districts without any discovery or production.

Given the nature of our data, multiple discoveries or productions and multiple treatments and control groups within and across districts, our GDID model allows for (i) specific IM across districts by introducing district fixed-effects α_i, (ii) the common change in IM to vary across cohorts (decade in baseline, and each year of birth in the robustness) and years of census/survey by introducing cohort fixed-effects or year-birth fixed effects γ_t and census-year fixed effects δ_t, and (iii) different timing of the discovery or production for different treated groups. This allows to filter out all rigid characteristics. The model is estimated using linear probability specification and obtained as follows:

$$IM_{jith} = \alpha_i + \gamma_t + \delta_t + \beta d_h + X_{jit}\theta + \varepsilon_{jit} \tag{2}$$

Where IM_{jith} is our measures of upward (and downward) mobility for primary or secondary/tertiary levels that takes the value one if the child j in district i has on average a higher (lower) education than its biological/step- parents knowing that its biological/step-parents have not completed (have completed) primary or secondary/tertiary education, respectively. d_h is a dummy that takes the value of one if the individual is in the treated group (e.g., born between the year of the discovery or production to up to 15 years later) and zero if the individual is in the control group (e.g., either born between 15 years to one year before the discovery or production, or born in districts without any discovery or production). β is the variable of interest. It captures the treatment effect of mineral discovery/production on upward and downward educational IM by comparing the educational IM in the treated and control groups. X_{it} is a set of control variables including the gender of individuals and of their household head, the occupation of household head, the dummies of cohabitation with biological parents (only biological/step- father, only biological/step- mother, or both biological/step- father and mother), the size of the household, and urban/rural residency. ε_{jit} is the idiosyncratic term.

Our model requires the parallel trends assumption to hold, i.e., in the absence of the discovery or production, the change of educational IM would have been the same in both the treated and control groups. This assumption is violated when they are unobserved factors that are correlated with both the exposition to the discovery or production and the timing of the discovery or production. As discussed above, we have good reasons to believe that the timing of mineral discoveries is exogenous. Regarding the exposition to the discovery or production, since we focus on a relatively short period around the discovery or production in our baseline and include either cohort fixed effects or year-birth fixed effects, we limit the risks that other shocks or interventions polluted our findings. However, since we cannot test for the parallel trends' assumption in our GDID, we apply the following strategy to test the robustness of our findings and implicitly verified whether this assumption holds. First, we analyze the dynamic effects and conduct a standard leads-and-lags test following the literature (see e.g., Angrist and Pischke, 2009;

Maurer, 2019). This allows testing whether the effects of discoveries occurred after the discovery or production and tend to intensify thereafter. Second, we cross validate our findings by using different control groups while dropping from the control group all individuals in (i) countries without mineral discoveries (Mauritius and South Sudan) and (ii) in districts without mineral discoveries. This reduces the heterogeneity and differences in characteristics between our treated and control groups.

6 Results

In this section, we present our main findings. We first present the baseline results for the primary and secondary/tertiary levels of education. Second, we present the dynamic effects of mineral discoveries and productions on educational IM.

6.1 Baseline results

6.1.1 Educational Primary IM

Table 1 reports the baseline results for various sample compositions and definitions of the variables. The dependent variable is the occurrence of upward (columns 1-4) or downward (columns 5-8) educational IM. As explained in the previous section (Section 5), we consider a time window of 15 years before and after the mineral discoveries or productions. We start with the results in Panel (A) where control variables are not included in the estimates. In columns (1) and (5), the treatment group includes individuals born after the mineral discoveries or production. The estimates then provide the difference in the likelihood of upward or downward primary educational IM for individuals in districts with mineral discoveries or production born before (control group) and after (treatment group) the discovery within the exposure window period of 15 years. We do so by controlling for the likelihood of educational IM in districts without mineral discoveries/productions. The results show that the probability of experiencing an upward educational IM is 2.7 percent higher for an individual born after a discovery of a mining site compared to an individual born before the discovery (column 1). In other words, individuals who are born from parents who are uneducated have better chances of achieving at least primary education if a mining site is already discovered in the district. Inversely, the likelihood of experiencing a downward educational IM for individuals born after the discovery of a mining site is 1.2 percent lower than those before the mining discovery (column 5). That said, individuals who are born from educated parents are less likely to fail if a mining site is already discovered in the district.

Table 1: Baseline results, primary education

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Upward mobility				Downward mobility			
	Disc-B/A	Disc-5	Prod-B/A	Prod-5	Disc-B/A	Disc-5	Prod-B/A	Prod-5
Panel (A) Without control variables								
Mining	0.027***	0.026***	0.067***	0.056***	-0.012***	-0.005***	-0.011***	-0.011***
	(0.002)	(0.002)	(0.004)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	8306024	8306024	8537407	8537407	4374423	4374423	4478390	4478390
R-squared	0.251	0.251	0.252	0.252	0.124	0.124	0.123	0.123
# Treated	148633	192236	53986	67663	98793	123151	36768	49337
Control variables	No	No	No	No	No	No	No	No
Panel (B) With control variables								
Mining	0.028***	0.027***	0.070***	0.059***	-0.013***	-0.007***	-0.012***	-0.012***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	8306024	8306024	8537407	8537407	4374423	4374423	4478390	4478390
R-squared	0.269	0.269	0.270	0.270	0.134	0.134	0.133	0.133
# Treated	148633	192236	53986	67663	98793	123151	36768	49337
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01

In columns (2) and (6), we expand the treatment group to include individuals who are born 5 years before the discovery. In fact, these individuals may have not been sent to school at the time of the discovery as they do not meet the minimum years of schooling in most African countries. The coefficient of interest in column (2) remains broadly the same as in column (1), suggesting that the change in the time exposition to the mining discovery does not after the likelihood of upward primary educational IM. However, the coefficient is significantly lower in column (6) than in column (5), implying that individuals born after the discovery of the mining sites would have a lower likelihood of downward mobility than those born just before (five years before) the discovery.

In columns (3) and (7), we use an alternative definition of mining activity where the binary variable is now equal to one for districts where mining production has started and zero otherwise. The estimates compare the likelihood of upward or downward educational IM between individuals born before and after the beginning of the mining production. We find that the probability of experiencing an upward educational IM is 6.7 percent higher for an individual born after the mining production compared to those born before the beginning of the mining production. The coefficient associated with mining is higher in column (3) than in column (1), implying that the mining production tends to have higher effect on the likelihood of upward primary educational IM than just the discovery. The higher effect could be linked to the increase in investments required to start production, which can create more jobs and income opportunities for district residents than the proceeds associated with the exploration and discovery of mining sites. Indeed, the start of the production reveals a new information that would affect the parents own and child's life expectation. We also observe that our coefficient of interest remains broadly unchanged in column (7) compared to column (5), suggesting that individuals born after the discovery and the beginning of the mining production have the same likelihood of experiencing downward primary educational IM. We also include the individuals born 5 years before the beginning of production in the treatment group in columns (4) and (8). We find that the coefficient associated with mining production is lower in column (4) than in column (3), while remaining the same in columns (7) and (8).

In Panel (B), we control for several covariates that can affect the likelihood of upward and downward educational IM as presented in the previous section (see Table F.31 for the coefficients associated with each control variable). We find that the coefficients associated with mining are highly significant at the 1 percent level in all columns, and their magnitude are broadly equal to those found in Panel (A). Our findings remain unchanged even when we control for individual characteristics.

6.1.2 Educational secondary/tertiary IM

We now turn to secondary and tertiary education. Given the few number of observations for tertiary education, we combine secondary and tertiary education. We estimate eq. (2), with the dependent variable being the probability of experiencing upward or downward secondary and tertiary educational IM. The results are reported in Table 2. We find that the coefficient associated with mineral discoveries and productions is not statistically significant in all columns, except the slightly significance in column (5) at the 10 percent level. The result suggests that the likelihood for individuals born after the mineral discoveries and productions to experience an upward or downward secondary/tertiary educational IM is not statistically different from that of individuals born before the start of mining activities-discovery or production. The insignificance of the effect of mining activities on secondary and tertiary educational IM could be due to the presence of mixed effects, both positive and negative, that are offsetting each other. For instance, as illustrated by Gradstein and Ishak (2020), a positive oil price shock is found to have a positive effect on educational attainment for children (ages 0-4), and a negative effect for adolescence (ages 10-14). Indeed, when the child reaches secondary and tertiary education levels, the trade-off between education and employment is biting more. He/she is now able to do some domestic tasks or work outside of the household, and therefore be forced or decide to drop out of school. This situation could be particularly prone when there is a mining site within the district. For instance, Ahlerup et al. (2020) found that individuals who had gold mines within their district when they were adolescent have significantly lower educational attainment as adults, explained by myopic educational decisions when employment in gold mining is an alternative. In contrast, the same reasons driving the benefits of mineral discoveries and productions on the primary education may still be playing a role, therefore re-balancing the negative effects at higher levels of education. In addition, as we will present in the sensitivity section (Section 9), these insignificant effects at higher levels of education can also be explained by the heterogeneous effects across African broad regions.

Table 2: Baseline results, secondary and tertiary education

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Upward mobility				Downward mobility			
	Disc-B/A	Disc-5	Prod-B/A	Prod-5	Disc-B/A	Disc-5	Prod-B/A	Prod-5
Panel (A) Without control variables								
Mining	-0.006	-0.000	0.016	0.006	0.034*	0.012	-0.002	0.015
	(0.012)	(0.011)	(0.020)	(0.019)	(0.019)	(0.018)	(0.022)	(0.022)
Observations	3335415	3335415	3461167	3461167	323998	323998	331618	331618
R-squared	0.195	0.195	0.195	0.195	0.155	0.155	0.155	0.155
# Treated	67525	89986	38002	43715	6197	7491	2813	3380
Control variables	No	No	No	No	No	No	No	No
Panel (B) With control variables								
Mining	-0.007	-0.000	0.016	0.007	0.037**	0.015	-0.010	0.007
	(0.013)	(0.011)	(0.021)	(0.020)	(0.019)	(0.018)	(0.024)	(0.022)
Observations	3335415	3335415	3461167	3461167	323998	323998	331618	331618
R-squared	0.217	0.217	0.217	0.217	0.169	0.169	0.169	0.169
# Treated	67525	89986	38002	43715	6197	7491	2813	3380
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01

In Panel (B), we include the control variables (see Table F.32 for the coefficient associated with each control variables). The results remain unchanged. The coefficients associated with mineral discoveries and productions are statistically not significant in all columns, except column (5). In the latter, the coefficient is positive and significant at the 5 percent level, suggesting that the likelihood of downward secondary/tertiary educational IM of individuals born after mining discoveries tend to be higher than those born before the discoveries. However, this finding does not hold when we expand the treatment group by including individuals born 5 years before the discovery (column (6)), meaning that the significance of the coefficient in column (5) is not robust.

6.2 Dynamic of the impact of natural resources

In this subsection, we explore the dynamic of the effect of mining activities based on the time distance between the years of discoveries or productions and the birth years of individuals in order to test the parallel trends' assumption. As explained previously, we conduct a leads-and-lags test following the literature (Angrist and Pischke, 2009; Maurer, 2019) to analyze whether the effects of mineral discoveries on IM occurred and tend to intensify the years after the shock. To do so, we estimate the likelihood of upward and downward educational IM for individuals born 0-5, 6-10 and 11-15 years after the discoveries or the beginning of mining production, and those born 5-10 and 10-6 years before the discoveries or the first year of mining production. The reference group is given by individuals born 11-15 years before the discoveries or the beginning of mining productions. The results are reported in Table 3 for upward IM (columns 1-2 and 5-6) and downward IM (columns 3-4 and 7-8).

Table 3: Dynamic effects of mining activities on educational IM

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Primary education				Secondary and tertiary education			
	Upward mobility		Downward mobility		Upward mobility		Downward mobility	
	Discovery	Production	Discovery	Production	Discovery	Production	Discovery	Production
Born 10-6 years before Disc/Prod	0.002	0.011***	-0.004**	-0.005*	0.010	-0.006	0.006	0.006
	(0.003)	(0.004)	(0.002)	(0.003)	(0.011)	(0.008)	(0.014)	(0.023)
Born 5-1 years before Disc/Prod	0.025***	0.035***	-0.005*	-0.006**	0.009	0.005	0.000	0.028
	(0.003)	(0.004)	(0.003)	(0.003)	(0.010)	(0.015)	(0.019)	(0.021)
Born 0-5 years after Disc/Prod	0.032***	0.075***	-0.014***	-0.013***	-0.004	0.009	0.032	0.020
	(0.003)	(0.005)	(0.003)	(0.003)	(0.016)	(0.020)	(0.024)	(0.020)
Born 6-10 years after Disc/Prod	0.042***	0.076***	-0.015***	-0.020***	-0.002	0.011	0.042	0.009
	(0.003)	(0.006)	(0.003)	(0.004)	(0.016)	(0.026)	(0.030)	(0.030)
Born 11-15 years after Disc/Prod	0.062***	0.153***	-0.029***	-0.028***	0.016	0.043	0.044	-0.012
	(0.004)	(0.006)	(0.003)	(0.005)	(0.019)	(0.034)	(0.030)	(0.024)
Observations	8306024	8537407	4374423	4478390	3335415	3461167	323998	331618
R-squared	0.269	0.270	0.134	0.133	0.217	0.217	0.169	0.169
# Treated, born 15-11 years before Disc/Prod	60590	27285	56998	17420	26819	14564	1540	1139
# Treated, born 10-6 years before Disc/Prod	55420	21713	42734	20391	27051	10265	1498	1130
# Treated, born 5-1 years before Disc/Prod	54183	17231	31550	15229	27820	7903	1587	764
# Treated, born 0-5 years after Disc/Prod	60051	22312	38694	15473	23993	12752	1602	769
# Treated, born 6-10 years after Disc/Prod	49568	15278	29402	11164	22707	11520	2192	799
# Treated, born 11-15 years after Disc/Prod	39014	16396	30697	10131	20825	13730	2403	1245
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The results are two folds. First, we find that mining activities affect the likelihood of primary educational IM for all age groups, while the effect is not statistically significant for secondary/tertiary educational IM. In fact, the results show that the coefficients associated with mineral discoveries and productions are positive and significant in columns 1-2, suggesting that mining activities tend to increase the likelihood of upward primary educational IM for all age groups of individuals. Inversely, the coefficients associated with mineral discoveries and productions are negative and significant in columns 3-4, meaning that mining activities are correlated with lower likelihood of downward primary educational IM for all age groups. On the other hand, the coefficients associated with mineral discoveries and productions are not statistically significant for all age groups of individuals in columns 5-8. This is in line with our findings in Table 2 that mining activities do not affect the likelihood of upward and downward secondary and tertiary educational IM. Second and more importantly, we find that the coefficients associated with mineral discoveries and productions are higher for individuals born later after the discovery and the beginning of mining production. For instance, the probability of upward primary educational IM is 7.6 percent for individuals born 6-10 years after the beginning of mining production against only 1.1 percent for those born 10-6 years before the beginning of mining production (column 2). This higher probability could be explained by the fact that it takes time for mining activities to have an impact on the local communities, particularly in terms of infrastructure provision. It also supports that the effects we are capturing can be fully attributed to mineral discoveries and start of productions.

7 Transmission channels

We explore the channels through which mining activities affect the likelihood of educational IM. We focus on four channels including the income effect proxied by parents working in the mining sector, the structural transformation of the local economy, the returns to education, and the provision of infrastructures. First, the increase of income for parents working in the mining sector, due to the novel abundant opportunities, will allow them to invest more in their child's education attainment Becker and Tomes (1979). Second, the structural transformation of the local economy will lead to a shift of individuals from the agriculture sector to manufacturing and services sectors (as described by Cavalcanti et al. (2019), in the case of Brazil). Third, this new economic dynamism, creation of new jobs, will lead to an increasing demand for skilled workers. Thus, the higher returns or benefits to education in terms of wealth and income will motivate individuals to increase their educational attainment relative to their parents (Torche, 2014). Fourth, the provision of infrastructures in districts with discoveries through an increase in government spending in education, or more accessible access to basic needs such as electricity and clean water, can also be a driver of the positive effect of mineral discoveries on educational IM.

To capture the income effect, we include an interactive variable between the discovery or production variable and a dummy equals to one if individuals have one of their parents who is working in the mining sector, and the latter itself as additional variables. For the other transmission channel variables, we employ a two-step strategy where, in the first step, the effects of the mining discovery or production on the transmission channel variables is analyzed, and in the second step, we check the correlation between each transmission channel variable and upward/downward educational IM. This allows us to test whether the effect of mineral discoveries and productions on the probability of upward and downward educational IM transits through any of our transmission channel variables. We perform the estimates separately for each transmission channel considered in the paper.

