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Is Poverty in the African DNA (Gene) — Source link

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Is Poverty in the African DNA (Gene)?

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Abstract

A 2015 World Bank report on attainment of Millennium Development Goals concludes that the number of extremely poor has dropped substantially in all regions with the exception of Sub-Saharan Africa. We assess if poverty is in the African gene by revisiting the findings of Ashraf and Galor (2013, AER) and reformulating the 'Out of Africa Hypothesis' into a 'Genetic Diversity Hypothesis' for a 'Within Africa Analysis'. We motivate this reformulation with five shortcomings arising for the most part from the 2015 findings of the African Gerome Variation Project, notably: limitations in the concept of space, African dummy in genetic diversity, linearity in migratory patterns, migratory origins and underpinnings of genetic diversity in Africa. Ashraf and Galor have concluded that cross-country differences in development can be explained by genetic diversity in a Kuznets pattern. Our results from an exclusive African perspective confirm the underlying hypothesis in a contemporary context, but not in the historical analysis. From a historical context, the nexus is U-shaped for migratory distance, mobility index and predicted diversity while for the contemporary analysis; it is hump-shaped for ancestry-adjusted predicted diversity. Hence, poverty is not in the African gene from a within-Africa comparative standpoint. Policy implications are discussed.

Keywords : Africa; Genetic diversity; Comparative economic development
JEL Codes: N10; N30 ; N50; O10; O50; Z10

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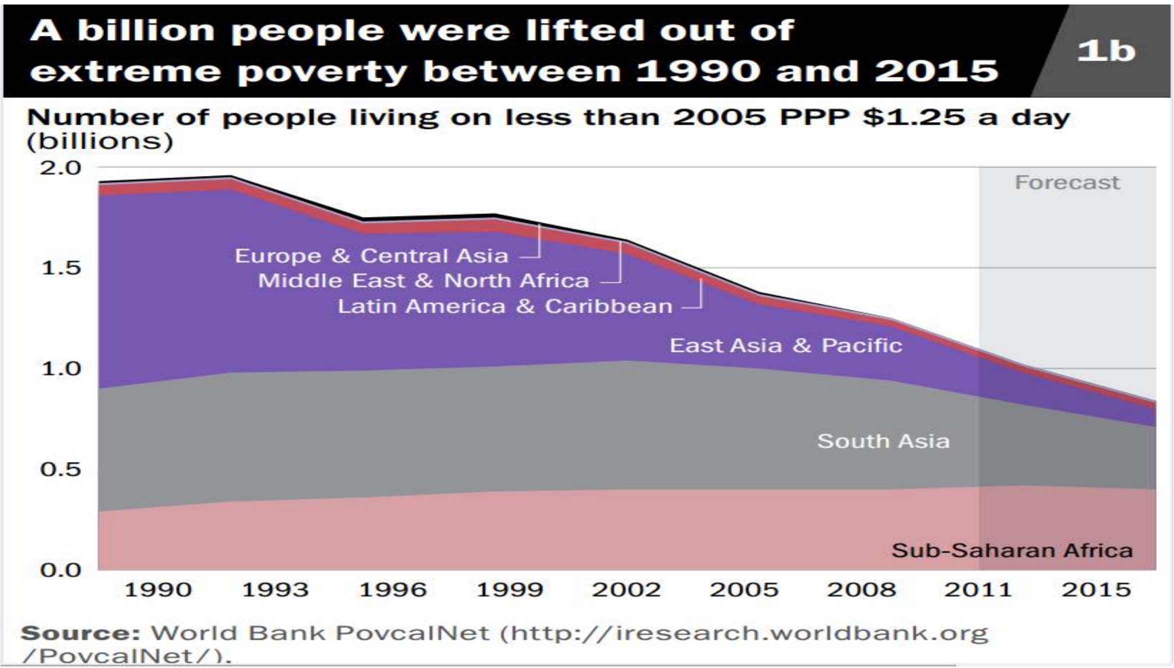
1. Introduction

A 2015 World Bank report on attainment of Millennium Development Goals (MDGs) concludes that the number of extremely poor has dropped substantially in all regions with the exception of Sub-Saharan Africa (Caulderwood, 2015). According to the narrative, with respect to poverty eradication, about 45% of countries in the region are "seriously off track" from attaining the MDGs. As shown in Figure 1, while other developing regions have seen those living in extreme poverty declining, these rates have been increasing in Sub-Saharan Africa despite its growth-resurgence in recent years. Hence, the African continent is still substantially the poorest region in the world, despite recent narratives of it being on time for Millennium Development Poverty targets (Pinkivskiy & Sala-i-Martin, 2014) or experiencing decreasing poverty relative to other regions of the world (Fosu, 2015). These stream of studies which have been motivated by currents of, inter alia: an African growth miracle (Young, 2012), Africa rising (Leautier, 2012), may be more concerned about extolling the appeals of capital accumulation and the neoliberal ideology, hence, neglecting fundamental ethical issues about sustainable jobs, ecological crisis and inequality (Obeng-Odoom, 2014).

Figure 1: Comparative regional poverty levels



Over the past few years, researchers have been interested in the causes of poverty in Africa (Englebert, 2002; Jerven, 2011; Kodila-Tedika & Agbor, 2014). The studies have either been based on the hypothesis that Africa is different or on the assumption of an African dummy. Some causes of poverty have been social obstacles to technological change and economic prosperity (Amavilah, 2015). Others entail: (1) loss of traditional institutions (Amavilah, 2014a, 2006; Lewis, 1955) and/or deinstitutionalization of Africa (Nunn, 2008, 2009; Nunn & Puga, 2012); (2) confusion between 'private use rights' and 'private property rights' (Amavilah, 2015); (3) devaluation of local knowledge and overvaluation of foreign knowledge (Brush & Stabinsky, 1996; Raseroka, 2008; Lwoga et al., 2010; Asongu, 2014a; Tchamyou, 2014; Amavilah et al., 2014; Asongu et al., 2014); (4) '*Ignoring art as an expression of technological knowledge*' (Amavilah, 2014); (5) too much natural resource idleness (Doftman, 1939; Lewis, 1955; ; Amavilah, 2014a); (6) the lack of 'scarcity acknowledgment' (Lewis, 1955; Dorfman, 1939; Lucas, 1993; America, 2013; Fosu, 2013b; Drine, 2013; Looney, 2013; Asongu, 2014ab); (7) excessive consumption by the rich of luxurious commodities (Adewole & Osabuohien, 2007; Efobi et al., 2013); (8) concerns about colonialism and neocolonialism (Ndlovu-Gatsheni, 2013); (9) overly reliance on foreign aid (Moyo, 2009; Obeng-Odoom, 2013; Asongu, 2014d) or Western-led policies (Fofack, 2014); (10) lost decades from the Washington consensus (Lin, 2015) owing partly to the false economics of preconditions (Monga, 2014); (11) failure to embody qualitative measurements of development into Africa's development paradigms (Obeng-Odoom, 2013); (12) fragile institutions, lack of suitable local conditions and inability to effectively negotiate for development assistance (Kayizzi-Mugerwa, 2001); (13) low-depth of regional integration (Kayizzi-Mugerwa, et al., 2014) and (14) rational asymmetric development policies of globalisation (Asongu, 2015a) and corruption in international trade (Musila & Sigué, 2010).

