

Migration and Urbanization in Post-Apartheid South Africa

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Abstract

Although Africa has experienced rapid urbanization in recent decades, we know little about the process of urbanization across the continent. The paper exploits a natural experiment, the abolition of South African pass laws, to explore how exogenous population shocks affect the spatial distribution of economic activity. Under apartheid, black South Africans were severely restricted in their choice of location and many were forced to live in homelands. Following the abolition of apartheid they were free to migrate. Given a migration cost in distance, a town nearer to the homelands will receive a larger inflow of people than a more distant town following the removal of mobility restrictions.

Drawing upon this exogenous variation, the authors study the effect of migration on urbanization in South Africa. While they find that on average there is no endogenous adjustment of population location to a positive population shock, there is heterogeneity in these results. Cities that start off larger do grow endogenously in the wake of a migration shock, while rural areas that start off small do not respond in the same way. This heterogeneity indicates that population shocks lead to an increase in urban relative to rural populations. Overall, the evidence suggests that exogenous migration shocks can foster urbanization in the medium run.

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Migration and Urbanization in Post-Apartheid

South Africa*

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1 Introduction

Africa is the least urbanized continent, but its urbanization rate is catching up. The pace of urbanization is remarkable and the continent is due to overtake Asia as the fastest urbanizing region of the world within a decade (United Nations, 2014). Managing the challenges of this rapid transformation represents a key policy challenge and yet the evidence base, particularly in the case of Sub-Saharan Africa, remains limited. One central question for policy makers is to what degree this process can be managed by policy as opposed to being determined by fundamentals alone.

To illustrate this issue, consider a town experiencing an exogenous migration shock. Theoretically it can evolve in just three ways. First, the town's population could shrink back to the initial population level, i.e. mean-revert. Such a reaction would be consistent with an optimal urban network of relative city sizes, where relative sizes might be driven by location fundamentals. Secondly, the town's population could simply remain at the new increased population level and not adjust endogenously to the shock. In this case, the distribution of city sizes would be path dependent. Thirdly, the city could grow further. This would be consistent with a theory of agglomeration effects and multiple equilibria, where an initial population shock moves the town onto a new population trajectory growth path from one equilibrium to another. If city sizes behave according to the first scenario, policies to affect the location of people would be ineffective, while in the other two, policies that induce migration can in turn affect urbanization.

In this paper, we study how cities in South Africa behave having been exposed to exogenous population shocks following the abolition of apartheid. Under the apartheid

regime, the black South African population was severely restricted in its mobility. Large parts of the population were forced to live in so-called homelands and townships. En-route to the democratic transition in 1994, these restrictions were lifted and in June 1991 black South Africans could move freely. Substantial internal migration flows resulted, which led to increased urbanization during the 1990s and 2000s (see Figure 1 below). We use the fact that the locations of the homelands resulted from a long historical process beginning in the 18th century (Lapping, 1986), which makes it plausible that, conditional on covariates, their location is quasi-random with respect to economic conditions today. Assuming the subsequent migration outflows from the homelands behave according to some migration cost in distance, we are able to exploit the exogenous variation from this positive migration shock to identify the effect of increased internal migration on the distribution of population in South Africa. In other words, assuming migration costs increase with distance, *ceteris paribus*, a town physically located nearer to a homeland is assumed to have received a larger inflow of previously mobility-restricted black migrants.¹ Hence, while the homelands are crucial to our empirical design, we do not study the development of population within the homelands.

Our main findings are threefold. First, we show that the distance to homelands is a strong predictor of black population growth in the years following the end of apartheid (i.e. our “first stage”). Second, we show that on average, an exogenous increase in population in a town leads to an increase in population by just that amount, in the medium to long run. This suggests that on average, the population distribution follows a path dependent process. Third, we find heterogeneous responses to exogenous

¹Even if the distance cost of migration are small, there would be a distance coefficient if migrants “radiate” from their origin (Rauch, 2016).

population shocks across rural and urban areas. Population levels in areas with initially high population densities experience further agglomeration, i.e. exogenous immigration leads to population growth. Only in rural areas do we continue to find path dependence.² This suggests that a positive exogenous population shock generates a ‘Matthew effect’ (‘those who have will be given’), as densely populated areas gain population relative to sparsely populated areas. We further investigate this heterogeneity by examining how the effect varies with both initial population density and the reduced form magnitude of the shock. For a given initial density, a larger shock leads to higher endogenous population growth. This is consistent with the idea that a significant shock is required to push a locality from its current equilibrium onto a new trajectory. These results imply that policies aiming to foster migration can further trigger urban agglomeration forces in high density areas.