7.1 Income channel: parents working in the mining sector

We first test whether the income effect proxied by parents working in the mining sector could be a channel through which mining activities affect the likelihood of upward/downward educational IM. One would expect that mining activities will create jobs in the local communities, thus generating a source of income which could allow parents to invest more in their children education. We define a binary variable taking the value of one if one of the parents of the child is working in the mining sector, and zero otherwise and interact it with mineral discoveries or productions variables. The results are displayed in Table 4, with the estimates about primary education in columns 1-4, and secondary and tertiary education in columns 5-8. We find that the coefficients associated with mineral discoveries or productions and the interactive term in column 1-4 are statistically significant and have the expected sign. First, the mineral discoveries and productions increase (decrease) the likelihood of upward (downward) primary IM. Second and more importantly, these benefits of mining are accentuated for individuals those one of the parents works in the mining sector. We find that having one of the parents working in the mining sector raises the likelihood of upward primary IM by 2.2 and 6.3 percent following mineral discoveries and productions, respectively. Moreover, it diminishes the likelihood of downward primary IM by 1.1 percent following mineral discovery. For secondary and tertiary IM, we find no significant effects of both the mineral discovery or production and its interactive term with parents working in mining. This suggests that the insignificant effects of mineral discoveries and productions hold for all individuals, independently of whether they have a parent working in the mining sector or not.

Table 4: Income channel: parents working in the mining sector

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Primary education				Secondary and tertiary education			
	Upward mobility		Downward mobility		Upward mobility		Downward mobility	
	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A
Yes Parents work in mining	-0.018***	-0.019***	-0.003*	-0.005***	-0.015***	-0.016***	-0.007	-0.005
	(0.003)	(0.003)	(0.002)	(0.002)	(0.004)	(0.004)	(0.007)	(0.007)
Yes Mining	0.029***	0.078***	-0.015***	-0.014***	-0.007	0.010	0.032	0.024
	(0.002)	(0.004)	(0.002)	(0.002)	(0.014)	(0.026)	(0.032)	(0.044)
Yes Parents work in mining X Yes Mining	0.022**	0.063***	-0.011**	-0.006	0.006	0.030*	0.013	0.003
	(0.010)	(0.014)	(0.004)	(0.006)	(0.010)	(0.016)	(0.018)	(0.021)
Observations	7891058	7891058	4307002	4307002	10621699	10621699	1576361	1576361
R-squared	0.278	0.278	0.137	0.137	0.204	0.204	0.266	0.266
# Treated; with parents in mining	20171	20171	29589	29589	39923	39923	9837	9837
# Treated	270002	87980	237652	106496	436000	157564	71654	36912
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

7.2 Structural transformation

We next explore the structural transformation channel and job creation by checking whether mineral discoveries and productions affect the reallocation of individuals across the broad sectors agriculture, manufacturing, services. Specifically, the mineral discoveries and productions, by creating new opportunities, may change the economic prospects at the local level. They can accelerate the demand for skilled workers by more capital-intensive and better paid activities in the manufacturing and services sectors, whereas individuals may be less prone to work in labor-intensive agriculture sector. As the incomes of the local workers increase, the amount spent on agricultural products declines relative to the amount spent on manufactured goods and services; therefore implying an adjustment of the labor force composition to accommodate the change in the income share spent on each good and service. We focus on the educational IM for the primary education only. We apply a GDID model as in our baseline with the several dummies taking the value one if individuals work in the agriculture, manufacturing, or services sectors, respectively.

The results are reported in Table 5. First, we show that the likelihood to work in the agriculture sector decreases by 1.1 percent for individuals exposed to the mineral discoveries or productions (see columns 1-2). Second, we also find that the likelihood to work in the manufacturing or services sector increases by around 0.8–1.4 percent, respectively (see columns 3-4 and 5-6). This finding supports that mineral discoveries and productions are among the critical determinants of structural transformation in Africa.

Table 5: Structural transformation channel: effects of mineral discoveries and productions on sectoral employment

	(1)	(2)	(3)	(4)	(5)	(6)
	Agriculture		Manufacturing		Services	
	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A
Mining	-0.011***	-0.010***	0.008***	0.012***	0.003***	0.014***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
Observations	7167154	7167154	7167154	7167154	7167154	7167154
R-squared	0.659	0.659	0.145	0.145	0.220	0.220
# Treated	335257	138082	335257	138082	335257	138082
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01

To complement our analysis, we also check whether the likelihood of educational IM is correlated with the sectors in which workers are employed. The results are presented in Table 6. They show that for workers in the agricultural sector, the likelihood of upward primary IM is lower by 8 percent. Similarly, their likelihood of downward primary IM is higher by 6.9 percent. The opposite finding holds for workers in the manufacturing or services sector. Indeed, our results reveal that the likelihood of upward primary IM increases by close to 3 and 13 for workers in the manufacturing or services sector, respectively. Likewise, the likelihood of primary downward mobility decreases by around 1 and 4-10 percent for workers in the manufacturing or services sector, respectively.

Table 6: Structural transformation channel: primary educational IM and sectoral employment

	(1)	(2)	(3)	(4)
	Upward mobility		Downward mobility	
	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A
Mining	0.025***	0.078***	-0.013***	-0.016***
	(0.002)	(0.004)	(0.002)	(0.003)
Agriculture	-0.081***	-0.081***	0.069***	0.069***
	(0.001)	(0.001)	(0.002)	(0.002)
Manufacturing	0.029***	0.029***	-0.009***	-0.009***
	(0.001)	(0.001)	(0.002)	(0.002)
Services	0.127***	0.128***	-0.041***	-0.041***
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	4802295	4802295	2361752	2361752
R-squared	0.327	0.327	0.173	0.173
# Treated	177169	60450	157924	77558
District FE	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

7.3 Return to education: Wealth index and LIDO score

We further test a third channel of returns to education to check whether individuals in districts with mineral discoveries and productions increase their level of education to get a higher wealth and income. Indeed, as shown in the structural transformation channel, individuals exposed to the mineral discoveries and productions have a higher likelihood to work in the manufacturing and services sectors, and a lower likelihood to work in the agriculture sector. Given that the manufacturing and services sector may require a higher educational attainment and skills, individuals would have to increase their education level to work in these sectors, and have a better socio-economic status. To study the effect of mineral discoveries and productions on the returns to education, we first estimate a Mincer-like equation using a GDID model. The dependent variables are a proxy of wealth and income, given the lack of data on income and consumption in our data. The explanatory variables include the educational levels (primary and secondary/tertiary), the mineral discoveries and productions dummy, and their interactive term.

First, we construct the wealth index using a principal component analysis on several variables at the household level reflecting the economic status of household, closely to the Demographic and Health Survey wealth index (see e.g., Rutstein and Staveteig, 2014).[16] Second, we apply the lasso-ajusted industry, demographic, and occupational (LIDO) scores computed using actual data of labor market for the United States in 1950 by Saavedra and Twinam (2020) to our individuals in Africa. This LIDO score is an occupational income rankings score used as an alternative measure of income, socioeconomic status, and labor market outcome. It is dependent on (i) the fine categories of sectors of employment based on the industry classification (e.g., agriculture, mining and extraction, manufacturing, construction, hotels and restaurants, etc.), (ii) the occupation within employment based on the occupation classification (e.g., legislators, senior officials and managers, technicians and associate professionals, service works and market sales, elementary occupations), and (iii) individuals characteristics (e.g., age, gender). When applied to workers in Africa, the cross-individual, district and country differences at each period and over time would only come from the differences in the labor market conditions (sectors of activities, and occupation within employment) and demographics.

[16]The variables used to construct the Wealth index include: (i) whether the household (HH) has at least one domestic servant, (ii) whether any HH member owns a dwelling unit, (iii) HH services and possessions such as drinking water, electricity, fuel cook, and their sources or types, (iv) characteristics of the dwelling such as characteristics of the floor, wall, and roof. The choice of variables is constrained by the availability of data for all countries included in the analysis.

We neutralize the effects of the demographic variables in the estimations by controlling for gender and age. We show in the Figure G.20 and Figure G.21 that the LIDO Score and Wealth index are strongly correlated with PPP GDP per capita at the country level, thereby implying that they are good proxies of income in Africa.

The results for the Wealth index and LIDO score are reported in Table 7 in columns 1–3 and 4–6, respectively. We find that an increase in the levels of education are associated with a higher Wealth index and LIDO score in all districts (with or without mineral discoveries) and all individuals (exposed to mineral discoveries/productions or not). This implies higher returns to education in Africa. More importantly, we find that the returns to education are higher in districts with mineral discoveries or productions (columns 1 and 4), and there are even greater for individuals exposed to the mineral discoveries and productions (columns 2–3 and 5–6+, respectively). In a second step equation, we look how the Wealth index and LIDO score correlate with the educational IM. Table 8 shows a strong and positive (negative) association between the Wealth index and LIDO score with the upward (downward) primary educational IM. Thus, our findings suggest that in districts with mineral discoveries and productions, and specifically for individuals born after the mineral discoveries and productions, the returns to higher education has played a key role as an incentive to achieve higher educational levels and greater educational IM.

Table 7: Return to education channel: Mincer-type equation

	(1)	(2)	(3)	(4)	(5)	(6)
	LIDO Score			Wealth Index		
	With Disc.	Disc-B/A	Prod-B/A	With Disc.	Disc-B/A	Prod-B/A
Primary completed	0.021***	0.021***	0.021***	0.041***	0.041***	0.041***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Secondary and/or tertiary completed	0.048***	0.049***	0.049***	0.097***	0.097***	0.098***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Primary completed X Yes Mining	0.001***	0.003***	0.007***	0.013***	0.027***	0.045***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Secondary and/or tertiary completed X Yes Mining	0.009***	0.010***	0.012***	0.017***	0.042***	0.064***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Yes Mining		0.003***	0.001		-0.012***	-0.052***
		(0.001)	(0.001)		(0.001)	(0.002)
Observations	4615725	4665165	4665165	4254638	4254638	4254638
R-squared	0.518	0.520	0.520	0.789	0.789	0.789
# Treated	396901	136323	46519	387670	178970	66437
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01

Table 8: Returns to education channel; primary educational IM and LIDO score, Wealth index

	(1)	(2)	(3)	(4)
	Upward mobility		Downward mobility	
	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A
Mining	0.014**	0.118***	-0.014*	-0.003
	(0.006)	(0.009)	(0.008)	(0.018)
LIDO score, 0-1	0.592***	0.592***	-0.352***	-0.351***
	(0.007)	(0.007)	(0.009)	(0.009)
Wealth index, 0-1	0.433***	0.434***	-0.252***	-0.252***
	(0.004)	(0.004)	(0.005)	(0.005)
Observations	1032317	1032317	369737	369737
R-squared	0.227	0.228	0.177	0.177
# Treated	48751	23733	15531	4664
District FE	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes

Standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01

7.4 Infrastructures: access to electricity and clean water

Finally, we analyze the channel of infrastructures. Following a mineral discovery, large scale investments in mining infrastructures and other transport infrastructures related to the exploitation and transportation of the resources are needed. Moreover, the revenues generated by the resource offer an opportunity for the region and the country to address infrastructure gaps and enhance economic development. Among the types of infrastructures, the general or local government may increase their public spending in education in the mining regions. Given the lack of data for public spending in education and educational infrastructures at the district level, we use the access to electricity and clean water as a proxy for the provisions of public goods at the district levels. We explore this channel by relating the exposition to mineral discoveries and productions to access to electricity and clean water using a GDID model as in the baseline.

The findings are report in Table 9. We find that for individuals exposed to the mineral discoveries and productions, the likelihood of having access to electricity and clean water increase by around 4 percent. We also show in Table 10 that access to electricity and clean water is strongly and positively (negatively) correlated with the upward (downward) primary educational IM. Consequently, our findings show that the provisions and access to infrastructures is a channel through which mineral discoveries and productions improve the primary educational IM in Africa.

Table 9: Infrastructures channel: effects of mineral discoveries and productions on access to electricity and clean water

	(1)	(2)	(3)	(4)
	Electricity and clean water			
	Disc-B/A	Disc-5	Prod-B/A	Prod-5
Mining	0.040***	0.031***	0.005***	0.031***
	(0.001)	(0.001)	(0.001)	(0.002)
Observations	8864385	8864385	8864385	8864385
R-squared	0.834	0.834	0.834	0.834
# Treated	357611	398147	154905	171991
District FE	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Infrastructures channel: primary educational IM and on access to electricity and clean water

	(1)	(2)	(3)	(4)
	Upward mobility		Downward mobility	
	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A
Mining	0.031***	0.098***	-0.013***	-0.009***
	(0.003)	(0.004)	(0.002)	(0.003)
Electricity and clean water	0.212***	0.212***	-0.107***	-0.107***
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	5610331	5610331	3250520	3250520
R-squared	0.275	0.275	0.162	0.162
# Treated	179636	67176	177824	87668
District FE	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes

Standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01

8 Robustness checks

We undertake various robustness tests to check the validity of our results to alternative samples and specifications.

8.1 Use of alternative control groups (only countries/districts with discoveries)

We start by using an alternative definition of the control groups. In our baseline, we compared the likelihood of upward and downward educational IM between individuals born after the discovery or the beginning of mining production, and those born before the discovery or beginning of production or in regions and countries without discoveries, regardless of their residing countries or districts. In this robustness check, we restrict the control group to individuals living in countries or districts where mining sites are discovered or with production activities. This allows to reduce the heterogeneity of our sample. The results are reported in Table 11, with the estimates for primary educational IM being in Panel (A) and those for secondary and tertiary educational IM in Panel (B). As in the baseline, we find that the coefficients associated with mining activities are significant for primary educational IM, and insignificant for secondary and tertiary educational IM. Therefore, mining activities affect the likelihood of upward and downward primary educational IM in countries and districts with mineral resources, while the effect on secondary and tertiary educational IM is not statistically significant. Our results remain thus unchanged and are robust to the change of control groups and samples.

Table 11: Robustness check: Using different control groups

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Countries with mining activities				Districts with mining activities			
	Upward mobility		Downward mobility		Upward mobility		Downward mobility	
	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A
Panel (A) Primary education								
Mining	0.027***	0.069***	-0.013***	-0.012***	0.045***	0.072***	-0.012***	-0.005**
	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.004)	(0.002)	(0.002)
Observations	8226648	8458031	4320910	4424877	318826	550209	230075	334042
R-squared	0.266	0.267	0.130	0.130	0.342	0.326	0.121	0.116
# Treated	148633	53986	98793	36768	148633	53986	98793	36768
Panel (B) Secondary and tertiary education								
Mining	-0.007	0.015	0.038**	-0.010	0.011	0.017	0.024	-0.008
	(0.013)	(0.021)	(0.019)	(0.024)	(0.008)	(0.020)	(0.020)	(0.024)
Observations	3289349	3415101	321879	329499	149215	274967	10822	18442
R-squared	0.217	0.217	0.168	0.168	0.152	0.169	0.119	0.127
# Treated	67525	38002	6197	2813	67525	38002	6197	2813
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

8.2 Use of alternative structures of fixed effects and time variable

We then perform a series of consistency checks based on the structure of the fixed effects. The results are in Table 12, with Panel (A) being for primary education and Panel (B) for secondary and tertiary education. In columns 1-4, we replace the cohort fixed effect by birth year fixed and compare individuals born within the same year instead of cohort since they may have experienced different shocks in 10 years. In columns 5-8, we include both the birth year fixed effects and the common time trend to capture the evolution of IM and rule out the possibility that individuals born before and after the discoveries or the beginning of mining production were already on differential growth trajectories in their education outcomes, i.e. a change in the educational IM indices that would have happened even in the absence of the mining activities. These factors could include particularly the family background of individuals (rich, poor and others). In columns 9-12, we control for cohort fixed effects and common time trend to filter out all persistent cohort related differences that could affect the likelihood of educational IM of individuals born before and after the discoveries of mining sites: for example the availability of school infrastructure and change in the education system. Table 12 shows that our main findings remain unchanged even after accounting for all these different structures of fixed effects and time variable.