Another stream of the literature has been attempting to address the concern with evidence from comparative economic development. A recent study in this strand which has been qualified as the most important by Santos and Ferreira-Lopes (2013) is that of Ashraf and Galor (2011, 2013). According to these authors, differences in economic development are traceable to genetic diversity. This relationship in their perspective is non-monotonous (see Figure 2) and Kuznets or hump in shaped. The findings are consistent with Spolaore and Wacziarg (2009) who had earlier established the relevance of genetic distance in the diffusion of development.

As shown in Figure 2, the findings of Ashraf and Galor (hence AG) in what is now known as the 'Out of Africa Hypothesis' (OAH) postulates that "*in the course of the prehistoric exodus of Homo sapiens out of Africa, variation in migratory distance to various settlements across the globe affected genetic diversity and has had a persistent humpshaped effect on comparative economic development, reflecting the trade-off between the beneficial and the detrimental effects of diversity on productivity. While the low diversity of Native*

American populations and the high diversity of African populations have been detrimental for the development of these regions, the intermediate levels of diversity associated with European and Asian populations have been conducive for development" (p.1).

Figure 2: The Hump-Shaped relationship or Out of African Hypothesis (OAH)

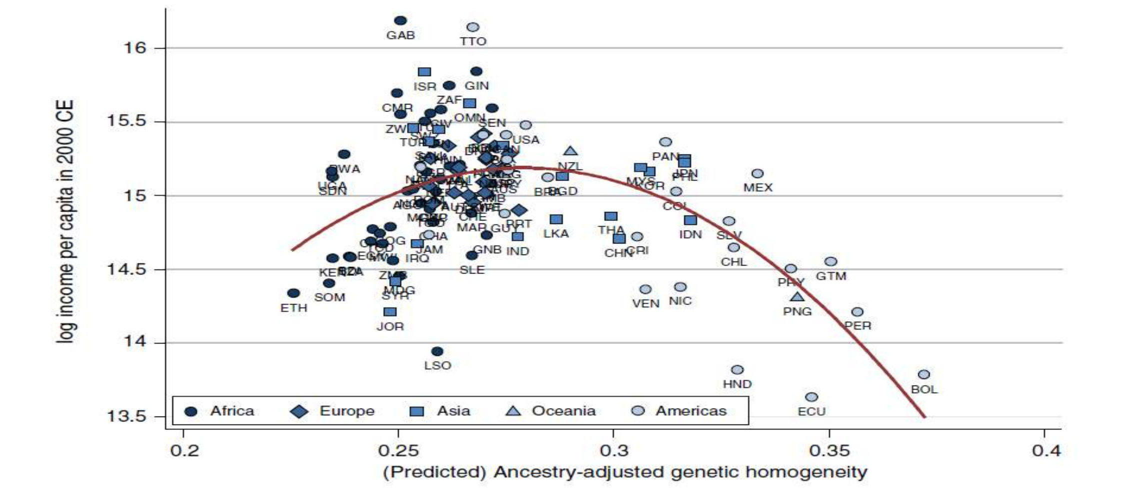


FIGURE 5. ANCESTRY-ADJUSTED GENETIC DIVERSITY AND INCOME PER CAPITA IN 2000 CE

Source: Ashraf and Galor (2011; 2013)

Interestingly, the findings of AG have received many commentaries and criticisms in academic and policy-making circles. We present them in terms of direct and indirect responses. First on indirect responses: (1) Ager and Bruckner (2013) have investigated the impact of genetic diversity on economic development in the United States; (2) Campell and Pyun (2015) have examined why societies are poor to find that, contrary to the mainstream narrative, the relationship between GDP per capita and 'genetic distance from the US' disappears after controlling for geography; (3) the indirect and direct relationships between economic growth and ethnic fragmentation have been examined by Papyrakis and Mo (2014); (4) Cook (2013) finds that prior to popular usage of effective vaccines and medicines, cross-country genetic disparities are linked to positive aggregate health effects and nexus between ancestral genetic diversity and (5) human capital is examined by Sequeira et al. (2013), to conclude on a strong hump-shaped nexus.

Second on direct responses: (1) William (2013) is positioned on testing the validity the OAH from a net productivity perspective; (2) Ashraf et al. (2014) have reinvestigated the relationship using 'nigh time light intensity'; (3) Pickrell and Reich (2014) have argued that it is high time to critically engage the relevance of natural selection and current models of genetic diversity; (4) Cardella et al. (2015) have extended AG by investigating the effect of genetic diversity on financial development to confirm the OAH and (5) Guedes et al. (2013)

posit that the arguments presented by AG are substantially flawed on both methodological and factual grounds.

Guedes et al. (2013) have expressed substantial doubts on the conclusions, pointing to serious issues in the underlying study, among others: deficiencies in the construction of the diversity indicator, concerns in the measurement of development and the abusive use of terminology. Another worry from the critics is the attempt by authors of the underlying study to associate poverty to genes. The present line of inquiry builds on this concern.

In light of the above, this study investigates if poverty is in the African gene. The positioning on Africa has a twofold motivation. First, as far as we have reviewed or judging from the literature highlighted above, no study responding to Ashraf and Galor has exclusively focused on Africa. Second, as evident from the stylized facts above, relative to other developing regions, the continent is still the poorest in the world.

Without undermining the criticisms of Guedes et al. (2013) on the underlying study, we think their critic provides a perspective from researchers who are not economists for the most part and hence, may have limited familiarity with the universe of the economic discipline. In accordance with Gelman (2013), authors of the study have been quite lucky with their critics because they have been attacked by anthropologists who have presented criticisms on scientific and political grounds. This tendency has provided economists a higher platform because, unlike their antagonists, they have the sentiment of being more critical scholars.