Table 12: Robustness check: Inclusion of fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Upward mobility		Downward mobility		Upward mobility		Downward mobility		Upward mobility		Downward mobility	
	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A
Panel (A) Primary education												
Mining	0.016***	0.039***	-0.009***	-0.009***	0.016***	0.039***	-0.009***	-0.009***	0.014***	0.052***	-0.009***	-0.008***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Observations	8306024	8537407	4374423	4478390	8306024	8537407	4374423	4478390	8306024	8537407	4374423	4478390
R-squared	0.273	0.274	0.135	0.134	0.273	0.274	0.135	0.134	0.272	0.273	0.134	0.133
# Treated	148633	53986	98793	36768	148633	53986	98793	36768	148633	53986	98793	36768
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Common Time-Trend	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District X Cohort FE	No	No	No	No	No	No	No	No	No	No	No	No
Panel (B) Secondary and tertiary education												
Mining	-0.017	0.011	0.050***	-0.001	-0.017	0.011	0.050***	-0.001	-0.017	0.011	0.048**	-0.001
	(0.012)	(0.020)	(0.019)	(0.024)	(0.012)	(0.020)	(0.019)	(0.024)	(0.012)	(0.020)	(0.019)	(0.025)
Observations	3335415	3461167	323998	331618	3335415	3461167	323998	331618	3335415	3461167	323998	331618
R-squared	0.221	0.221	0.171	0.171	0.221	0.221	0.171	0.171	0.221	0.221	0.170	0.170
# Treated	67525	38002	6197	2813	67525	38002	6197	2813	67525	38002	6197	2813
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	No	No	No	No	No	No	No	No	No	No	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Common Time-Trend	No	No	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes
District X Cohort FE	No	No	No	No	No	No	No	No	No	No	No	No

Standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01

8.3 Use of alternative time window around the mineral discoveries and productions

Another important element of our analysis is the time window around the mineral discovery and production. In the baseline, we used a time window of 30 years (15 years before and after the discovery or the beginning of production). We test the robustness to alternative time windows, including 40 years (i.e., 20 years before and after), 50 years (25 years before and after) and 60 years (30 years before and after the discovery/production) to account for the individuals who take more time to complete their education and the potential long lasting effect of mining activities. The results are reported in Table 13, with Panel (A) for primary education, and Panel (B) for secondary and tertiary education. We find that the coefficients associated with our variable of interest are significant for the primary education, while insignificant for the secondary and tertiary education, thus in line with the findings in the baseline estimates. This confirms that our baseline results are not driven by the choice of the time window around the discovery or the beginning of mining production.

Table 13: Robustness check: Using alternative time window

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Window of 40 years				Window of 50 years				Window of 60 years			
	Upward mobility		Downward mobility		Upward mobility		Downward mobility		Upward mobility		Downward mobility	
	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A
Panel (A) Primary education												
Mining	0.030***	0.074***	-0.015***	-0.018***	0.032***	0.074***	-0.016***	-0.019***	0.033***	0.073***	-0.016***	-0.016***
	(0.002)	(0.004)	(0.002)	(0.003)	(0.002)	(0.004)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Observations	8397851	8397851	4459701	4459701	8487171	8487171	4534408	4534408	8563949	8563949	4603751	4603751
R-squared	0.270	0.270	0.134	0.134	0.271	0.271	0.134	0.134	0.271	0.271	0.134	0.134
# Treated	182250	37372	128892	27622	211230	50369	154302	38299	242877	66867	180868	55795
Panel (B) Secondary and tertiary education												
Mining	-0.003	0.026	0.039**	-0.021	-0.001	0.029	0.040**	-0.021	-0.001	0.022	0.040**	-0.011
	(0.012)	(0.016)	(0.019)	(0.023)	(0.012)	(0.020)	(0.020)	(0.023)	(0.012)	(0.019)	(0.019)	(0.022)
Observations	3388392	3388392	329884	329884	3442816	3442816	337347	337347	3495819	3495819	343205	343205
R-squared	0.217	0.217	0.168	0.168	0.218	0.218	0.167	0.167	0.217	0.217	0.166	0.166
# Treated	88176	26107	7715	1948	106151	36649	9003	2871	126826	50705	11022	4475
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

8.4 Use of alternative time exposition to the mineral discoveries or productions

We further explore whether our results are robust to the change in the time exposition to the mining activities. We expand the definition of the treatment group to account for individuals who may not have completed their education before the discovery or the beginning of mining production. Our baseline estimates compare the likelihood of individuals born before and after the start of mining activities. However, some individuals born before the start of mining activities may complete their education after the beginning of mining activities. In this case, those individuals will benefit from the economic and social impact from the exploitation of mining resources. We have already tried to account for these individuals by including in the treatment group the individuals born 5 years before the discovery/production in Table 1 and Table 2. In this robustness check, we further expand by including in the treatment group the individuals born 10 and 15 years before the discovery or the start of mining production. To this end, we consider a longer time window of 60 years (30 years before and after the discovery/production). The results are reported in Table 14, with the primary educational IM in Panel (A), and secondary and tertiary educational IM in Panel (B). In all cases, we confirm our findings that mining activities have a statistically significant positive (negative) effect on the probability of upward (downward) primary educational IM, while the effect on the probability of secondary and tertiary educational IM is not statistically significant.

Table 14: Robustness check: Use of alternative time exposition to mining activities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	10 years				15 years			
	Upward mobility		Downward mobility		Upward mobility		Downward mobility	
	Disc-10	Prod-10	Disc-10	Prod-10	Disc-15	Prod-15	Disc-15	Prod-15
Panel (A) Primary education								
Mining	0.022***	0.052***	-0.008***	-0.012***	0.005**	0.048***	-0.003*	-0.013***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.001)	(0.002)
Observations	8397851	8397851	4459701	4459701	8397851	8397851	4459701	4459701
R-squared	0.270	0.270	0.134	0.134	0.270	0.270	0.134	0.134
# Treated	281879	65666	194290	56478	341347	90201	248730	74213
Panel (B) Secondary and tertiary education								
Mining	0.009	0.003	0.012	0.022	0.009	-0.001	-0.007	-0.002
	(0.010)	(0.015)	(0.015)	(0.032)	(0.009)	(0.016)	(0.019)	(0.026)
Observations	3388392	3388392	329884	329884	3388392	3388392	329884	329884
R-squared	0.217	0.217	0.168	0.168	0.217	0.217	0.168	0.168
# Treated	138784	38651	10596	3304	165254	51506	11988	4546
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

8.5 Use of alternative IM definitions

We also check the robustness of our findings to alternative definitions of our dependent variables. In the baseline, we considered children living with their biological or step- parents and the average values of parents' education achievements to construct the intergenerational mobility indices. In this subsection, we first broaden the definition of parental authority to include all other immediate relatives from older generations such as uncles/aunts (in law), parents-in-law, grand-parents, and grand-uncles/aunts to account for abandoned or orphan children sent to relatives, and biological parents deliberately sending their children to relatives or places where education conditions are better. The results are reported in Table 15, columns 1-4. Panel (A) is for primary education and Panel (B) is for secondary and tertiary education. Second, we use the minimum and the maximum of the parents' education attainment instead of the average education attainment to better capture potential parents' education inequalities as women tend to have lower education attainment then men in Africa. In this case, a child will experience upward (downward) educational IM if his/her education attainment is higher (lower) than the minimum or the maximum of his/her parents' education attainment. The results of the estimates are displayed in Table 15, columns 5-12. We still find that mining discoveries and productions increase (reduce) the likelihood of upward (downward) primary educational IM (see Panel (A)), while the effect on secondary/tertiary educational IM is insignificant (see Panel (B)). That said, the use of alternative intergenerational mobility definitions does not alter our findings.

Table 15: Robustness check: Using alternative IM definitions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	All immediate older generations				Minimum parents' education				Maximum parents' education			
	Upward mobility		Downward mobility		Upward mobility		Downward mobility		Upward mobility		Downward mobility	
	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A
Panel (A) Primary education												
Mining	0.022***	0.070***	-0.016***	-0.008***	0.028***	0.067***	-0.008***	-0.006***	0.028***	0.070***	-0.013***	-0.012***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Observations	9317365	9583522	4759270	4876916	9656297	9920198	3024150	3095599	8306024	8537407	4374423	4478390
R-squared	0.279	0.280	0.137	0.136	0.280	0.281	0.0917	0.0909	0.269	0.270	0.134	0.133
# Treated	168029	63557	112392	41220	172451	62158	74975	28596	148633	53986	98793	36768
Panel (B) Secondary and tertiary education												
Mining	-0.009	0.011	0.028	-0.011	-0.009	0.017	0.031*	0.011	-0.012	-0.001	0.025*	-0.003
	(0.012)	(0.018)	(0.022)	(0.022)	(0.013)	(0.021)	(0.017)	(0.032)	(0.010)	(0.006)	(0.013)	(0.008)
Observations	4026641	4178603	381313	390657	3472544	3601346	186869	191439	3390543	3609255	330215	345236
R-squared	0.220	0.219	0.183	0.183	0.234	0.233	0.162	0.162	0.216	0.216	0.167	0.166
# Treated	80221	45703	7960	3549	69345	38973	4377	1842	86544	45422	7904	3240
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01

8.6 Use of all mineral discoveries and productions

We test for robustness to the coverage of mineral discoveries and productions. As explained in Section 5, we focused on the first discovery and the first production to cancel out any potential anticipation and duplication effects as resource-rich districts are more likely to experience several discoveries or have many production sites. In this subsection, we use all discoveries and productions of mineral resources. The results are displayed in Table 16. We still find that mining activities affect the likelihood of primary educational IM, while the effect on secondary and tertiary educational IM is not statistically significant. Therefore, the change in coverage of mineral discoveries and productions does not alter our baseline findings.

Table 16: Robustness check: Using all mining sites

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Primary education				Secondary and tertiary education			
	Upward mobility		Downward mobility		Upward mobility		Downward mobility	
	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A
Mining	0.014***	0.028***	-0.008***	-0.007***	-0.012	-0.001	0.025*	-0.003
	(0.002)	(0.002)	(0.001)	(0.001)	(0.010)	(0.006)	(0.013)	(0.008)
Observations	8432049	8797840	4485265	4679709	3390543	3609255	330215	345236
R-squared	0.270	0.272	0.134	0.133	0.216	0.216	0.167	0.166
# Treated	185161	64163	136094	45205	86544	45422	7904	3240
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

8.7 Use of conflicts as additional control variables

Finally, we verify if our baseline results hold after the inclusion of conflicts as additional control variables, given their negative association with mineral discoveries, extensively found in the literature. We have not included this variable in the baseline since geolocalized data on conflicts at district level is available from 1989, thereby restraining our sample of study. We use the Georeferenced Event Dataset (GED) on conflicts from Uppsala Conflict Data Program. We create a dummy equal to one if individuals aged 0–16 years old were exposed to a conflict with more than 25 deaths at the district level, and use it as explanatory of primary educational IM. For secondary and tertiary educational IM, we rather consider individuals aged 0–25 years old for exposition to conflicts. The results are reported in Table 17. We show that conflicts are negatively associated with upward primary IM, while they have no significant effects on downward primary IM as well as both upward and downward secondary and tertiary IM. However, the effect of mining activities (discoveries or production) on educational upward (downward) IM remain positive (negative) for the primary level, and not significant for the secondary and tertiary level. Then, additional conflicts as an explanatory of educational IM does not alter our baseline findings.

Table 17: Robustness check: Adding conflicts as explanatory of educational IM

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Primary education				Secondary and tertiary education			
	Upward mobility		Downward mobility		Upward mobility		Downward mobility	
	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A
Mining	0.028***	0.020***	-0.016***	0.001	0.012	0.024	0.019	0.002
	(0.003)	(0.005)	(0.003)	(0.002)	(0.026)	(0.029)	(0.037)	(0.022)
Conflict	-0.009***	-0.009***	-0.000	-0.000	0.010	0.010	-0.012	-0.014*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.010)	(0.009)	(0.008)	(0.007)
Observations	2240418	2327927	1529992	1566001	1051050	1094890	111055	115467
R-squared	0.380	0.382	0.162	0.161	0.180	0.180	0.100	0.100
# Treated	57972	11529	34160	21096	31019	12668	3016	2093
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01

9 Sensitivity tests

In this section, we undertake some sensitivity tests to explore whether our findings vary in function of some characteristics, including the African regions, the size of the mining sites, the gender status, and the urban-rural residency.

9.1 Depending on the African regions

We first explore whether the regional subdivision matters. We split the African continent into four regions: Eastern Africa, Northern Africa, Southern Africa, and Western and Central Africa. We then estimate the effects of mining activities on the probability of upward/downward educational IM for each region. The results reported in Table 18 show that there are some heterogeneities across regions. We find that the coefficients associated with mineral discoveries or productions are positive and strongly significant at the 1 percent level (columns 1–2), suggesting that mining activities tend to increase the probability of upward primary educational IM in all African regions. However, mining activities reduce the likelihood of downward primary educational IM only in Eastern Africa and Northern Africa, as the coefficients associated with mineral discoveries or productions are negative and significant only for these two regions (columns 3–4). Regarding secondary and tertiary educational IM, the results are more divergent. We find that the coefficient associated with mining activities are negative and significant in Eastern Africa and Northern Africa, while positive and significant in Southern Africa, and Western and Central Africa (columns 5–6). In other words, mining activities increase the probability of upward secondary and tertiary educational IM in Southern Africa, and Western and Central Africa, while reducing the probability of upward secondary and tertiary educational IM in Eastern Africa and Northern Africa. On the other hand, the coefficients associated with downward secondary and tertiary educational IM are not statistically significant in all regions, except some positive associations in Eastern and Northern Africa.

Table 18: Sensitivity: African Regions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Primary education				Secondary and tertiary education			
	Upward mobility		Downward mobility		Upward mobility		Downward mobility	
Mining	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A
Eastern Africa	0.011***	0.054***	-0.024***	-0.017***	-0.013***	-0.029***	0.037*	0.036
	(0.003)	(0.005)	(0.004)	(0.003)	(0.004)	(0.008)	(0.022)	(0.036)
Northern Africa	0.039***	0.105***	-0.008***	-0.012***	-0.016***	0.015	0.045***	0.030
	(0.003)	(0.006)	(0.002)	(0.004)	(0.005)	(0.010)	(0.016)	(0.036)
Southern Africa	0.044***	0.026**	-0.005	-0.008	0.048***	0.066***	0.003	-0.056*
	(0.008)	(0.011)	(0.005)	(0.006)	(0.010)	(0.009)	(0.060)	(0.032)
Western and Central Africa	0.078***	0.062***	0.007	0.007	0.063***	0.050***	-0.015	-0.063
	(0.016)	(0.017)	(0.011)	(0.007)	(0.016)	(0.018)	(0.060)	(0.058)
Observations	8306024	8537407	4374423	4478390	3335415	3461167	323998	331618
R-squared	0.269	0.270	0.134	0.133	0.217	0.217	0.169	0.169
# Treated; Eastern Africa	71453	32587	35765	11765	27505	19397	1880	541
# Treated; Northern Africa	57616	11335	45223	10666	25016	6121	2935	476
# Treated; Southern Africa	16186	7765	12252	10160	11255	10185	888	1457
# Treated; Western and Central Africa	3378	2299	5553	4177	3749	2299	494	339
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

9.2 Depending on the size of mineral discoveries

We now study whether our results generalize to all sizes of mineral discoveries or if some subgroups of minerals have specific effects on education outcomes. The Minex Consulting Dataset (2019) splits mineral discoveries into four categories: moderate, major, giant and super-giant mining. We merge the last two categories as there was not sufficient observations to include each of them in the estimates. The results are in Table 19, columns 1–4 for primary education and 5–6 for secondary and tertiary education. We find that the coefficient associated with all sizes of mineral discoveries are positive and significant at the 1 percent in columns 1-2, suggesting that mineral discoveries or productions, regardless of its size, is positively correlated with higher likelihood of primary educational upward IM for individuals born after the discovery than those born before. However, we observe in columns 3-4 that the coefficients associated with giant and super-giant mining are not statistically significant, while those associated with moderate and major mining are significant and in line with our baseline findings. Therefore, individuals living in districts with moderate and major mining operations are less likely to experience downward primary educational IM. Furthermore, we find that the coefficients associated with major and moderate mining are higher in absolute terms than those associated with giant and super-giant mining. On the other hand, only the coefficients associated with giant and super-giant mining discoveries are statistically significant in columns 5-6, meaning that individuals exposed to the discoveries and productions of giant and super-giant mining have a higher likelihood of upward secondary and tertiary educational IM.

Table 19: Sensitivity: Size of mineral discoveries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Primary education				Secondary and tertiary education			
	Upward mobility		Downward mobility		Upward mobility		Downward mobility	
	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A
Moderate Mining	0.011***	0.054***	-0.024***	-0.017***	-0.013	-0.029**	0.037	0.036**
	(0.003)	(0.005)	(0.004)	(0.003)	(0.024)	(0.013)	(0.037)	(0.017)
Major Mining	0.039***	0.105***	-0.008***	-0.012***	-0.016	0.015	0.045**	0.030
	(0.003)	(0.006)	(0.002)	(0.004)	(0.010)	(0.047)	(0.021)	(0.032)
Giant and Super-Giant Mining	0.051***	0.036***	-0.003	-0.003	0.053***	0.062***	-0.007	-0.057***
	(0.007)	(0.009)	(0.005)	(0.005)	(0.019)	(0.015)	(0.045)	(0.014)
Observations	8306024	8537407	4374423	4478390	3335415	3461167	323998	331618
R-squared	0.269	0.270	0.134	0.133	0.217	0.217	0.169	0.169
# Treated; Moderate	71453	32587	35765	11765	27505	19397	1880	541
# Treated; Major	57616	11335	45223	10666	25016	6121	2935	476
# Treated; Giant and Super-Giant	19564	10064	17805	14337	15004	12484	1382	1796
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Moderate <> Major, p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Moderate <> Giant / Super Giant, p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Major <> Giant / Super Giant, p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

9.3 Depending on the gender

We then look at whether the effect of mining activities varies based on the gender status of individuals. The estimates are run separately for male and female genders. The results are reported in Table 20 for both primary education (columns 1–4) and secondary and tertiary education (columns 5–6), with male gender being in Panel (A) and female gender in Panel (B). The p-values of the difference-in-means test between males and females are presented at the bottom of the table. Interestingly, the results in Table 20 show that the coefficient associated with mining in Panel (A) and (B) in column (1) are not statistically different, suggesting that mining discoveries affect by the same magnitude the probability of upward primary educational IM of men and women. However, the coefficient associated with mining in column (2) is nearly 2 times higher in Panel (A) than in Panel (B), reflecting the gender gap in benefits associated with mining production, in favor of males. Indeed, the probability for males to experience an upward primary educational IM is 8.4 percent, against 4.9 percent for females. We also find that the coefficients associated with mining in columns (3) and (4) are higher in absolute terms in Panel (A) than in Panel (B). Males are therefore less likely to experience downward primary educational IM than females. Regarding secondary and tertiary education, Table 20 shows that the coefficient associated with mining is mostly not statistically significant or inconsistently estimated both for males and females.