A natural criticism of the above positioning may be that the underpinning for the OAH, while unrestricted in time, is limited in space and therefore a line of inquiry within Africa is not theoretically feasible. To address this issue, we reformulate the 'Out of Africa Hypothesis' into the 'Genetic Diversity Hypothesis' for a 'Within Africa Analysis'. This reformulation has a fivefold motivation: limitations in the concept of space; African dummy in genetic diversity; linearity in migratory patterns, migration origin and underpinnings of genetic diversity in Africa. The last-three are motivated by recent findings from the African Genome Variation Project (Gurdasani et al., 2015)[2]

First, on the shortcomings in the concept of space, in spite of the short migratory distance from East Africa to other regions in the continent (Figure 1, p. 3), the distance from Addis Ababa to intermediate waypoints is also significantly granted within Africa. For instance (see Figure 2, p. 15): (1) the distance from Addis Ababa to Istanbul in Asia is almost

[2] The Journal Nature in January 2015 published a study by Gurdasani et al. (2015) on African Genome Variation which is the first comprehensive study of genetic diversity in the continent.

similar to that from the same origin to some represented ethic groups in Southern Africa; (2) the distance from Cairo to Phnom Penh in South East Asia is also almost similar to that from Cairo to the same substantially represented ethnic groups in Southern Africa and (3) the consistent example of ethnic groups in Southern Africa is far higher than the represented ethnic groups in the two American continents, from Anadyr in North East Asia to Karitiana in Southern America, passing through Prince Rupert in Northern America. In light of the above, it follows that the concept of space used by AG in the: (i) location of intermediate waypoints utilised to construct migratory paths from Addis Ababa and (ii) identification of ethnic groups; can be relaxed for a within-Africa analysis.

Second, the OAH is founded directly or indirectly on an African dummy of genetic diversity. The dummy within this framework represents high genetic diversity. But within this continent there are regions with very high and very low levels of genetic diversity. Hence, a within-Africa analysis is interesting to clarify this heterogeneity. Accordingly, the substantial genetic diversity in Africa (Sanchez-Mazas & Poloni, 2008), has been documented to also have considerable development implications (Campbell & Tishkoff, 2008). Unfortunately, while the comparative development effects of genetic diversity is the basis for AG, the authors have considered the continent (with the highest level of genetic diversity) as a dummy in the formulation of the hypothesis underpinning the study. Therefore, there is need to reformulate the OAH into a 'Genetic Diversity Hypothesis', which is the objective of the present line of inquiry.

Third, a broad assumption by GA on the migratory paths from Addis Ababa is that they are linear. This assumption can be debunked on empirical and intuitive grounds. (1) Intuitively, these can only be linear if the migrating population has a prior or final destination in mind. Unfortunately, this was not the case. Hence, migratory patterns might have been S-shaped, U-shaped, O-shaped….etc. In this light, migratory patterns within-Africa should be the most apparent. The position is consolidated by the fact that, the apparent exit from Africa is a relatively small distance connecting Egypt to the Middle East, which would not have been easily found by the migrating populations. (2) From an empirical standpoint, the African Genome Variation Project (AGVP) has established that many Africans have some Eurasian DNA within their genetic ancestry, which means that some Eurasians migrated back into Africa after they left many thousand years ago (Morelle, 2014). Hence, the destination from Addis Ababa may also have been Africa. In light of the above, we do not find this pattern in Figure 2 (p. 15) of the underlying study, which suggest that the OAH does not account for: (i) exclusive within-Africa migration owing to climatic and logistic factors and (ii) return-to-

Africa migration as evidenced from the AGVP findings. Hence, there are solid grounds for a within-Africa analysis because of heterogeneity in genetic diversity across the continent owing to (i) and (ii).

Fourth, on the migration origin provided by the underlying study, the AGVP has provided other insights into how ancient populations migrated within Africa by revealing that, several of the populations in the continent descended from the Bantu, an ethnic group that spread across Africa about 5000 years ago. This is consistent with Bousman (1998) on: (i) Cameroon being the likely core region of the expansion of Bantu people between 2000-1500 BCE (Before the Common Era); (ii) the second migration expansion downward to Southern Africa from the Urewe nucleus of Eastern Bantu around 1000-500 BCE and (iii) the third migration phase from the Congo nucleus between 500 BCE and 1000 in the Common Era (CE). According to the narrative, migration towards Addis Ababa is apparent only during the third phase of these expansionary patterns[3].

Fifth, on the underpinnings of genetic diversity, the assumptions that Africa is very genetically diverse are not so apparent from the conclusions of the AGVP: "*Dr Sandhu said: 'The diversity among populations is not as diverse as we expected it to be. That's good, because it means we can now design large scale trials to understand diseases susceptibility'*" (Morelle, 2014). This factor is also a natural motivation for a within-Africa assessment.

In light of the five points above, a Genetic Diversity Hypothesis is preferable to an OAH within the context of this line of inquiry. Given that this study is an extension of Ashraf and Galor, the estimation technique is also consistent with that adopted by the underlying study. The rest of the study is organised as follows. Section 2 reviews existing literature on causes of African poverty and responses to the 'Out of Africa Hypothesis' (OAH). Section 3 provides a historical analysis while Section 4 covers the contemporary analysis. Section 5 concludes.

2. Causes of African poverty and responses to the 'Out of Africa Hypothesis'

2.1 Causes of African poverty

Amavilah (2015) has documented an interesting literature on the causes of African poverty, notably: loss of traditional economic institutions, confusion between 'rights of private use' and 'private property rights', overvaluation of foreign knowledge and undervaluation of local knowledge, ignorance of art as an expression of technological know-how, too much natural

[3] The interested reader can find more insights into the patterns on the following link : http://fileserver.net-texts.com/asset.aspx?dl=no&id=5684

resource idleness, too little knowledge on scarcity and overstressing of the appeals of excessive consumption and benefits of luxury.

In the first strand on loss of traditional economic institutions, consistent with Amavilah (2014a), Lewis (1955) listed economic institutions as second-most relevant in the drivers of economic growth. In line with Amavilah (2015), the invention of a very 'sophisticated cowrie-based monetary system' by traditional African economic institutions made a substantial but unrecognized contribution to banking and financial technology. This system heralded fiat money when China and Europe were still focusing on commodity money. The combination of the cowrie-based monetary system with paper money in some regions in Africa represented 'sophisticated economic institutions' in the continent. Hence, given that dysfunctional institutions (especially financial) have contributed to African poverty (Fosu, 2013a; Andrés et al., 2013; Asongu & Kodila-Tedika, 2014), there is growing evidence in the literature suggesting that countries that retained their traditional institutions (e.g Mauritius and Botswana) and those that have re-established such institutions like Somaliland are doing relatively better, institutionally-speaking (Amavilah, 2006; Eubank, 2012; Asongu, 2015b). This narrative is consistent with: (i) the negative effects of institutional confidence and knowledge in knowledge acquisition and innovations (Amavilah, 2009a) and (ii) the evolving stream of studies on the negative long-run impacts of deinstitutionalization on African economic prosperity (Nunn, 2008, 2009; Nunn & Puga, 2012).