Table 20: Sensitivity: Gender

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Primary education				Secondary and tertiary education			
	Upward mobility		Downward mobility		Upward mobility		Downward mobility	
	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A
Panel (A) Male								
Mining	0.027***	0.084***	-0.016***	-0.017***	-0.006	0.017***	0.045**	-0.024
	(0.003)	(0.005)	(0.003)	(0.003)	(0.004)	(0.006)	(0.018)	(0.026)
Observations	5101686	5241058	2361599	2417884	2089939	2165635	190636	194782
R-squared	0.257	0.258	0.126	0.125	0.232	0.232	0.172	0.172
# Treated	85358	32490	51792	19482	37088	23104	3269	1553
Panel (B) Female								
Mining	0.027***	0.049***	-0.010***	-0.006*	-0.014***	0.014*	0.029	0.011
	(0.003)	(0.005)	(0.003)	(0.003)	(0.005)	(0.008)	(0.018)	(0.027)
Observations	3204338	3296349	2012824	2060506	1245476	1295532	133362	136836
R-squared	0.308	0.308	0.153	0.153	0.217	0.217	0.194	0.194
# Treated	63275	21496	47001	17286	30437	14898	2928	1260
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean difference, p-value	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

9.4 Depending on the urban-rural living area

We split the sample into two subsamples based on the place of living of individuals- urban and rural, and then run the estimates of the effect of mining activities on the likelihood of upward and downward educational IM for each subgroup. The results are reported in Table 21 for both primary education (columns 1–4) and secondary and tertiary education (columns 5–6). The estimates for urban residents are in Panel (A), while those of rural residents are in Panel (B). We report at the bottom of the table the p-value of the significance of the difference in coefficients between urban and rural areas. In columns 1–4, we find that the coefficients associated with mining are broadly higher in absolute terms in urban areas than in rural areas, suggesting that the effect of mining activities on the probability of educational IM tends to be high for individuals living in urban areas. In columns 5–6, we observe that the coefficients associated with our variable of interest are not statistically significant in rural areas, while there are significant in urban areas, meaning that the place of living also matters with regard to the effect of mining activities on the probability of secondary and tertiary educational IM.

Table 21: Sensitivity: Urban Rural residency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Primary education				Secondary and tertiary education			
	Upward mobility		Downward mobility		Upward mobility		Downward mobility	
	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A	Disc-B/A	Prod-B/A
Panel (A) Urban								
Mining	0.055***	0.083***	-0.015***	-0.010***	-0.013**	0.020***	0.047***	-0.022
	(0.005)	(0.006)	(0.003)	(0.003)	(0.006)	(0.007)	(0.017)	(0.021)
Observations	2620209	2675545	2639013	2672691	1407813	1447625	258097	263176
R-squared	0.118	0.118	0.0772	0.0766	0.156	0.155	0.151	0.150
# Treated	31407	20106	41516	22049	23830	19390	3612	2319
Panel (B) Rural								
Mining	0.018***	0.060***	-0.005**	-0.009***	-0.007	0.006	0.046	0.050*
	(0.002)	(0.004)	(0.003)	(0.003)	(0.015)	(0.021)	(0.030)	(0.029)
Observations	5685815	5861862	1735410	1805699	1927602	2013542	65901	68442
R-squared	0.290	0.291	0.152	0.152	0.230	0.229	0.208	0.208
# Treated	117226	33880	57277	14719	43695	18612	2585	494
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean difference, p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01

10 Conclusion and Policy implications

This paper sheds light on the effects of mineral discoveries and productions on the educational IM on more than 14 million individuals across 28 countries, 2,890 districts from 61 surveys. First, we compute absolute measures of intergenerational mobility and provide a panorama of stylized facts about the trend, dynamics, and disparities of educational IM across countries, regions of the continent, and depending on the characteristics of the individuals. We show that primary and secondary/tertiary educational IM have significantly improved in Africa over time, with a more significant increase in primary IM (higher upward IM and lower downward IM) than in secondary/tertiary IM. We find that the gender gap in favor of males has closed over time, with sometimes females doing better than males in most recent cohorts. Regarding the living area, we show that although the residency gap has diminished over time, educational IM has always been better in urban than rural areas. We also provide country-specific characteristics regarding educational IM and rank countries by their educational IM and its within-country disparity across districts. In addition, we identify where is the land of opportunities by mapping the district-level educational IM to unveil the heterogeneities across the African continent.

Second, we empirically study the potential role of mineral discoveries and productions on educational IM in Africa given the abundance of mineral resources across the continent and the progress that have been made in terms of education. To so do, we employ a generalized difference-in-differences method in a quasi-natural experiment. Our findings suggest that mineral discoveries and productions positively affect primary educational IM in Africa for individuals exposed to the mineral sites and living in districts with discoveries. However, no significant effects are found for secondary/tertiary educational IM. We also unveil four transmission channels through which the positive effects of mineral discoveries and productions on educational primary IM operate, including the income effect proxied by parents working in the mining sector, the structural transformation of the local economy, the returns to education, and the provision of infrastructures.

Our paper has many policy implications. The massive increase in world demand for raw materials amid growing emerging countries such as China, India, South Korea, etc., and the rise in raw material and metal prices has led to a growing competition among mining operators to acquire rights to new mineral reserves and invest in the mineral exploratory. This implies that new discoveries will certainly occur in Africa, therefore creating new opportunities for African countries to finance their social and economic development. We show that mineral discoveries and productions have helped improved the social and educational intergenerational mobility in Africa, but these average effects may hide tears of millions of individuals that have seen the opportunities of mineral resources turn into disappointments. For these opportunities to be seized, several challenges must be met. First, the profits from the resources should be better and equitably redistributed between governments, mining companies, and every single citizen. This starts by renegotiating existing contracts and learning from past contracts to better negotiate the coming ones. These contracts should provide sufficient hedge against price volatility and enable countries to better benefit from rising price. Second, the financial returns of the resources should finance the structural transformation of countries, provision of public goods, and accumulation of human capital. To do so, a better management of the foreign currency generated by the resources is required to avoid corruption and counter-productive macro-economic effects such the Dutch disease. As shown by Seri (2021), what seems to matter for the effects of natural resources is the behavior of governments in the aftermath of those discoveries. Third, the control of extraction should aim at avoiding negative environmental and social externalities at the local and country level. In this respect, mineral discoveries across African countries may be an engine of social and economic development and of intergeneration mobility which is critical for an equality of opportunities for all Africans. But for this to happen, governments, mining operators, and to some extent Africans, have a critical role to play.

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Appendix A Sample

Table A.22: Construction of sample from raw IPUMS data

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Country	**Year**	**Nall**	**Ndistrict**	**Neduc**	**Nliverelative**	**Nlivebiop**	**Nage**	**Nsex**	**Nurban**	**Ncont**	**NIMiog**	**NIMbiop**	**Inc.**
Benin	1979	331 049	331 049	246 094	96 925	80 434	22 566	22 566	0	0	0	0	no
Benin	1992	498 419	498 419	435 827	212 711	196 722	50 851	50 851	50 851	40 875	38 869	38 689	yes
Benin	2002	685 467	685 467	612 658	317 380	250 883	84 593	84 593	84 593	48 913	48 651	48 606	yes
Benin	2013	1 009 693	1 009 693	911 604	512 405	412 923	152 398	152 398	152 398	94 195	93 987	93 975	yes
Total		**2 524 628**	**2 524 628**	**2 206 183**	**1 139 421**	**940 962**	**310 408**	**310 408**	**287 842**	**183 983**	**181 507**	**181 270**	
Botswana	1981	97 238	97 238	73 096	32 554	25 225	9 359	9 359	0	0	0	0	no
Botswana	1991	132 623	132 623	113 172	49 711	41 258	16 624	16 624	16 624	13 877	13 058	13 037	yes
Botswana	2001	168 676	168 676	159 446	76 312	63 327	29 167	29 167	0	0	0	0	no
Botswana	2011	201 752	201 752	190 510	84 347	69 536	33 686	33 686	0	0	0	0	no
Total		**600 289**	**600 289**	**536 224**	**242 924**	**199 346**	**88 836**	**88 836**	**16 624**	**13 877**	**13 058**	**13 037**	
Burkina Faso	1985	884 797	884 797	484 993	0	0	0	0	0	0	0	0	no
Burkina Faso	1996	1 081 046	1 081 046	803 642	377 219	327 148	112 834	112 834	0	0	0	0	no
Burkina Faso	2006	1 417 824	1 417 824	1 244 906	609 130	543 338	127 886	127 886	127 886	103 987	103 605	103 518	yes
Total		**3 383 667**	**3 383 667**	**2 533 541**	**986 349**	**870 486**	**240 720**	**240 720**	**127 886**	**103 987**	**103 605**	**103 518**	
Cameroon	1976	736 514	736 514	605 857	224 570	210 439	40 560	40 555	0	0	0	0	no
Cameroon	1987	897 211	897 211	763 744	312 705	301 224	63 193	63 193	63 193	55 113	52 612	52 357	yes
Cameroon	2005	1 772 359	1 766 211	1 536 785	769 108	712 995	240 864	240 864	240 864	207 506	205 996	205 902	yes
Total		**3 406 084**	**3 399 936**	**2 906 386**	**1 306 383**	**1 224 658**	**344 617**	**344 612**	**304 057**	**262 619**	**258 608**	**258 259**	
Egypt	1986	6 799 093	6 799 093	5 421 801	2 825 392	2 552 405	1 297 832	1 297 829	1 297 829	1 131 225	1 100 397	1 098 502	yes
Egypt	1996	5 902 243	5 902 243	4 453 785	2 126 960	2 027 351	1 185 312	1 185 312	1 185 312	1 090 368	1 083 995	1 083 953	yes
Egypt	2006	7 282 434	7 282 434	5 739 722	2 553 381	2 450 443	1 610 591	1 610 591	1 610 591	1 515 467	1 514 369	1 514 364	yes
Total		**19 983 770**	**19 983 770**	**15 615 308**	**7 505 733**	**7 030 199**	**4 093 735**	**4 093 732**	**4 093 732**	**3 737 060**	**3 698 761**	**3 696 819**	
Ethiopia	1984	3 404 306	3 400 221	2 735 271	1 209 735	1 149 841	228 972	228 971	228 971	196 636	175 867	175 365	yes
Ethiopia	1994	5 044 598	5 044 598	4 201 617	2 015 604	1 979 879	566 246	566 246	566 246	539 043	524 827	524 590	yes
Ethiopia	2007	7 434 086	7 434 086	1 097 614	544 065	514 140	154 345	154 345	154 345	141 002	140 034	140 024	yes
Total		**15 882 990**	**15 878 905**	**8 034 502**	**3 769 404**	**3 643 860**	**949 563**	**949 562**	**949 562**	**876 681**	**840 728**	**839 979**	
Ghana	1984	1 309 352	1 309 352	1 050 813	545 036	545 036	187 288	187 288	0	0	0	0	no
Ghana	2000	1 894 133	1 894 133	1 730 902	727 288	671 959	243 122	243 122	243 122	212 320	208 074	208 010	yes
Ghana	2010	2 466 289	2 466 289	2 262 894	1 091 326	1 018 943	400 015	400 015	400 015	360 219	359 524	359 489	yes
Total		**5 669 774**	**5 669 774**	**5 044 609**	**2 363 650**	**2 235 938**	**830 425**	**830 425**	**643 137**	**572 539**	**567 598**	**567 499**	
Guinea	1983	457 837	457 837	364 823	106 728	105 679	30 830	30 815	30 749	30 444	29 418	28 999	yes
Guinea	1996	729 071	729 071	553 173	246 286	207 001	89 851	89 851	89 851	66 128	63 700	63 495	yes
Guinea	2014	1 050 916	1 050 916	951 617	539 972	444 014	184 293	184 293	184 293	126 181	125 892	125 830	yes
Total		**2 237 824**	**2 237 824**	**1 869 613**	**892 986**	**756 694**	**304 974**	**304 959**	**304 893**	**222 753**	**219 010**	**218 324**	
Kenya	1969	659 310	659 310	659 310	273 058	263 394	20 959	20 959	0	0	0	0	no
Kenya	1979	1 033 769	1 033 769	854 251	0	0	0	0	0	0	0	0	no
Kenya	1989	1 074 098	1 074 098	829 247	364 258	355 117	115 571	115 571	115 571	110 185	106 171	106 095	yes
Kenya	1999	1 407 547	1 407 547	1 191 268	487 645	482 717	160 587	160 587	160 587	156 553	154 897	154 879	yes
Kenya	2009	3 841 935	3 841 935	3 402 695	1 717 135	1 593 028	507 075	507 075	507 075	462 754	456 403	456 195	yes
Total		**8 016 659**	**8 016 659**	**6 936 771**	**2 842 096**	**2 694 256**	**804 192**	**804 192**	**783 233**	**729 492**	**717 471**	**717 169**	
Lesotho	1996	187 795	187 776	165 945	88 666	79 967	39 728	39 728	39 728	34 241	33 503	33 496	yes
Lesotho	2006	180 208	180 208	171 947	85 473	77 758	37 556	37 556	37 556	32 983	32 851	32 850	yes
Total		**368 003**	**367 984**	**337 892**	**174 139**	**157 725**	**77 284**	**77 284**	**77 284**	**67 224**	**66 354**	**66 346**	
Liberia	1974	150 256	150 256	127 442	0	0	0	0	0	0	0	0	no
Liberia	2008	348 057	348 057	294 517	126 770	118 977	47 631	47 631	47 631	44 199	44 012	44 007	yes
Total		**498 313**	**498 313**	**421 959**	**126 770**	**118 977**	**47 631**	**47 631**	**47 631**	**44 199**	**44 012**	**44 007**	
Malawi	1987	798 669	798 669	658 449	222 672	220 229	49 617	49 617	49 617	48 293	45 303	45 291	yes
Malawi	1998	991 393	991 393	826 197	292 284	286 039	77 453	77 453	77 453	73 746	72 671	72 668	yes
Malawi	2008	1 341 977	1 341 977	1 156 748	497 097	492 609	106 570	106 570	105 741	102 459	101 882	101 877	yes
Total		**3 132 039**	**3 132 039**	**2 641 394**	**1 012 053**	**998 877**	**233 640**	**233 640**	**232 811**	**224 498**	**219 856**	**219 836**	
Mali	1987	785 384	784 096	581 806	243 229	227 034	78 724	78 724	0	0	0	0	no
Mali	1998	991 330	991 330	737 487	340 903	318 695	117 063	117 063	117 063	98 261	96 126	95 816	yes
Mali	2009	1 451 856	1 451 856	1 285 750	741 784	648 243	209 408	209 408	209 408	157 779	156 175	155 877	yes
Total		**3 228 570**	**3 227 282**	**2 605 043**	**1 325 916**	**1 193 972**	**405 195**	**405 195**	**326 471**	**256 040**	**252 301**	**251 693**	