The second strand from Amavilah (2015) articulates the confusion between 'private use rights' and 'private property rights'. According to the narrative, economic history emphasises that this confusion can be assimilated to de-institutionalization which has stifled the progress of knowledge in African nations. Accordingly, conventional market theory has failed to accommodate certain important features of traditional economies. The equation of 'private use rights' to 'private ownership rights' or that the former is embodied in the latter has severely constrained African economies which have traditionally distinguished individuals' 'private use rights' to natural resources (e.g usage of land for corn cultivation) and ownership of the land, which is considered a gift of nature. While both ownership and use rights are inheritable privately, only the former rights can be exchanged privately, because they are the fruits of labour. A case in point is that a rented apartment cannot be owned and privately used simultaneous.

In the third strand, we engage why devaluation of local knowledge and overvaluation of foreign knowledge represents significant obstacles to progress in technologies. Accordingly, human local networks based on traditional societies are not very valuable in the field of information and communication technology (ICT) where local networks are important. In this regard, Brush and Stabinsky (1996) have emphasised the role of local knowledge in intellectual property rights. A view consistent with the need for indigenous knowledge systems in the drive towards knowledge (Raseroka, 2008; Lwoga et al., 2010; Asongu, 2014a; Tchamyou, 2014) in the increasing relevance of knowledge economy in African economies (Asongu, 2014cb; Amavilah et al., 2014; Asongu et al., 2014).

'*Ignoring art as an expression of technological knowledge*' is the fourth strand because art is skill from practise and/or formal knowledge (Amavilah, 2015). According to the narrative, mainstream denial of arts as a form of science has put African countries on the disadvantage. In essence, knowledge is needed to produce art, which can also be considered as applied science. Hence, it follows that art sciences is the creation of wealth.

Too much natural resource idleness in the fifth strand is a plague that has retarded African nations for many decades. Leaders on the continent have been laying too much emphasis on these natural resources (Lewis, 1955; Amavilah, 2014a) when historical evidence suggests that natural-resource rich countries have done relatively poorer than their resource-poor counterparts. As sustained by Doftman (1939) with British examples of the pre-Smith époque, unless idle resources are put to productive use, resources that are idle do not produce wealth. Idleness in resources engenders loss of employment and other negative growth externalities. Ultimately, the mere presence of resources is not enough for Africa to escape from poverty. Some have qualified this syndrome as the natural resource curse (Ogwumike & Ogunleye, 2008; Breisinger et al., 2010).

The sixth strand which is related to the fifth emphasises lack acknowledging scarcity in African countries. Given that some natural resources are finite (Lewis, 1955; Dorfman, 1939), failing (or refusing) to recognise a resource as both an opportunity and a constraint may be detrimental for the economy in the long-run. Ultimately, the use of resources depends on inter alia: leadership (America, 2013). Moreover, Asian countries with far less natural resources than African nations who have factored-in this scarcity element have produced an economic miracle that is today widely acknowledged as man-made (Lucas, 1993; Asongu, 2014ab). Some African countries have been employing more efforts than others in this respect, with interesting examples from Botswana. Fosu (2013b) who has recently documented an interesting literature on development strategies from other developing countries clearly emphasises lessons from resource-rich oil countries in the Middle East and North Africa (MENA) with examples from Oman and Bahrain (Drine, 2013; Looney, 2013).

A seventh stream of the literature focuses on excessive consumption and 'overstressing of rewards from luxury'. In situations of poverty, unproductive effort and time is allocated to acquiring very luxury products. Excessive consumption by the rich on luxurious goods that are often imported for the most part may reflect economic decay (Adewole & Osabuohien, 2007; Efobi et al., 2013). This has been the case with most African government officials in the past decades (Kodila-Tedika & Bolito-Losembe, 2014).

For brevity and lack of space, we summarise the last strand into concerns about colonialism and neocolonialism (Ndlovu-Gatsheni, 2013), overly reliance on foreign aid (Moyo, 2009; Asongu, 2014d) or Western-led policies (Fofack, 2014), lost decades from the Washington consensus (Lin, 2015) owing partly to the false economics of preconditions (Monga, 2014), political violence and terrorism which are associated with blur economic outlooks[4], failure to embody qualitative measurements of development into Africa's development paradigms (Obeng-Odoom, 2013) and rational asymmetric development policies (Asongu, 2015a) which are constantly putting African countries on the disadvantage when it comes to adopting globalisation-driven neoliberal policies.

2.2 Responses to the 'Out of Africa Hypothesis' (OAH)

Of the over 251 citations of AG at the time of this study, as far as we have reviewed, only about 13 have directly touched on the OAH. We briefly engage them by discussing indirect (direct) responses in the top- (bottom-) half of this section.

Ager and Bruckner (2013) have investigated the impact of genetic diversity on economic development in the United States by exploiting how immigrants with different genetic diversities from different origins settling in different regions in the country affect the development process. Two main findings are established from a sample of more than 2250 countries, notably: (1) increasing genetic diversity owing to the 19th century appealing immigration effect on economic development and (2) there is a long-term effect of genetic diversity on contemporary income.

Campell and Pyun (2015) have investigated why societies are poor to find that, contrary to the mainstream narrative, the relationship of GDP per capita with 'genetic distance from the US' disappears after controlling for geography, SSA and distance from the

[4] Accordingly, politico-economic violence increases ambiguity from investors who prefer to adopt ambiguity-safe economic strategies (Le Roux & Kelsey, 2015ab). This narrative is broadly consistent with the substantial bulk of literature on terrorism in developing countries (Singh, 2001, 2007; Efobi et al., 2015) and conflicts in African nations (Asongu & Kodila-Tedika, 2016; Asongu & Nwachukwu, 2014ab).

equator. Longhi (2013) investigates the effect of cultural diversity on individual wages using yearly population estimates and British Household Panel Survey of individual data to address the mainstream concern of whether people living in areas that are more diverse earn relatively higher after controlling for unobservable and observable features. The findings reveal that the hypothesis is valid (invalid) for cross-sectional (panel) data. Moreover, cross-sectional results may be upwardly biased because natives with relatively higher wages and skills have the tendency of self-selecting into areas with greater diversity.