Table A.23: Construction of sample from raw IPUMS data (continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Country	**Year**	**Nall**	**Ndistrict**	**Neduc**	**Nliverelative**	**Nlivebiop**	**Nage**	**Nsex**	**Nurban**	**Ncont**	**NIMiog**	**NIMbiop**	**Inc.**
Mauritius	1990	106 710	106 710	101 646	54 683	52 074	24 727	24 727	24 727	22 367	21 738	21 736	yes
Mauritius	2000	119 695	119 695	114 499	56 350	53 366	28 650	28 650	28 650	25 829	25 539	25 539	yes
Mauritius	2011	126 332	126 332	121 383	54 820	51 921	29 191	29 191	29 191	26 478	26 431	26 430	yes
Total		**352 737**	**352 737**	**337 528**	**165 853**	**157 361**	**82 568**	**82 568**	**82 568**	**74 674**	**73 708**	**73 705**	
Morocco	1982	1 012 873	1 012 873	948 008	546 732	511 677	178 034	178 034	0	0	0	0	no
Morocco	1994	1 294 026	1 294 026	1 293 467	835 569	783 915	338 124	338 124	0	0	0	0	no
Morocco	2004	1 482 720	1 482 720	1 482 716	928 290	864 824	442 157	442 157	0	0	0	0	no
Morocco	2014	3 341 426	3 340 830	3 340 830	1 939 870	1 803 530	935 976	935 976	933 662	808 379	808 249	808 242	yes
Total		**7 131 045**	**7 130 449**	**7 065 021**	**4 250 461**	**3 963 946**	**1 894 291**	**1 894 291**	**933 662**	**808 379**	**808 249**	**808 242**	
Mozambique	1997	1 551 517	1 551 517	1 248 483	515 184	472 203	146 861	146 861	146 861	120 325	118 632	118 617	yes
Mozambique	2007	2 047 048	2 047 048	1 616 853	718 962	664 244	197 113	197 113	197 113	164 534	163 418	163 380	yes
Total		**3 598 565**	**3 598 565**	**2 865 336**	**1 234 146**	**1 136 447**	**343 974**	**343 974**	**343 974**	**284 859**	**282 050**	**281 997**	
Nigeria	2006	83 700	83 700	82 740	46 326	44 662	10 436	10 436	10 436	9 802	9 738	9 708	yes
Nigeria	2007	85 183	85 183	84 123	47 618	45 235	10 557	10 557	10 557	9 761	9 715	9 696	yes
Nigeria	2008	107 425	107 425	105 944	62 622	60 823	15 199	15 184	15 142	14 469	14 323	14 306	yes
Nigeria	2009	77 896	77 896	77 666	41 179	39 621	9 690	9 673	9 673	8 920	8 883	8 876	yes
Nigeria	2010	72 191	72 191	59 173	30 890	29 756	11 240	11 240	11 240	10 584	10 392	10 377	yes
Total		**426 395**	**426 395**	**409 646**	**228 635**	**220 097**	**57 122**	**57 090**	**57 048**	**53 536**	**53 051**	**52 963**	
Rwanda	1991	742 918	742 918	0	0	0	0	0	0	0	0	0	no
Rwanda	2002	843 392	843 392	629 146	277 153	264 800	107 446	107 446	107 446	103 899	102 745	102 725	yes
Rwanda	2012	1 038 369	1 038 369	938 201	485 203	463 875	150 671	150 671	150 671	144 338	143 843	143 826	yes
Total		**2 624 679**	**2 624 679**	**1 567 347**	**762 356**	**728 675**	**258 117**	**258 117**	**258 117**	**248 237**	**246 588**	**246 551**	
Senegal	1988	700 199	700 199	527 680	207 551	181 977	76 093	76 093	0	0	0	0	no
Senegal	2002	994 562	994 562	911 891	477 330	440 205	192 555	192 555	192 555	168 266	167 086	166 999	yes
Senegal	2013	1 245 551	1 016 023	908 310	578 764	477 271	257 347	257 347	257 347	186 875	186 345	186 044	yes
Total		**2 940 312**	**2 710 784**	**2 347 881**	**1 263 645**	**1 099 453**	**525 995**	**525 995**	**449 902**	**355 141**	**353 431**	**353 043**	
Sierra Leone	2004	494 298	494 298	397 137	182 198	144 915	74 010	74 010	74 010	55 065	53 064	52 469	yes
Total		**494 298**	**494 298**	**397 137**	**182 198**	**144 915**	**74 010**	**74 010**	**74 010**	**55 065**	**53 064**	**52 469**	
South Africa	1996	3 621 164	3 621 164	3 083 346	1 385 515	1 255 578	621 444	621 444	621 435	562 421	538 506	537 039	yes
South Africa	2001	3 725 655	3 725 655	3 353 684	1 509 080	1 366 352	728 007	728 007	727 870	656 452	650 438	650 174	yes
South Africa	2007	1 047 657	1 047 657	842 103	384 555	347 943	197 500	197 500	197 500	179 236	177 447	177 401	yes
South Africa	2011	4 418 594	4 418 594	3 845 633	1 494 142	1 355 066	777 948	777 948	766 491	699 181	697 461	697 347	yes
South Africa	2016	3 328 793	3 328 793	3 023 034	1 345 876	1 186 490	674 872	674 872	674 872	603 780	591 480	590 681	yes
Total		**16 141 863**	**16 141 863**	**14 147 800**	**6 119 168**	**5 511 429**	**2 999 771**	**2 999 771**	**2 988 168**	**2 701 070**	**2 655 332**	**2 652 642**	
South Sudan	2008	542 765	542 765	542 333	300 590	273 961	71 220	71 220	71 220	60 552	60 416	60 399	yes
Total		**542 765**	**542 765**	**542 333**	**300 590**	**273 961**	**71 220**	**71 220**	**71 220**	**60 552**	**60 416**	**60 399**	
Sudan	2008	5 066 530	5 066 530	3 902 071	2 048 229	1 936 664	792 810	792 810	792 810	714 673	699 070	697 097	yes
Total		**5 066 530**	**5 066 530**	**3 902 071**	**2 048 229**	**1 936 664**	**792 810**	**792 810**	**792 810**	**714 673**	**699 070**	**697 097**	
Tanzania	1988	2 310 424	2 310 424	1 916 737	683 484	679 664	183 596	183 596	0	0	0	0	no
Tanzania	2002	3 732 735	3 732 735	3 123 724	1 245 172	1 186 155	366 594	366 594	366 594	336 996	333 681	333 660	yes
Tanzania	2012	4 498 022	4 498 022	3 918 823	1 763 397	1 661 165	503 981	503 981	503 981	466 289	464 823	464 806	yes
Total		**10 541 181**	**10 541 181**	**8 959 284**	**3 692 053**	**3 526 984**	**1 054 171**	**1 054 171**	**870 575**	**803 285**	**798 504**	**798 466**	
Togo	1960	13 759	13 759	13 758	5 005	4 238	0	0	0	0	0	0	no
Togo	1970	23 680	23 680	23 672	12 267	11 999	712	712	0	0	0	0	no
Togo	2010	584 859	584 859	517 900	120 225	115 641	33 730	33 730	33 730	32 274	31 926	31 889	yes
Total		**622 298**	**622 298**	**555 330**	**137 497**	**131 878**	**34 442**	**34 442**	**33 730**	**32 274**	**31 926**	**31 889**	
Uganda	1991	1 548 460	1 529 024	1 226 290	450 737	442 411	131 819	131 819	131 819	124 996	121 888	121 856	yes
Uganda	2002	2 497 449	2 497 449	2 042 838	847 255	838 411	213 799	213 799	213 799	208 499	207 355	207 284	yes
Uganda	2014	3 506 546	3 506 546	3 145 894	1 600 477	1 506 609	400 450	400 450	400 450	374 435	373 919	373 908	yes
Total		**7 552 455**	**7 533 019**	**6 415 022**	**2 898 469**	**2 787 431**	**746 068**	**746 068**	**746 068**	**707 930**	**703 162**	**703 048**	
Zambia	1990	787 461	787 461	664 239	304 994	304 281	106 751	106 751	106 751	106 406	104 920	104 920	yes
Zambia	2000	996 117	996 117	825 110	417 749	341 108	145 247	145 247	145 247	98 694	97 967	97 933	yes
Zambia	2010	1 321 973	1 321 973	1 028 628	537 693	465 478	177 428	177 428	0	0	0	0	no
Total		**3 105 551**	**3 105 551**	**2 517 977**	**1 260 436**	**1 110 867**	**429 426**	**429 426**	**251 998**	**205 100**	**202 887**	**202 853**	
Zimbabwe	2012	654 688	654 688	587 748	222 825	204 736	65 518	65 518	65 518	60 166	59 615	59 599	yes
Total		**654 688**	**654 688**	**587 748**	**222 825**	**204 736**	**65 518**	**65 518**	**65 518**	**60 166**	**59 615**	**59 599**	
Total All		**130 727 972**	**130 466 872**	**104 306 886**	**48 454 385**	**45 000 794**	**18 160 723**	**18 160 667**	**16 214 531**	**14 459 893**	**14 263 922**	**14 252 719**	**61/82**

Notes: This table shows how we construct our final sample from the raw IPUMS data. Columns (1) and (2) give the country and census year, respectively. Columns (3) shows the initial number of observation in IPUMS data. Columns (4) gives the number of observations with available information on district. Columns (5) gives the number of observations with available information on educational attainment and district. Columns (6) gives the number of observations for individuals living with at least one relative and for which information on educational attainment and district is available. Columns (7) gives the number of observations for individuals living with at least one biological or step- parents and for which information on educational attainment and district is available. Columns (8) gives the number of observations for individuals aged 16-50 years old and born after 1950 living with at least one relative and for which information on educational attainment and district is available. Columns (9) gives the number of observations for individuals aged 16-50 years old and born after 1950 living with at least one relative and for which information on gender, educational attainment and district is available. Columns (10) gives the number of observations for individuals aged 16-50 years old and born after 1950 living with at least one relative and for which information on residency (urban or rural areas), gender, educational attainment and district is available. Columns (11) gives the number of observations for individuals aged 16-50 years old and born after 1950 living with at least one relative and for which information on residency (urban or rural areas), gender, educational attainment, district, and other control variables is available. Columns (12) gives the final sample with immediate older generation used as reference group for individuals. Columns (13) gives the final sample with biological or step- parents (in-line) used as reference group for individuals. Columns (14) gives the census/survey used in the final sample.

Appendix B Summary statistics of educational IM

Table B.24: Summary statistics of Educational IM

	(1)	(2)	(3)	(4)	(5)	(6)
	Obs.	Mean	Sd	Obs.	Mean	Sd
	Panel (A) Primary			**Panel (B) Secondary and tertiary**		
(I) Upward mobility						
(a) Biological or step- parents						
IM (Mean)	9 258 374	0,508	0,500	12 447 352	0,204	0,403
IM (Min)	10 727 953	0,550	0,497	13 228 050	0,221	0,415
IM (Max)	9 258 374	0,508	0,500	12 447 352	0,204	0,403
(b) Immediate older generation						
IM (Mean)	9 280 274	0,507	0,500	12 462 921	0,204	0,403
IM (Min)	10 811 989	0,552	0,497	13 275 780	0,222	0,415
IM (Max)	9 132 978	0,505	0,500	12 370 537	0,204	0,403
(II) Downward mobility						
(a) Biological or step- parents						
IM (Mean)	4 994 345	0,099	0,299	1 805 367	0,438	0,496
IM (Min)	3 524 766	0,064	0,245	1 024 669	0,384	0,486
IM (Max)	4 994 345	0,099	0,299	1 805 367	0,438	0,496
(b) Immediate older generation						
IM (Mean)	4 983 648	0,097	0,296	1 801 001	0,435	0,496
IM (Min)	3 451 933	0,062	0,241	988 142	0,375	0,484
IM (Max)	5 130 944	0,104	0,305	1 893 385	0,449	0,497

Appendix C Additional stylized facts on mineral discoveries

Figure C.10: Number of mineral discoveries for all African countries, 1950-2019

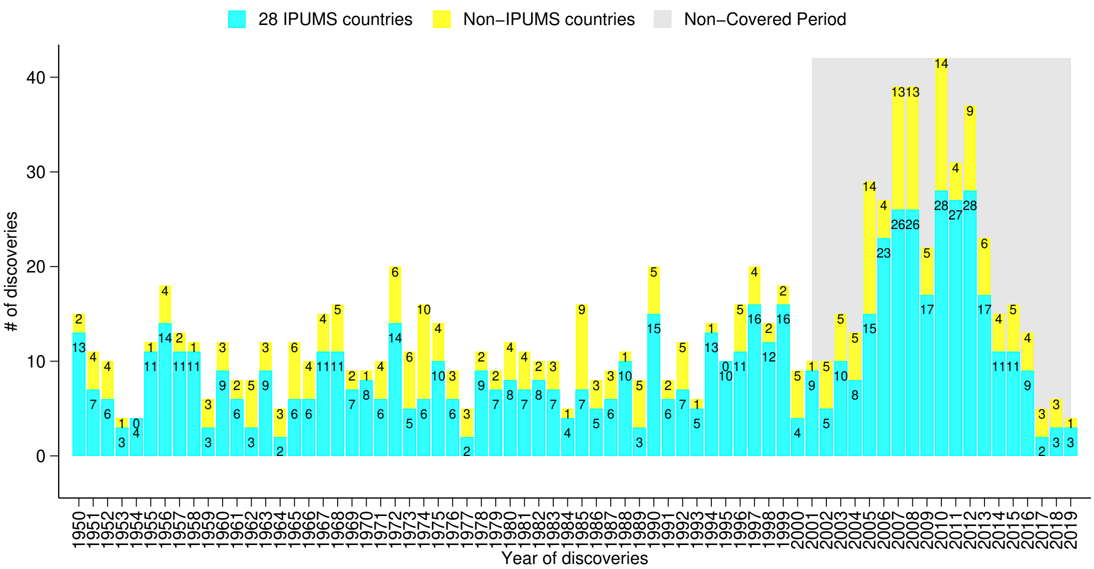


Table C.25: Summary statistics of mineral discoveries, IPUMS countries, 1950-2000

Characteristics	**# of disc.**	**Percentage**
by African regions		
Eastern Africa	48	11,82
Northern Africa	23	5,67
Southern Africa	196	48,28
Western and Central Africa	139	34,24
by Size of mineral discoveries		
Moderate	184	45,32
Major	121	29,8
Giant	88	21,67
Super-Giant	13	3,2
by Mineral categories		
Gold	141	34,73
Bulk	75	18,47
Precious	64	15,76
Base Metal	61	15,02
Other	34	8,37
Mineral Sands	17	4,19
Uranium	14	3,45
Total	406	100

Table C.26: Composition of minerals in each metal category

Class of mineral categories	**Composition**
Gold	Gold
Bulk	Bauxite, Coal, Iron ore, Phosphate, Potash
Precious	Diamond, Emerald, PGE, Platinum, Ruby, Rutile, Silver
Base Metal	Copper, Lead, Nickel, Zinc
Other	Andalusit, Chromium, Cobalt, Flourine, Graphite, Lithium, Manganese, Niobium, Rare earth, Tantalum, Tanzanite, Tin, Tungsten, Vanadium
Mineral Sands	Mineral sands, Zircon
Uranium	Uranium