The indirect and direct relationships between economic growth and ethnic fragmentation have been examined by Papyrakis and Mo (2014) to conclude that, if taken into account in isolation, both ethnic polarization and fragmentation are linked to growth: a nexus that is contingent on other growth-oriented features, notably, corruption-control, investment, fertility and conflicts. The corruption mechanism is the most important for both measures of ethnic fragmentation in terms of relative importance in elucidating a development curse.

Cook (2013) finds that prior to popular usage of effective vaccines and medicines, cross-country genetic disparities are linked to positive aggregate health effects. According to the findings, genetic diversity with a genetic system linked with the disposal and recognition of foreign pathogens mitigates the prevalence and virulence of diseases that are infectious. In essence, prior to effective vaccines and medicine, nations endowed with higher genetic diversity within the system (which also has higher innate resistance levels), experience higher life expectancies and lower rates of mortality resulting from infectious diseases.

The nexus between ancestral genetic diversity and human capital is examined by Sequeira et al. (2013), who conclude on a strong hump-shaped nexus. The implication is that considerable human capital values these days may be traceable to the genetic diversity of many centuries past.

William (2013) is directly positioned on testing the validity of the OAH from a net productivity perspective that is: a negative impact on social capital and positive effect on technological productivity. The author confirms the hump-shaped nexus between per capita income and genetic diversity to confirm the underlying hypothesis.

Ashraf et al. (2014) have reinvestigated the relationship using 'nigh time light intensity per capita' from satellite observations and the findings further validate the OAH by establishing that a considerable part of variations in living standards globally could be traceable '*to factor that are were determined in the distant past*', like '*the migratory distance from the cradle of anatomically modern human in East Africa*'.

Pickrell and Reich (2014) have built on a supposedly growing consensus that the OAH has fundamentally modified the genetic structure of a great portion of the world's population to argue that it is high time to critically engage the relevance of natural selection and current models of peopling the world in order to determine how phenotypes are geographically distributed. The authors '*specifically highlight the transformative potential of*' past Deoxyribonucleic acid (DNA), a molecule which encodes the genetic instructions for the functioning and development of all living organisms. By investigating how populations are genetically made-up in times and places of archaeological relevance, ancient DNA enables a direct tracking of responses to natural selection and migrations.

Cardella et al. (2015) have extended AG by investigating the effect of genetic diversity on financial development, assuming that the former can affect the latter through two mechanisms: (i) directly via its impact on financial sector innovation and (ii) indirectly through its effect on productivity and latter demand for finance. The authors conclude on a hump-shaped nexus between a country's level of financial development and degree of genetic diversity from a cross-sectional analysis of 150 countries.

Guedes et al. (2013) present a critic building on a position by AG that '*the high degree of diversity among African populations and the low degree of diversity among Native American populations have been a detrimental force in the development of these regions*'(p. 71). The authors demonstrate that the arguments presented by AG are substantially flawed on both methodological and factual grounds. They further caution that as social scientists start exploring the freshly available data on genetic diversity, it is also critical to bear in mind that methodological and data perspectives from non-experts can have substantial detrimental politico-social impacts.

We have already discussed how our present line of inquiry steers clear of the above literature in the introductory section. Our contribution to the underlying literature also draws from the five main criticisms of the OAH we have discussed in the same section; on which bases we have reformulated the OAH into the Genetic Diversity Hypothesis. Accordingly, this reformulation has been motivated by five shortcomings arising for the most part from recent findings of the African Gerome Variation Project published in the journal Nature. The engaged limitations, include: shortcomings in the concept of space, African dummy in genetic diversity, linearity in migratory patterns, migratory origins and underpinnings of genetic diversity in Africa.

3. The Historical Analysis

3.1Data and Methodology

This section is focused on the data and methodology used for assessing the pre-colonial effect of genetic diversity on development. For brevity, lack of space and the interest of avoiding repetitions from the underlying paper, in order to focus on the main contributions of this study, we assume that the interested reader has foreknowledge of the underlying paper. Hence, we do not expand discussions on variables and methodology which are straight forward and simple to understand. Consistent with the underlying paper, the dependent variable is historical population density, the main independent variable is genetic diversity while the control variables are Neolithic transition timing and land productivity. The latest embodies three geographic indicators, inter alia: (i) absolute latitude, (ii) an index used to assess the suitability of land for the purpose of agriculture and (iii) the percentage of arable land.

The estimation technique consists of employing heteroscedasticity consistent Ordinary Least Squares (OLS) to regress the 'logarithm (log) of population density in 1500 CE' on genetic diversity, conditional on other covariates. The baseline specifications which are consistent with the underlying study can be provided upon request. What is worthy of note however, is the information criterion used to determine the presence of a hump-shaped nexus or investigated hypothesis. Accordingly, the interactive regressions are interpreted as marginal effects. Hence, evidence of diminishing marginal impacts of genetic diversity on the dependent variable is consistent with a hump-shape relationship. In other words, we expect the estimated coefficient for genetic diversity to be positive while that corresponding to the 'squared value of genetic diversity' should be negative.

3.2 Historical empirical findings

In this section, we present the historical empirical findings of the nexus between population growth and genetic diversity in the pre-colonial Malthusian era. Three main issues are addressed: the effect of observed diversity in the limited sample, baseline assessments for the extended model and robustness checks based on the diversity mechanism in relation to alternative concepts of distance (entailing aerial distance from East Africa and migratory distances from various global 'placebo' points of origin).

Table 1 which is based on results from the limited sample explains the comparative development by regressing the logarithm of population density in 1500 CE. Two findings are noticeable in relation to the underlying study: (1) the OAH is not confirmed and (2) but for land suitability for agricultural purposes which has the expected significant positive sign, the other control variables are not significant.

Table 1: Observed Diversity and Economic Development in 1500 CE

	(1)	(2)	(3)
Observed diversity	8 680.392	4 718.098	**-105.069***
	(6 248.255)	(1 064.964)	**(34.302)**
Observed diversity square	-5 728.804	-3 161.152	
	(4 145.866)	(707.831)	
Log [Neolithic transition timing]		0.949	0.374
		(0.219)	(0.384)
Log [percentage of arable land]		0.285	0.064
		(0.162)	(0.126)
Log [absolute latitude]		0.005	-0.028
		(0.066)	(0.127)
Log [land suitability for agriculture]		0.985	**1.659****
		(0.218)	**(0.375)**
Constant	-3 287.613	-1 765.900	79.755
	(2 353.684)	(400.778)	(29.189)
Number of observations	8	8	8
R^2	0.197	0.997	0.986

Notes: .01 - ***; .05 - **; .1 - *; ( ): standard errors. Dependent variable: log of population density in 1500 CE.