Appendix D Additional stylized facts on country-level educational IM

Appendix D.1 Ranking: Country-level educational IM by gender

Figure D.11: Primary level

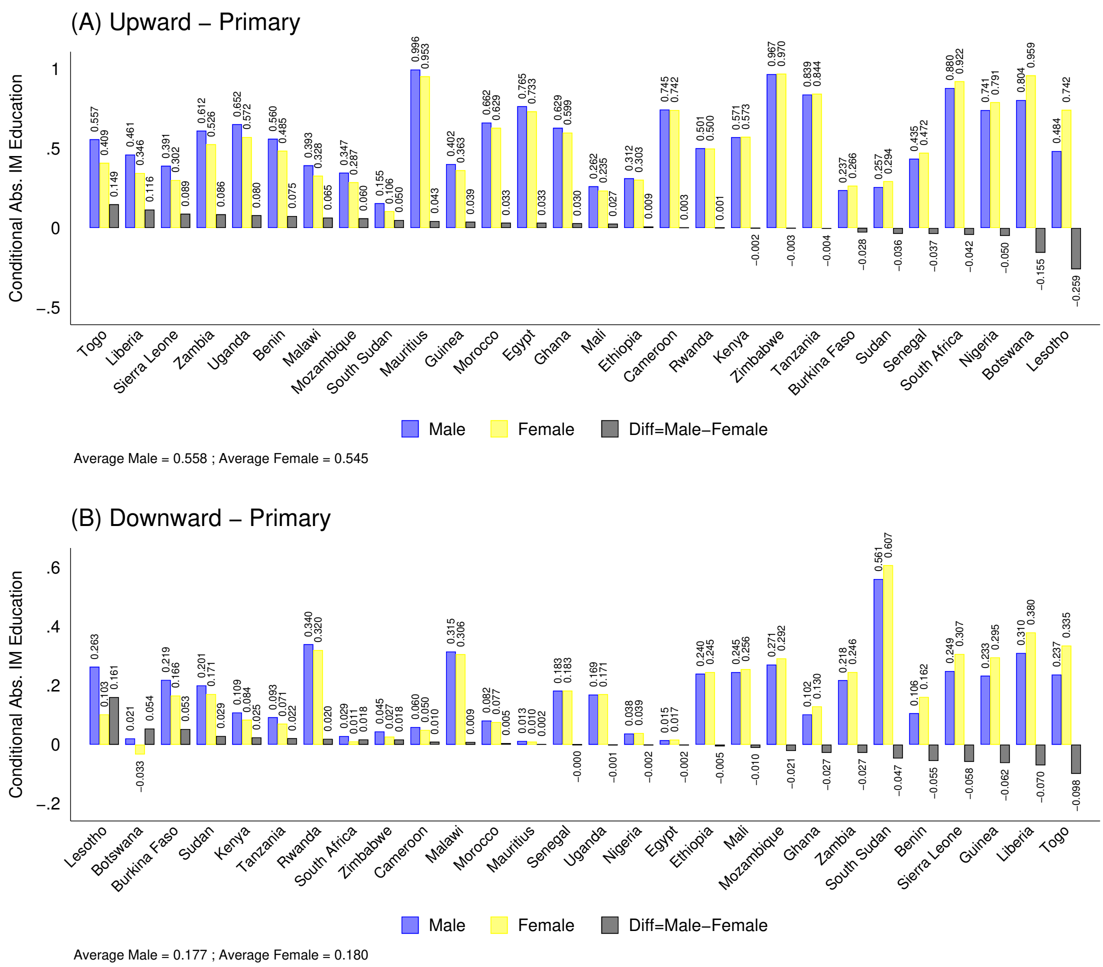
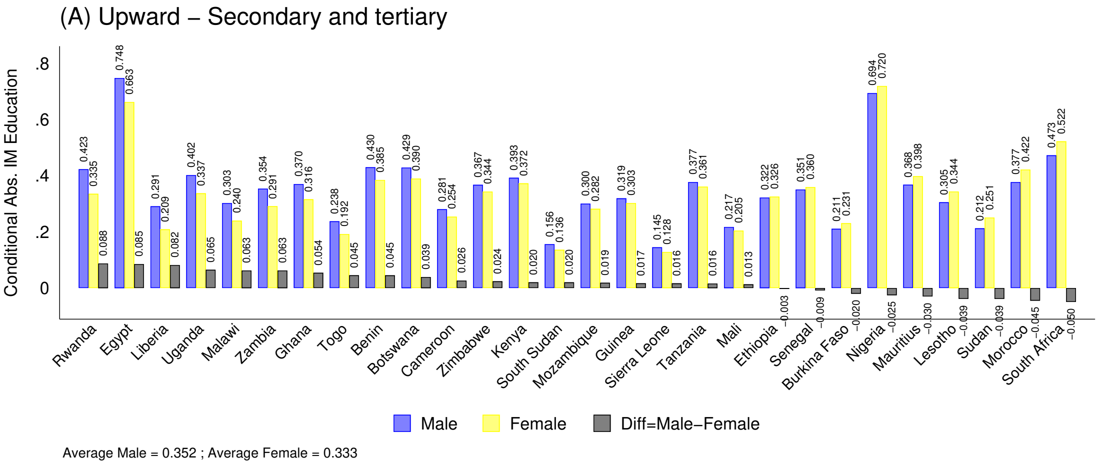
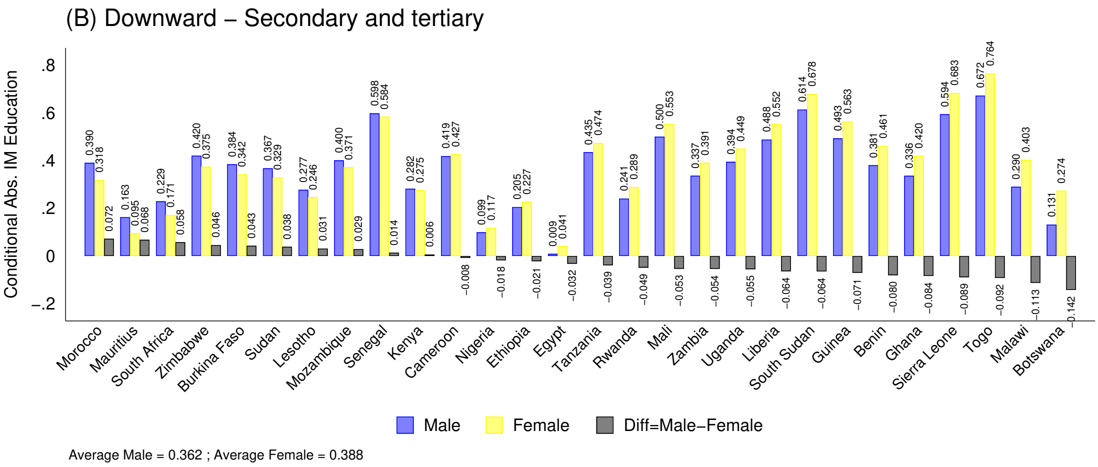


Figure D.12: Secondary and Tertiary level





Appendix D.2 Ranking: Country-level educational IM by urban-rural residency

Figure D.13: Primary level

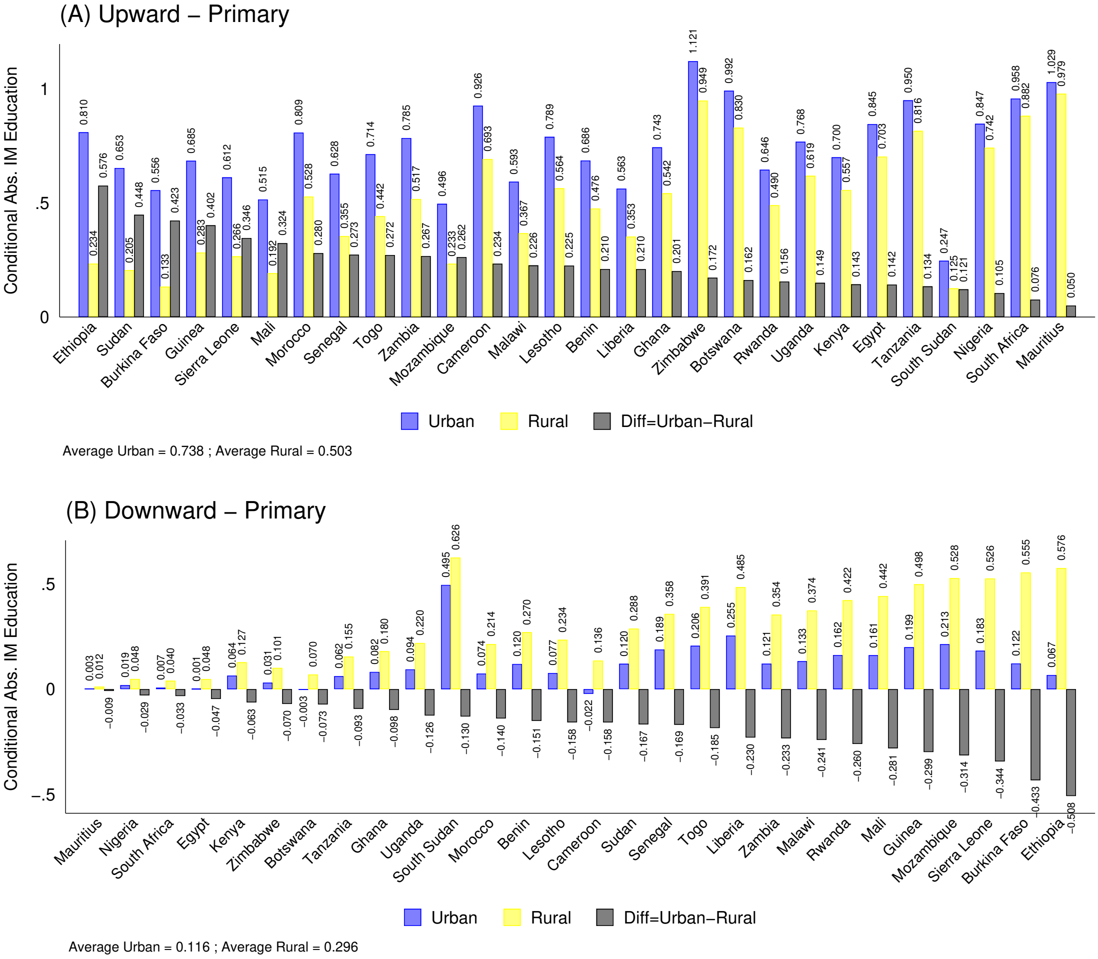
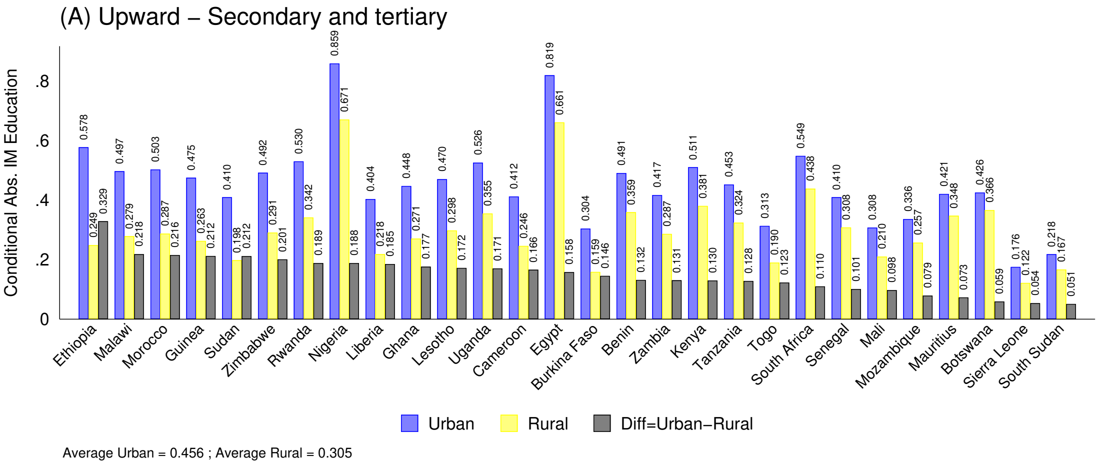
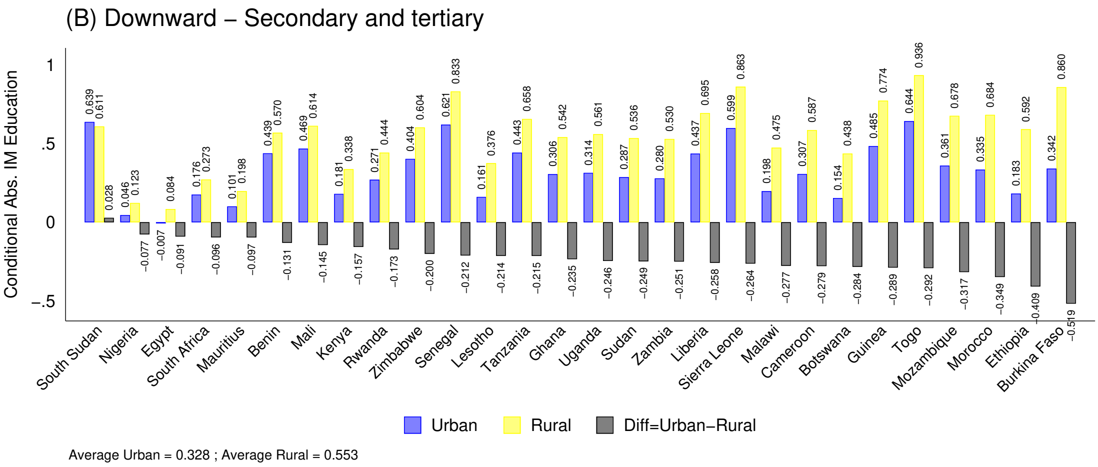


Figure D.14: Secondary and Tertiary level





Appendix D.3 Dynamics of IM by districts with and without discoveries, cohorts and gender

Figure D.15: Primary level

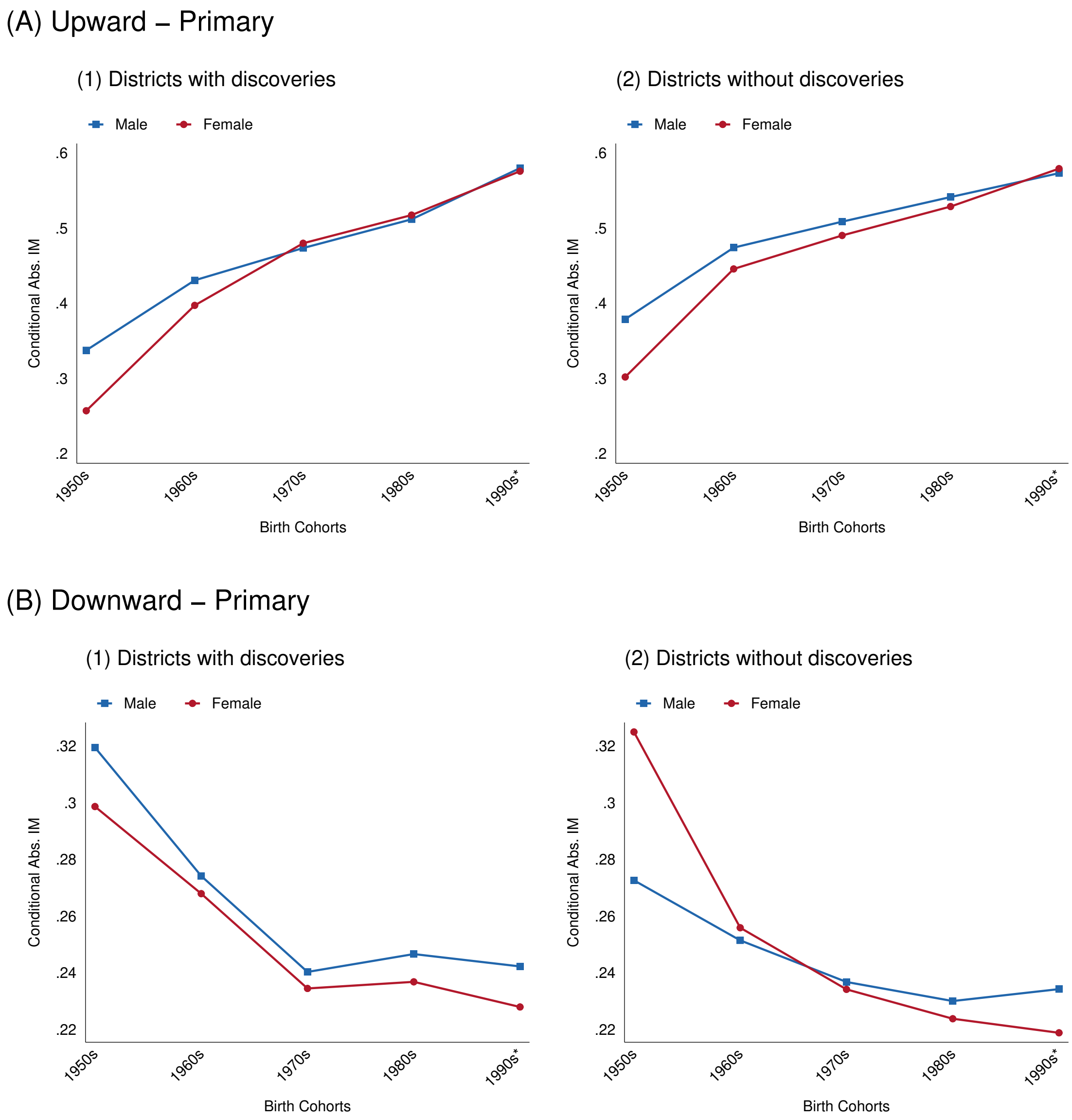
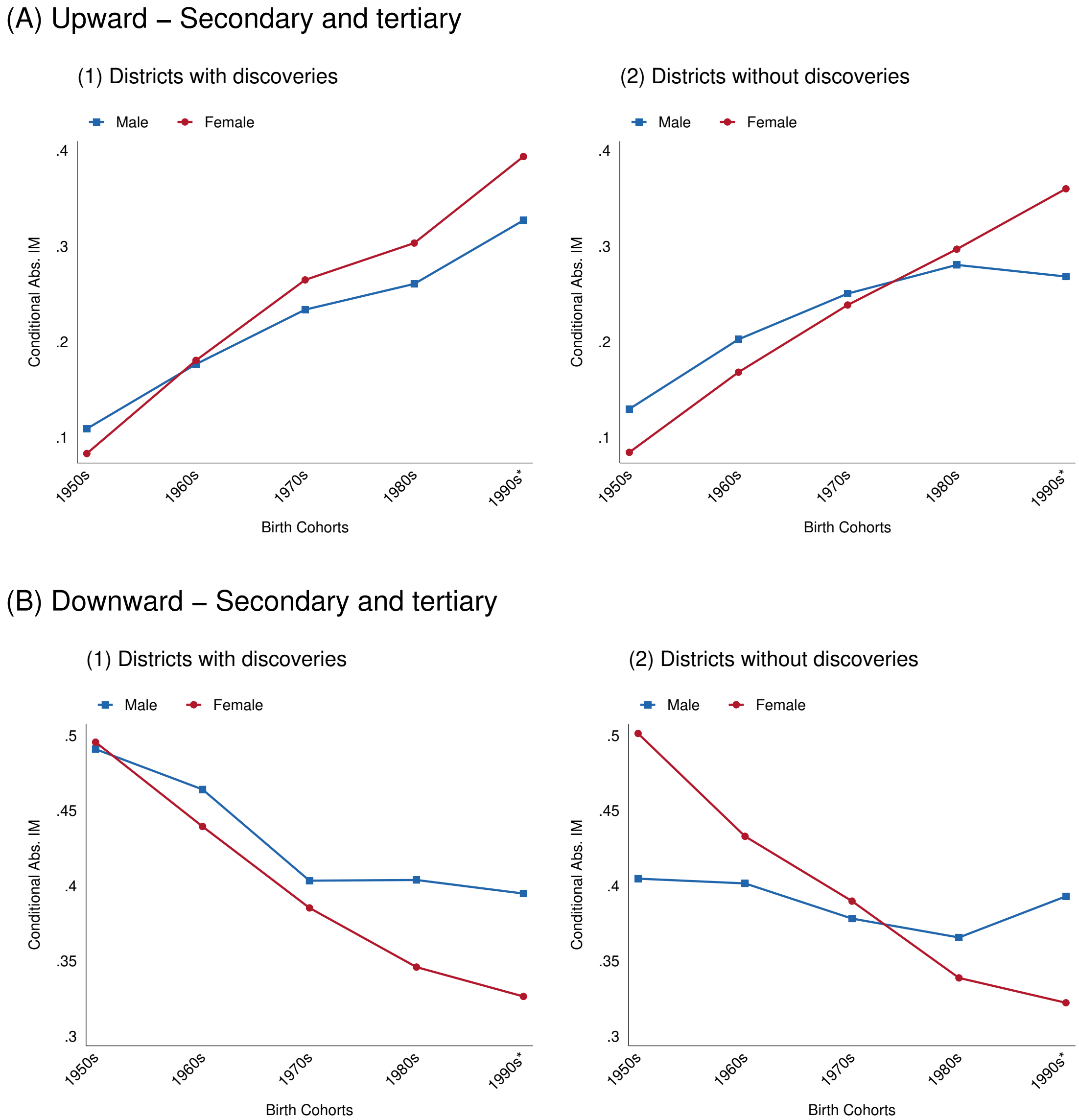


Figure D.16: Secondary and Tertiary level



Appendix D.4 Dynamics of IM by districts with and without discoveries, cohorts and urban-rural residency

Figure D.17: Primary level

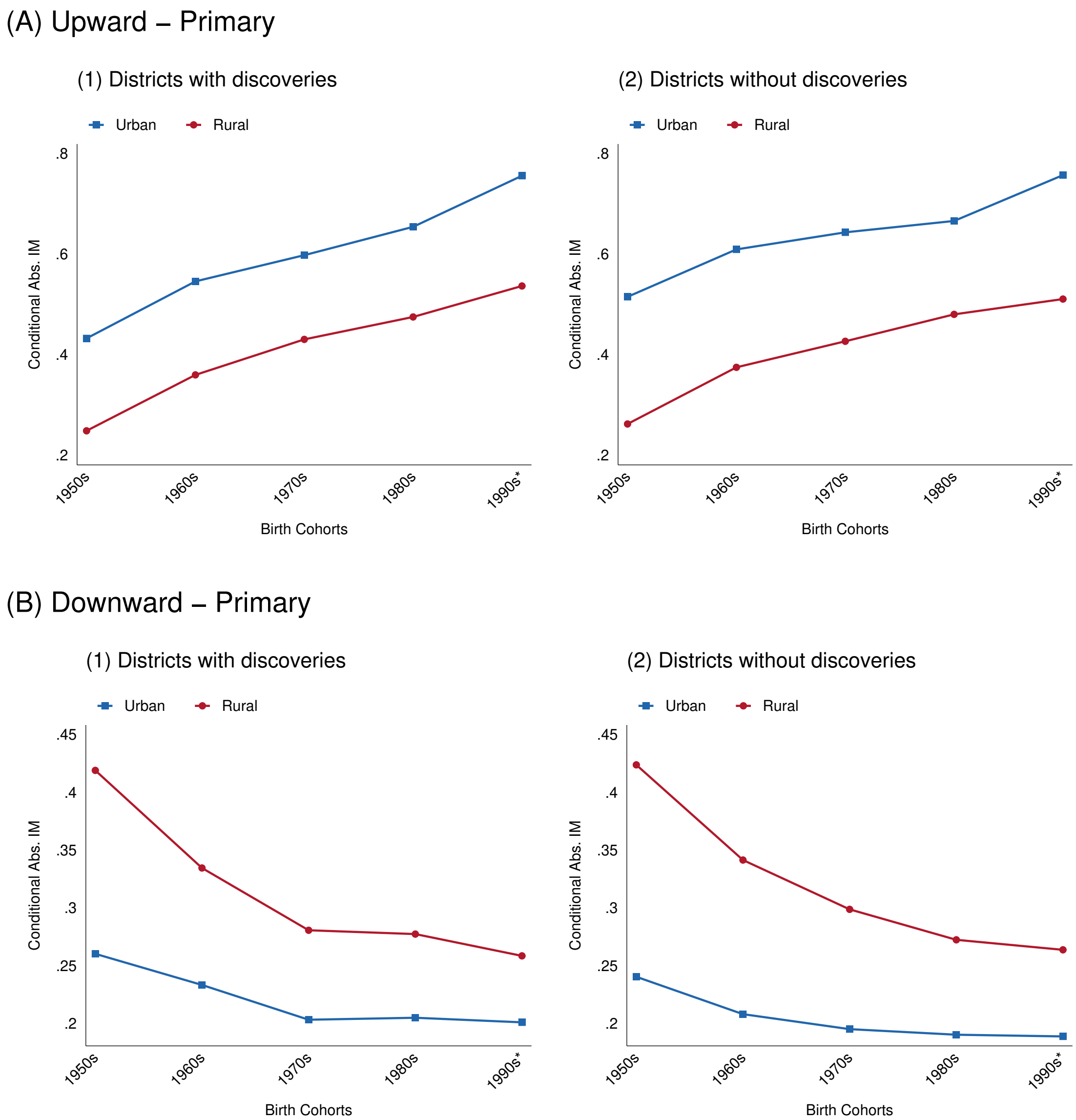


Figure D.18: Secondary and Tertiary level

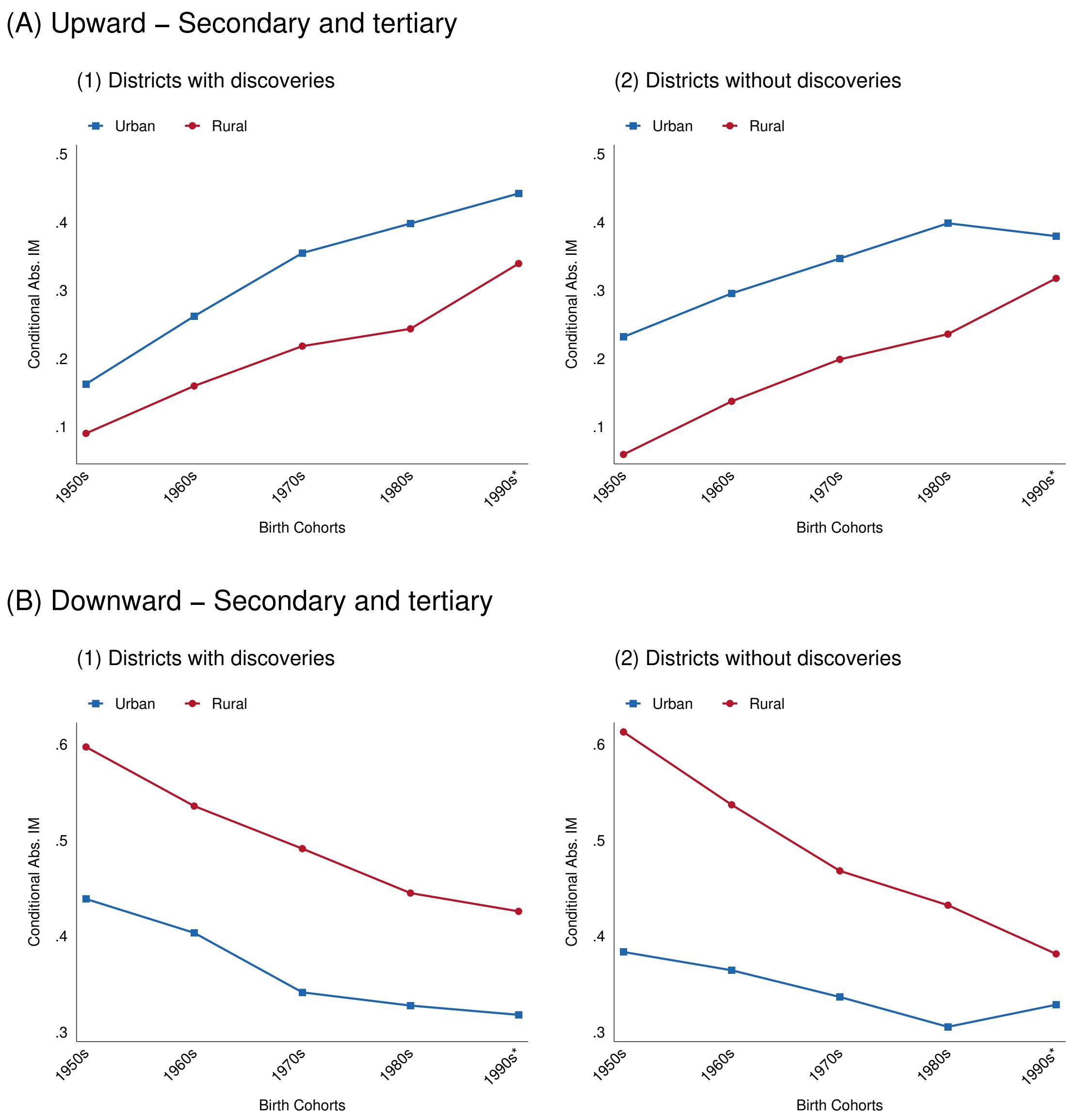


Table E.27: District-Level Primary IM by country

(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel (A): Upward			Panel (B): Downward		
Country	# districts	mean	cv	# districts	mean	cv
Benin	77	0,509	0,278	77	0,240	0,357
Botswana	21	0,924	0,119	21	-0,002	-16,700
Burkina Faso	45	0,174	0,519	45	0,399	0,416
Cameroon	229	0,685	0,356	229	0,204	0,899
Egypt	236	0,793	0,149	236	0,027	1,143
Ethiopia	97	0,374	0,684	95	0,336	0,575
Ghana	110	0,659	0,228	110	0,182	0,472
Guinea	34	0,357	0,320	34	0,383	0,291
Kenya	173	0,671	0,321	173	0,136	0,661
Lesotho	10	0,574	0,122	10	0,228	0,277
Liberia	47	0,346	0,310	47	0,461	0,274
Malawi	227	0,412	0,359	227	0,355	0,384
Mali	242	0,191	0,462	242	0,519	0,386
Mauritius	42	1,047	0,051	45	0,005	2,224
Morocco	55	0,675	0,167	55	0,103	0,346
Mozambique	144	0,279	0,457	144	0,476	0,380
Nigeria	37	0,787	0,259	37	0,057	0,772
Rwanda	30	0,500	0,143	30	0,354	0,268
Senegal	34	0,437	0,376	34	0,280	0,398
Sierra Leone	107	0,358	0,439	107	0,455	0,419
South Africa	216	0,902	0,072	216	0,033	0,658
South Sudan	72	0,141	0,803	70	0,712	0,265
Sudan	129	0,282	0,782	129	0,395	0,505
Tanzania	113	0,859	0,140	113	0,092	0,644
Togo	37	0,497	0,301	37	0,371	0,308
Uganda	161	0,656	0,200	161	0,210	0,407
Zambia	72	0,605	0,209	72	0,313	0,349
Zimbabwe	88	0,999	0,103	88	0,056	0,868
Total	2885	0,562	0,520	2884	0,259	0,861

Notes: This table shows the average conditional district-level educational IM by country. Columns (2)-(5), (3)-(6), and (4)-(7) give the number of districts, the average educational IM, and the coefficient of variation of education IM, for each country, respectively.

Appendix E Additional stylized facts on district-level educational IM

Appendix E.1 Supplementary tables

Table E.28: District-Level Secondary and tertiary IM by country

(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel (A): Upward			Panel (B): Downward		
Country	# districts	mean	cv	# districts	mean	cv
Botswana	21	0,400	0,113	14	0,194	1,539
Egypt	236	0,745	0,165	236	0,053	1,305
Ethiopia	97	0,326	0,483	76	0,397	0,837
Malawi	227	0,311	0,419	203	0,436	0,666
Mauritius	44	0,362	0,283	41	0,161	0,617
Nigeria	37	0,691	0,254	37	0,121	0,581
Zimbabwe	88	0,366	0,313	74	0,529	0,561
Kenya	173	0,395	0,299	169	0,346	0,550
Cameroon	229	0,231	0,331	172	0,558	0,535
Burkina Faso	45	0,170	0,195	27	0,720	0,517
Mali	242	0,195	0,118	128	0,681	0,507
Mozambique	144	0,261	0,190	81	0,655	0,467
Rwanda	30	0,388	0,191	30	0,321	0,447
Sudan	129	0,207	0,429	106	0,583	0,440
South Sudan	72	0,155	0,262	45	0,754	0,405
Benin	77	0,388	0,148	59	0,649	0,398
Lesotho	10	0,307	0,124	10	0,385	0,382
Zambia	72	0,309	0,165	68	0,511	0,372
South Africa	216	0,438	0,168	216	0,254	0,327
Liberia	47	0,218	0,301	47	0,672	0,310
Guinea	34	0,292	0,181	32	0,685	0,289
Togo	37	0,198	0,209	29	0,870	0,287
Uganda	161	0,378	0,180	161	0,544	0,283
Sierra Leone	107	0,135	0,197	64	0,809	0,271
Tanzania	113	0,391	0,175	113	0,507	0,253
Morocco	55	0,393	0,210	55	0,411	0,246
Ghana	110	0,311	0,205	110	0,502	0,220
Senegal	34	0,342	0,137	33	0,757	0,172
Total	2887	0,342	0,517	2436	0,457	0,658

Notes: This table shows the average conditional district-level educational IM by country. Columns (2)-(5), (3)-(6), and (4)-(7) give the number of districts, the average educational IM, and the coefficient of variation of education IM, for each country, respectively.