In Table 2, the information criterion for a hump-shaped nexus between economic development (proxied with population density) and ethnic diversity is not confirmed for migratory distance and mobility index. Moreover, contrary to the underlying study, the nexus is more likely to be U-shaped.

Table 2: Migratory Distance from East Africa and Economic Development in 1500 CE

	(1)	(2)	(3)	(4)
	coef/p-value	**coef/p-value**	**coef/p-value**	**coef/p-value**
Migratory distance	**-0.668****	-1.441		
	(0.301)	(1.932)		
Migratory distance square	**0.092****	0.193		
	(0.039)	(0.244)		
Observed diversity		5 370.968		4 737.638
		(10 987.171)		(10 942.012)
Observed diversity square		-3 541.840		-3 123.668
		(7 273.175)		(7 242.756)
Mobility index			**-1 135.436*****	-1 702.984
			(405.203)	(1 974.939)
Mobility index square			**762.680*****	1 149.847
			(273.298)	(1 341.603)
Constant	**1.551*****	-2 033.465	**422.842*****	-1 165.759
	(0.539)	(4 151.663)	**(150.069)**	(4 818.838)
Number of observations	51	8	45	8
R^2	0.073	0.350	0.107	0.363

Notes: .01 - ***; .05 - **; .1 - *; ( ): standard errors. Dependent variable: log of population density in 1500

CE.

From Table 3 which provides baseline findings from an extended sample, the information criterion for a hump-shaped relationship between economic development (proxied with population density) and ethnic diversity is also not confirmed for predicted diversity. Moreover, contrary to the underlying study, the nexus is more likely to be U-shaped.

Table 3: Predicted Diversity and Economic Development in 1500 CE

	(1)	(2)	(3)	(4)	(5)
Predicted diversity	**-2 422.909****		-2 829.160	**-3 339.844*****	-886.764
	(984.546)		(1 790.036)	**(1 075.648)**	(1 261.103)
Predicted diversity square	**1 621.676****		1 890.948	**2 226.270*****	584.032
	(660.087)		(1 201.754)	**(722.240)**	(844.039)
Log [Neolithic transition timing]		**0.868****	**0.819****		**1.091*****
		(0.398)	**(0.338)**		**(0.376)**
Log [percentage of arable land]				**0.489*****	**0.434*****
				(0.166)	**(0.160)**
Log [absolute latitude]				**-0.453*****	**-0.380*****
				(0.106)	**(0.147)**
Log [land suitability for agriculture]				-0.045	0.189
				(0.157)	(0.170)
Constant	**905.349****	**-6.265****	1 052.067	**1 252.916*****	328.736
	(367.045)	**(3.136)**	(666.620)	**(400.494)**	(472.299)
Number of observations	51	46	46	48	45
R^2	0.073	0.136	0.218	0.566	0.716

Notes: .01 - ***; .05 - **; .1 - *; ( ): standard errors. Dependent variable: log of population density in 1500 CE.

Consistent with the underlying study, we assess the robustness of the earlier results by using aerial distance and migratory distances to examine the investigated relationship. While neither a U-shape nor a Kuznets pattern is confirmed, the control variables are significant with the expected signs.

Table 4: Robustness to Alternative Distances

	(1)	(2)	(3)	(4)	(4)
	East Africa		London	Tokyo	Mexico
Migratory distance	**4.073****		-0.224	-0.422	-0.669
	(1.692)		(1.452)	(2.737)	(3.938)
Migratory distance square	-0.422		0.017	0.017	0.017
	(0.275)		(0.092)	(0.099)	(0.094)
Aerial distance		-0.134			
		(0.337)			
Aerial distance square		0.033			
		(0.043)			
Log [Neolithic transition timing]	**1.707****	**1.091*****	**1.340*****	**1.340****	**1.340*****
	(0.825)	**(0.309)**	**(0.454)**	**(0.529)**	**(0.459)**
Log [percentage of arable land]	-0.345	**0.434****	**0.390****	**0.390***	**0.390****
	(0.979)	**(0.173)**	**(0.169)**	**(0.199)**	**(0.183)**
Log [absolute latitude]	-1.584	**-0.380*****	**-0.324****	**-0.324***	**-0.324****
	(1.077)	**(0.120)**	**(0.129)**	**(0.171)**	**(0.136)**
Log [land suitability for agriculture]	0.970	0.189	**0.256***	0.256	0.256
	(1.120)	(0.168)	**(0.147)**	(0.180)	(0.201)
Constant	**-15.565****	**-7.735*****	-8.928	-7.046	-3.088
	(7.604)	**(2.536)**	(6.885)	(19.517)	(41.368)
Number of observations	8	45	45	45	45
R^2	1.000	0.716	0.700	0.700	0.700

Notes: .01 - ***; .05 - **; .1 - *; ( ): standard errors. Dependent variable: log of population density in 1500 CE.

4. Contemporary Analysis

In this section we discuss the data, methodology and empirical findings of the contemporary investigation in an African context.

4.1Data and Methodology

4.1.1 Data

Consistent with the underlying study, this paper employs the index of contemporary national population. In order to account for the between-group dimension of diversity in the index, a new measure of genetic diversity that is ancestry-adjusted is employed. This is meant to take into consideration the diversity resulting from disparities in sub-national ethnic groups. Accordingly, this measurement of genetic diversity that is adjusted for ancestry should have a greater magnitude in the prediction of contemporary economic development. In Table 5 this intuition is apparent after comparing the fourth and fifth specifications.

Table 5: Adjusted versus Unadjusted Diversity

	(1)	(2)	(3)	(4)	(5)	(6)
Predicted diversity (ancestry adjusted)	2 278 241.392		-1 696.274	**-25.255*****		-66.895
	(5 664 917.332)		(7 177.675)	**(9.341)**		(81.408)
Predicted diversity (ancestry adjusted) square	-1 573 979.535		1 121.022			
	(3 768 959.012)		(4 837.187)			
Predicted diversity		790.852	3 574.335		**-21.052****	42.724
		(1 404.257)	(7 374.757)		**(10.644)**	(76.839)
Predicted diversity square		-542.990	-2 391.411			
		(937.933)	(4 969.006)			
Constant	-820 536.896	-280.186	-686.394	**26.309*****	**23.228*****	**25.475*****
	(2 128 085.921)	(525.494)	(495.533)	**(7.016)**	**(8.009)**	**(7.454)**
Number of observations	50	53	50	50	53	50
R^2	0.087	0.088	0.176	0.100	0.077	0.122

Notes: .01 - ***; .05 - **; .1 - *; ( ): standard errors. Dependent variable: log of income per capita in 2000 CE.