Table E.29: District-Level Primary IM by country and discovery

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Panel (A): Upward				Panel (B): Downward			
Country	discovery	disc. high	# districts	mean	cv	disc. high	# districts	mean	cv
Benin	yes	no	3	0,35	0,38	yes	3	0,25	0,31
Benin	no		74	0,52	0,27		74	0,24	0,36
Botswana	yes	no	12	0,89	0,13	yes	12	0,01	3,66
Botswana	no		9	0,97	0,10		9	-0,02	-2,60
Burkina Faso	yes	no	28	0,16	0,46	yes	28	0,40	0,43
Burkina Faso	no		17	0,20	0,56		17	0,40	0,41
Cameroon	yes	yes	13	0,73	0,31	no	13	0,14	0,57
Cameroon	no		216	0,68	0,36		216	0,21	0,90
Egypt	yes	no	3	0,78	0,03	yes	3	0,05	0,15
Egypt	no		233	0,79	0,15		233	0,03	1,16
Ethiopia	yes	no	9	0,26	0,17	yes	9	0,39	0,27
Ethiopia	no		88	0,39	0,69		86	0,33	0,60
Ghana	yes	yes	22	0,69	0,18	no	22	0,18	0,35
Ghana	no		88	0,65	0,24		88	0,18	0,50
Guinea	yes	no	21	0,34	0,27	yes	21	0,39	0,30
Guinea	no		13	0,38	0,38		13	0,37	0,29
Kenya	yes	no	8	0,65	0,14	yes	8	0,17	0,20
Kenya	no		165	0,67	0,33		165	0,14	0,68
Lesotho	yes	no	2	0,54	0,16	yes	2	0,24	0,24
Lesotho	no		8	0,58	0,12		8	0,22	0,30
Liberia	yes	yes	6	0,37	0,14	yes	6	0,48	0,23
Liberia	no		41	0,34	0,33		41	0,46	0,28
Malawi	yes	yes	5	0,44	0,23	yes	5	0,37	0,16
Malawi	no		222	0,41	0,36		222	0,36	0,39
Mali	yes	yes	19	0,22	0,35	no	19	0,45	0,32
Mali	no		223	0,19	0,47		223	0,53	0,39
Mauritius	no	-	42	1,05	0,05	-	45	0,00	2,22
Morocco	yes	no	13	0,68	0,13	no	13	0,10	0,26
Morocco	no		42	0,68	0,18		42	0,10	0,37
Mozambique	yes	no	13	0,25	0,29	yes	13	0,52	0,31
Mozambique	no		131	0,28	0,47		131	0,47	0,39
Nigeria	yes	yes	2	0,83	0,25	no	2	0,04	0,77
Nigeria	no		35	0,79	0,26		35	0,06	0,77
Rwanda	yes	yes	1	0,51	-	no	1	0,33	-
Rwanda	no		29	0,50	0,15		29	0,36	0,27
Senegal	yes	no	3	0,34	0,29	yes	3	0,37	0,51
Senegal	no		31	0,45	0,38		31	0,27	0,37
Sierra Leone	yes	no	11	0,27	0,25	yes	11	0,53	0,31
Sierra Leone	no		96	0,37	0,44		96	0,45	0,43
South Africa	yes	yes	60	0,92	0,06	no	60	0,02	0,62
South Africa	no		156	0,90	0,08		156	0,04	0,63
South Sudan	no	-	72	0,14	0,80	-	70	0,71	0,27
Sudan	yes	yes	13	0,37	0,79	no	13	0,39	0,62
Sudan	no		116	0,27	0,77		116	0,40	0,49
Tanzania	yes	no	25	0,78	0,12	yes	25	0,14	0,36
Tanzania	no		88	0,88	0,13		88	0,08	0,71
Togo	yes	yes	2	0,59	0,01	no	2	0,35	0,13
Togo	no		35	0,49	0,31		35	0,37	0,32
Uganda	yes	yes	2	0,72	0,11	no	2	0,21	0,40
Uganda	no		159	0,66	0,20		159	0,21	0,41
Zambia	yes	yes	15	0,67	0,17	no	15	0,25	0,45
Zambia	no		57	0,59	0,21		57	0,33	0,31
Zimbabwe	yes	no	20	0,97	0,07	yes	20	0,07	0,41
Zimbabwe	no		68	1,01	0,11		68	0,05	1,02
Total	yes	12	331	0,60	0,51	17	331	0,23	0,87
Total	no	16	2554	0,56	0,52	11	2553	0,26	0,86
Total All	-	28	2885	0,56	0,52	28	2884	0,26	0,86

Notes: This table shows the average conditional district-level educational IM by country and district with or without mineral discovery. Columns (1) gives the country name. Columns (2) is "yes" for districts with discovery, and "No" otherwise. Columns (3) and (7) is "yes" if upward and downward IM is higher in districts with discovery than without discovery, respectively. Columns (4)-(8), (5)-(9), and (6)-(10) give the number of districts, the average educational IM, and the coefficient of variation of education IM, respectively.

Table E.30: District-Level Secondary and tertiary IM by country and discovery

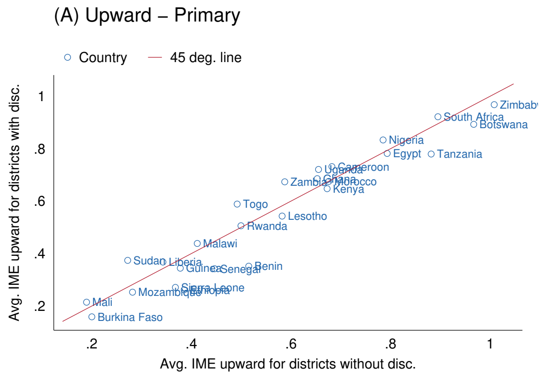
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Panel (A): Upward				Panel (B): Downward			
Country	discovery	disc. high	# districts	mean	cv	disc. high	# districts	mean	cv
Benin	yes	no	3	0,36	0,13	yes	2	0,87	0,39
Benin	no		74	0,39	0,15		57	0,64	0,40
Botswana	yes	no	12	0,40	0,07	yes	9	0,21	1,66
Botswana	no		9	0,40	0,16		5	0,16	1,23
Burkina Faso	yes	no	28	0,16	0,13	yes	16	0,76	0,46
Burkina Faso	no		17	0,18	0,25		11	0,67	0,62
Cameroon	yes	no	13	0,21	0,21	no	12	0,56	0,61
Cameroon	no		216	0,23	0,34		160	0,56	0,53
Egypt	yes	no	3	0,74	0,06	yes	3	0,06	0,02
Egypt	no		233	0,75	0,17		233	0,05	1,32
Ethiopia	yes	no	9	0,25	0,07	yes	7	0,56	0,77
Ethiopia	no		88	0,33	0,49		69	0,38	0,84
Ghana	yes	no	22	0,30	0,12	yes	22	0,54	0,20
Ghana	no		88	0,31	0,22		88	0,49	0,22
Guinea	yes	no	21	0,28	0,12	yes	20	0,69	0,18
Guinea	no		13	0,30	0,25		12	0,67	0,43
Kenya	yes	no	8	0,33	0,13	yes	8	0,39	0,22
Kenya	no		165	0,40	0,30		161	0,34	0,56
Lesotho	yes	no	2	0,29	0,13	yes	2	0,48	0,41
Lesotho	no		8	0,31	0,12		8	0,36	0,38
Liberia	yes	yes	6	0,22	0,19	yes	6	0,81	0,15
Liberia	no		41	0,22	0,32		41	0,65	0,33
Malawi	yes	no	5	0,27	0,13	yes	5	0,58	0,22
Malawi	no		222	0,31	0,42		198	0,43	0,68
Mali	yes	yes	19	0,20	0,11	yes	13	0,75	0,41
Mali	no		223	0,20	0,12		115	0,67	0,52
Mauritius	no	-	44	0,36	0,28	-	41	0,16	0,62
Morocco	yes	no	13	0,39	0,18	no	13	0,41	0,26
Morocco	no		42	0,39	0,22		42	0,41	0,25
Mozambique	yes	no	13	0,25	0,04	no	6	0,65	0,63
Mozambique	no		131	0,26	0,20		75	0,66	0,46
Nigeria	yes	yes	2	0,80	0,21	no	2	0,10	0,76
Nigeria	no		35	0,69	0,26		35	0,12	0,58
Rwanda	yes	no	1	0,36	.	no	1	0,24	.
Rwanda	no		29	0,39	0,19		29	0,32	0,45
Senegal	yes	no	3	0,31	0,06	yes	3	0,90	0,19
Senegal	no		31	0,35	0,14		30	0,74	0,16
Sierra Leone	yes	no	11	0,13	0,09	yes	6	0,92	0,13
Sierra Leone	no		96	0,14	0,20		58	0,80	0,28
South Africa	yes	yes	60	0,46	0,16	no	60	0,25	0,24
South Africa	no		156	0,43	0,17		156	0,26	0,35
South Sudan	no	-	72	0,16	0,26	-	45	0,75	0,41
Sudan	yes	yes	13	0,23	0,46	yes	12	0,72	0,31
Sudan	no		116	0,20	0,43		94	0,57	0,45
Tanzania	yes	no	25	0,35	0,07	yes	25	0,58	0,16
Tanzania	no		88	0,40	0,18		88	0,49	0,27
Togo	yes	yes	2	0,21	0,06	yes	2	1,02	0,02
Togo	no		35	0,20	0,22		27	0,86	0,30
Uganda	yes	no	2	0,37	0,01	no	2	0,53	0,25
Uganda	no		159	0,38	0,18		159	0,55	0,28
Zambia	yes	yes	15	0,34	0,18	no	15	0,42	0,39
Zambia	no		57	0,30	0,15		53	0,54	0,35
Zimbabwe	yes	no	20	0,30	0,11	no	16	0,46	0,68
Zimbabwe	no		68	0,39	0,32		58	0,55	0,53
Total	yes	7	331	0,31	0,39	19	288	0,51	0,56
Total	no	21	2556	0,35	0,53	9	2148	0,45	0,67
Total All	-	28	2887	0,34	0,52	28	2436	0,46	0,66

Notes: This table shows the average conditional district-level educational IM by country and district with or without mineral discovery. Columns (1) gives the country name. Columns (2) is "yes" for districts with discovery, and "No" otherwise. Columns (3) and (7) is "yes" if upward and downward IM is higher in districts with discovery than without discovery, respectively. Columns (4)-(8), (5)-(9), and (6)-(10) give the number of districts, the average educational IM, and the coefficient of variation of education IM, respectively.

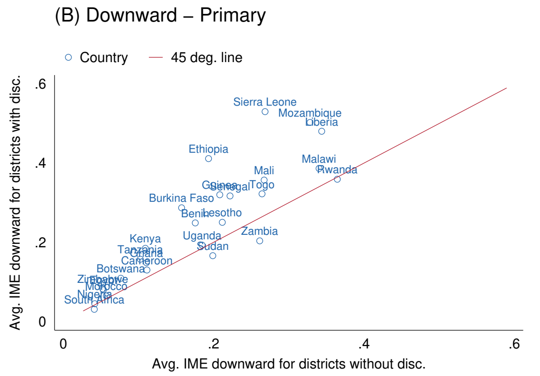
Appendix E.2 Gaps of IM by districts with and without discoveries for each country

Figure E.19: District-level educational IM

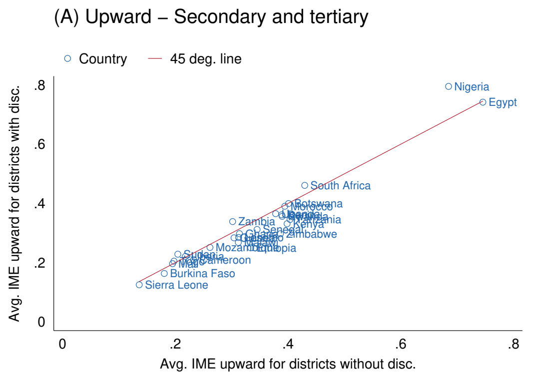
(A) Upward primary



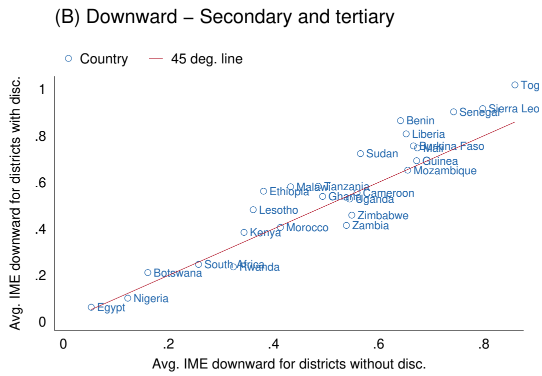
(B) Downward primary



(C) Upward secondary and tertiary



(D) Downward secondary and tertiary



Appendix F Baseline results with control variables

Appendix F.1 Primary educational IM

Table F.31: Baseline results with control variables, primary education

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Upward mobility				Downward mobility			
	Disc-B/A	Disc-5	Prod-B/A	Prod-5	Disc-B/A	Disc-5	Prod-B/A	Prod-5
Mining	0.028***	0.027***	0.070***	0.059***	-0.013***	-0.007***	-0.012***	-0.012***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Female	-0.037***	-0.037***	-0.038***	-0.038***	-0.003***	-0.003***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
HH head female	0.038***	0.038***	0.037***	0.037***	0.008***	0.008***	0.008***	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Low skilled occupation	-0.046***	-0.046***	-0.045***	-0.045***	0.040***	0.040***	0.040***	0.040***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Medium skilled occupation	0.050***	0.050***	0.050***	0.050***	-0.005***	-0.005***	-0.006***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
High skilled occupation	0.151***	0.151***	0.150***	0.150***	-0.039***	-0.039***	-0.039***	-0.039***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Mother/stepmother	0.001	0.001	0.002**	0.002**	-0.030***	-0.030***	-0.030***	-0.030***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Both father/stepfather and mother/stepmother	0.038***	0.038***	0.038***	0.038***	-0.012***	-0.012***	-0.012***	-0.012***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Household size	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Urban	0.152***	0.152***	0.152***	0.152***	-0.060***	-0.060***	-0.060***	-0.060***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	8306024	8306024	8537407	8537407	4374423	4374423	4478390	4478390
R-squared	0.269	0.269	0.270	0.270	0.134	0.134	0.133	0.133
# Treated	148633	192236	53986	67663	98793	123151	36768	49337
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix F.2 Secondary and Tertiary educational IM

Table F.32: Baseline results with control variables, secondary and tertiary education

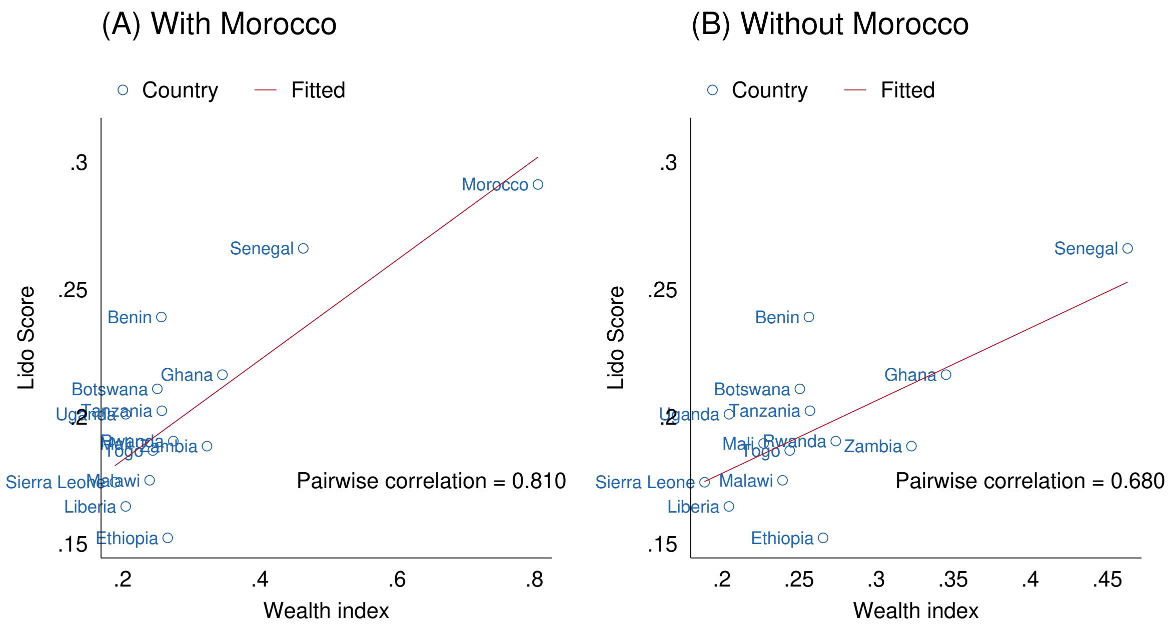
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Upward mobility				Downward mobility			
	Disc-B/A	Disc-5	Prod-B/A	Prod-5	Disc-B/A	Disc-5	Prod-B/A	Prod-5
Mining	-0.007	-0.000	0.016	0.007	0.037**	0.015	-0.010	0.007
	(0.013)	(0.011)	(0.021)	(0.020)	(0.019)	(0.018)	(0.024)	(0.022)
Female	-0.021***	-0.021***	-0.021***	-0.021***	0.002	0.002	0.001	0.001
	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
HH head female	0.003	0.003	0.003	0.003	0.055***	0.055***	0.054***	0.054***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.006)	(0.006)	(0.006)
Low skilled occupation	-0.050***	-0.050***	-0.049***	-0.049***	0.093***	0.093***	0.091***	0.091***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)
Medium skilled occupation	-0.001	-0.001	0.000	0.000	0.050***	0.050***	0.050***	0.050***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)
High skilled occupation	0.223***	0.223***	0.222***	0.222***	-0.027***	-0.027***	-0.027***	-0.027***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.004)	(0.004)	(0.004)	(0.004)
Mother/stepmother	0.006**	0.006**	0.005**	0.005**	-0.104***	-0.104***	-0.104***	-0.104***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)
Both father/stepfather and mother/stepmother	0.050***	0.050***	0.049***	0.049***	-0.061***	-0.061***	-0.062***	-0.062***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Household size	-0.004***	-0.004***	-0.004***	-0.004***	0.011***	0.011***	0.011***	0.011***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Urban	0.107***	0.107***	0.108***	0.108***	-0.087***	-0.087***	-0.090***	-0.090***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Observations	3335415	3335415	3461167	3461167	323998	323998	331618	331618
R-squared	0.217	0.217	0.217	0.217	0.169	0.169	0.169	0.169
# Treated	67525	89986	38002	43715	6197	7491	2813	3380
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Census-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix G Validation of LIDO score and Wealth index

Appendix G.1 Correlations between LIDO score and Wealth index

Figure G.20: Number of mineral discoveries for all African countries, 1950-2019



Appendix G.2 Correlations between LIDO score, Wealth index and PPP GDP per capita

Figure G.21: District-level educational IM

(A) LIDO score

(B) Wealth index