4.1.2 Methodology

In accordance with the underlying study, the regression specifications used in the contemporary context are consistent with those employed in the historical analysis, but for the fact that the contemporary specifications are augmented with more control variables to account for geographical, cultural and institutional factors. Moreover, it is should be noted that the income per capita employed is in the year 2000 CE, for the most part.

4.2.1 Results for Comparative Development

Based on the findings in Table 6, the hump-shaped relationship is confirmed. Hence, while the underlying 'genetic diversity' hypothesis is not valid from an exclusive African context in the pre-industrialisation époque; it is in the contemporary era. It should be noted that while the dependent variable of the first-three specifications is 'income per capita in 2000 CE', the dependent variable of the fourth specification is 'population density in 1500 CE'. The findings in Table 6 are broadly confirmed in Table 7, which controls for additional geographical, cultural and institutional factors. Most of the significant control variables have the expected signs that are consistent with the underlying study.

Table 6: Diversity and Economic Development in 2000 CE and 1500 CE

	(1)	(2)	(3)	(4)
Predicted diversity (ancestry adjusted)	2 151.611	**2 683.437***	**2 485.822***	
	(1 893.650)	**(1 424.014)**	**(1 371.287)**	
Predicted diversity (ancestry adjusted) square	-1 441.285	**-1 796.301***	**-1 665.854***	
	(1 268.686)	**(953.747)**	**(919.079)**	
Log [Neolithic transition timing]	-0.041			**1.091*** **
	(0.396)			**(0.386)**
Log [percentage of arable land]	-0.108	-0.179	-0.085	**0.434** **
	(0.219)	(0.262)	(0.297)	**(0.173)**
Log [absolute latitude]	0.234	0.275	0.192	**-0.380*** **
	(0.193)	(0.224)	(0.256)	**(0.142)**
Log [land suitability for agriculture]	-0.109	-0.007	0.028	0.189
	(0.247)	(0.264)	(0.251)	(0.162)
Log [Neolithic transition timing (ancestry adjusted)]		0.390	0.616	
		(0.553)	(0.500)	
Log [population density in 1500 CE]			-0.200	
			(0.219)	
Predicted genetic diversity				-886.764
				(1 261.270)
Predicted genetic diversity square				584.032
				(844.650)
Constant	-795.625	**-997.973***	**-924.779***	328.736
	(707.868)	**(533.661)**	**(512.313)**	(472.337)
Number of observations	45	45	45	45
R^2	0.279	0.291	0.311	0.716

Notes: .01 - ***; .05 - **; .1 - *; ( ): standard errors. Dependent variables: log of income per capita in 2000 CE (first-three specification) and log of population density in 1500 CE (4th specification).

Table 7: Diversity and Other Determinants of Economic Development in 2000 CE

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Predicted diversity (ancestry adjusted)	**1 987.558***	**1 958.693***	**1 537.683***	1 236.181	1 097.527	1 966.374	1 335.477
	(1 101.835)	**(1 042.611)**	**(834.747)**	(1 375.193)	(1 428.030)	(1 397.627)	(3 246.131)
Predicted genetic diversity (ancestry adjusted) square	**-1 337.240***	**-1 311.646***	**-1 034.087***	-834.545	-734.910	-1 307.447	-884.829
	(736.620)	**(695.176)**	**(559.546)**	(919.252)	(953.883)	(933.506)	(2 162.049)
Log Neolithic transition timing (ancestry adjusted)	0.703	**0.615****	**0.509****	**0.736***	0.511	0.304	-0.101
	(0.432)	**(0.289)**	**(0.243)**	**(0.422)**	(0.482)	(0.438)	(1.088)
Log percentage of arable land	-0.121	**-0.217*****	**-0.237*****	**-0.260*****	-0.178	**-0.232****	-0.033
	(0.119)	**(0.072)**	**(0.075)**	**(0.090)**	(0.109)	**(0.095)**	(0.237)
Log [absolute latitude]	0.292	0.094	-0.043	0.058	-0.111	-0.212	-0.074
	(0.193)	(0.137)	(0.155)	(0.209)	(0.236)	(0.210)	(0.423)
Social infrastructure		**4.694*****	**3.908*****	**3.416*****	**3.784****	**4.208*****	3.954
		(0.862)	**(0.993)**	**(1.135)**	**(1.741)**	**(1.112)**	(3.546)
Ethnic fractionalization			**-1.335*****	**-1.325****	-1.031	**-1.947***	-0.703
			(0.516)	**(0.570)**	(0.929)	**(1.020)**	(2.385)
British legal origin dummy				0.082	0.000	0.000	-0.461
				(0.221)	(0.246)	(0.295)	(0.704)
French legal origin dummy				0.000	0.147	0.216	0.000
				(0.093)	(0.129)	(0.220)	(0.300)
Share of Protestants in the population				-0.000	0.004	-0.008	-0.013
				(0.012)	(0.009)	(0.013)	(0.036)
Share of Roman Catholics in the population				0.003	-0.010	-0.017	-0.024
				(0.010)	(0.015)	(0.014)	(0.036)
Share of Muslims in the population				-0.004	-0.005	-0.004	-0.001
				(0.004)	(0.006)	(0.005)	(0.016)
Percentage of population at risk of contracting malaria					-0.268	0.350	-0.101
					(0.761)	(0.821)	(2.732)
Percentage of population living in tropical and subtropical zones					-0.133	0.142	0.365

					(0.403)	(0.548)	(1.910)
Mean distance to nearest waterway					-0.392	-0.318	0.207
					(0.276)	(0.283)	(1.390)
OPEC dummy					**1.013****	**1.105****	0.580
					(0.487)	**(0.485)**	(2.004)
Percentage of population of European descent						**11.097***	
						(6.233)	
Years of schooling							0.415
							(0.437)
Constant	**-736.948***	**-729.695***	**-567.827***	-455.815	-405.540	-733.107	-496.218
	(412.025)	**(391.975)**	**(312.045)**	(515.886)	(533.073)	(523.257)	(1 220.199)
Number of observations	47	45	45	45	43	43	30
R^2	0.265	0.584	0.662	0.681	0.784	0.856	0.854

Notes: .01 - ***; .05 - **; .1 - *; ( ): standard errors. Dependent variables: log of income per capita in 2000 CE. The first-five equations are based on the Full sample whereas the last-two are based on the Schooling sample. OPEC: Organisation of Petroleum Exporting Countries.

4.2.2 The Costs and Benefits of Genetic Diversity

In this section, we assess the mechanisms via which genetic diversity leads to a Kuznets curve when associated with per capita income in contemporary times. According to the theoretical underpinnings, such diversity should confer some costs on productivity in terms of social benefits and capital which entail the creation and dissemination of more knowledge. Consistent with the narrative, nations with greater diversity are characterised with a lower degree of interpersonal trust and a higher rate of contributions to knowledge by means of scientific publications.

Hence, we assess whether ethnic diversity affect scientific publications in Africa using the average number of scientific articles published annually for the period 1981-2000. Contrary to the findings of the underlying paper which has established a positive nexus, we find a negative relationship. The only significant control variable (or years of schooling) has the positive expected sign.

It is important to devote some space to elucidating why this relationship is insignificantly negative. In accordance with Asongu (2014c, p. 577), the low rate of scientific publications in Africa is traceable to other factors that may be more relevant than ethnic diversity. These include, inter alia: (1) the lack of substantial incentives from governments for research purposes; (2) very few tertiary school graduates pursuing studies to research levels for politico-economic reasons; (3) high levels of academic brain drain; (4) research disincentives, essentially because appointments in academia as politically-motivated and (5) a culture favouring oral exams and teaching experience for academic promotions[5].

[5] "*For example, university lecturers with an extensive teaching experience are more likely to pass the oral examination for promotion in CAMES (African and Malagasy Council for Higher Education)*" (Asongu, 2014c, p. 579).

Table 9: Costs and Benefits of Diversity

Scientific articles per capita per year 1981-2000

	(1)	(2)
Predicted diversity (ancestry adjusted)	-0.111	-0.111
	(0.158)	(0.231)
Log Neolithic transition timing (ancestry adjusted)	0.006	0.002
	(0.005)	(0.005)
Log percentage of arable land	0.002	0.002
	(0.002)	(0.002)
Log [absolute latitude]	0.002	0.001
	(0.002)	(0.002)
Social infrastructure	0.002	0.012
	(0.024)	(0.023)
Ethnic fractionalization	0.022	0.029
	(0.015)	(0.023)
Percentage of population a trisk of contracting malaria	-0.014	-0.031
	(0.013)	(0.021)
Percentage of population living in tropical and subtropical zones	-0.001	0.003
	(0.005)	(0.005)
Mean distance to nearest waterway	0.004	0.003
	(0.006)	(0.007)
Years of schooling	**0.006***	
	(0.003)	
Constant	0.017	0.064
	(0.122)	(0.184)
Number of observations	30	30
R^2	0.642	0.512

Notes: .01 - ***; .05 - **; .1 - *; ( ): standard errors.

5. Concluding implications

A 2015 World Bank report on attainment of Millennium Development Goals concludes that the number of extremely poor has dropped substantially in all regions with the exception of Sub-Saharan Africa. We have assessed if poverty is in the African gene by revisiting the findings of Ashraf and Galor (2011, 2013) and reformulating the 'Out of Africa Hypothesis' (OAH) into a 'Genetic Diversity Hypothesis' for a 'Within Africa Analysis'. We have motivated this reformulation with five shortcomings arising for the most part from the 2015 findings of the African Gerome Variation Project, notably: limitations in the concept of space, African dummy in genetic diversity, linearity in migratory patterns, migratory origins and underpinnings of genetic diversity in Africa. Ashraf and Galor have concluded that cross-country differences in development can be explained by genetic diversity in a Kuznets shape. Our results from an exclusive African perspective confirm the underlying hypothesis in a contemporary context, but not in the historical analysis. Concretely, we have established the following. First, from the historical findings, the U-shape nexus is valid for: migratory distance, mobility index and predicted diversity. Second, with regard to the contemporary results, the underlying Kuznets or hump-shape is valid for predicted diversity (ancestry adjusted).

We have limited the analytical discussion to assessing the shape of the investigated nexuses and resisted the itch of engaging the implications of magnitudes in estimated coefficients because; they have been heavily criticised as unrealistic. We quote Gelman (2013) to better articulate this perspective: "*Once institutional, cultural, and geographical factors are accounted for, [the fitted regression] indicates that: (i) increasing the diversity of the most homogenous country in the sample (Bolivia) by 1 percentage point would raise its income per capita in the year 2000 CE by 41 percent, (ii) decreasing the diversity of the most diverse country in the sample (Ethiopia) by 1 percentage point would raise its income per capita by 21 percent*".

What is more granted is that the deep-rooted factors that were determined thousands of years ago have had a significant impact on economic development since the dawn of civilization to the present contemporary period. While regions in Africa with medium ethnic diversity experienced the lowest levels of economic development in the pre-colonial era, in the post colonial era however, they have been experiencing higher levels of economic development as evident by the inverted U-shape relationship in the contemporary analysis. Hence it follows that, genetic diversity could explain poverty within Africa and poverty is not in the African gene from a within-Africa comparative standpoint.

In light of our motivation for extending Ashraf and Galor, the above findings have at least four main implications. First, there is a shortcoming in the concept of space. Accordingly, in spite of the short migratory distance from East Africa to other regions in the continent, the distance from Addis Ababa to intermediate waypoints is also significantly granted within Africa. Second, while the OAH is based on an African dummy of genetic diversity, within Africa, there are regions with significantly varying levels of genetic diversity which when considered, extends the debate with interesting findings. Third, the linearity assumption of migratory paths may be questionable owing to: (i) lack of knowledge by migrants of migration destinations from a theoretical perspective and (ii) a 'back to Africa' migration pattern recently established empirically by the African Genome Variation Project (AGVP) which has concluded that many Africans have some Eurasian DNA within their genetic ancestry, implying that some Eurasians migrated back into Africa after they left many thousand years ago (Morelle, 2014). Fourth, adopting a Genetic Diversity Hypothesis in place of an OAH would improve scholarly insights into the effects of genetic diversity on comparative development because we have shown that a within-Africa analysis also validates the underlying hump-shaped nexus. In essence, while from an OAH, poverty may be in the African gene, using a Genetic Diversity Hypothesis for a within-Africa assessment reveals the contrary

There is a growing body of evidence, suggesting that poverty may leave some marks on genes. Hence, assessing the role of poverty variables on genetic diversity in Africa is an interesting future research direction.

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