South Africa’s history lends itself to studying our research question and the country maintains excellent census data, both before and after Apartheid. One important limitation of the census data however, is that after apartheid many changes were made to various geographical and other definitions, which limits the comparability of our data before and after 1994, although the population data can be matched with some confidence on a level as fine as wards. Another drawback of our data on the regional level is that it does not identify internal migrants explicitly, so we have to infer differences in migration as differences in population growth conditional on covariates that account for differences in fertility and mortality. A third shortcoming is that no reliable information for population in homelands is available. For our purposes,

²While standard models of trade and urbanization typically do not predict path dependence, recent studies that have found path-dependent behavior for small and medium sized towns include Bleakley and Lin (2012) and Michaels and Rauch (2018).

information from outside homelands is sufficient. Hence we are unable to pinpoint the underlying micro-mechanisms driving our results.

The remainder of this paper is organized as follows. Section 2 details the historical development of South Africa thereby providing evidence for the quasi-random location of the homelands. Section 3 discusses the related literature and introduces the theoretical thought experiment that serves as a framework for the empirical analysis presented in Section 4. The heterogeneous responses to a positive population shock are discussed in Section 5, and section 6 concludes.

2 Historical Background

Around two-thirds of South Africa's total population live in urban areas, making it one of the most urbanized countries in Africa. In the second half of the 20th century, urbanization in South Africa was shaped by the apartheid policy of the National Party government (1948-1994). Apartheid - literally meaning "apart-ness" - was by its very nature a spatial concept (Christopher, 2001). The government aimed to completely separate the black and non-black populations.³ Policies ranged from installing two town hall bathrooms to segregating city quarters and creating native reserves, the so-called homelands (or 'bantustans') that were to become independent states for the black population.

Segregation and mobility restrictions imposed on the black population had a long tradition in South Africa dating back to at least the 18th century (Lapping, 1986). The

³We use the same terminology for racial categories as the census, namely 'Black' or 'African', 'Colored', 'Asian/Indian', and 'White', where the last three categories make up to the 'Non-black' category.

support for apartheid policies in the run-up to the 1948 elections, especially among poor white South Africans, resulted from the increasing black urbanization rate during the preceding decades. These dynamics derived from the expansion of manufacturing and labor shortages resulting from World War II (Ogura, 1996). It was generally believed that the problem of white poverty was linked to increasing black urbanization. The Native Economic Commission (1930-32) provides an example as it explicitly names black urbanization as a cause for greater levels of unemployment among low-skilled white people (Beinart, 2001, p.122). One of the main goals of the apartheid policies was therefore to prevent and reverse black urbanization, or to put it in the words of the Stallard Commission (1922): *'The Native should only be allowed to enter urban areas, [...], when he is willing to enter and to minister to the needs of the white man, and should depart therefrom when he ceases so to minister.'* (Feinstein, 2005, p.152). The policies that took shape after 1948 were therefore unique in aiming to achieve complete spatial and social segregation and were achieved by mobilizing significant government resources and displacing large numbers of black South Africans.

In order to control the movement of the black population, the government restricted blacks' rights to own land and their legal ability to settle where they wished. The literature distinguishes two dimensions of separation, 'urban apartheid' and 'grand apartheid' (Christopher, 2001). Urban apartheid aimed at creating separate quarters for that part of the black population that was allowed to stay permanently in urban areas. Grand apartheid rather aimed at moving the majority of the black population - that was not needed as laborers in white urban areas - to native reserves.

The three main measures to implement 'grand' and 'urban apartheid' were the Group

Areas Act (1950), the Pass Laws Act (1952) and the Population Registration Act (1950). The latter assigned a population group to each citizen, which largely defined an individual's political and social rights. The Group Areas Act assigned a native reserve to each black population group and enabled the government to remove people that were not living in the area assigned to their population group. To control population flows and black urbanization in particular, the government relied on a pass system. The Pass Laws Act forced every black African to carry an internal passport at all times.⁴ If a black African could not present their passport demonstrating their right to be in a particular region, they were subject to arrest.

These strictly enforced laws significantly constrained the distribution of population in space as well as the process of urbanization. According to the Surplus People Project (1985),⁵ the South African government forcefully relocated at least 3.5 million people between 1960 and 1983. Additionally, several hundred thousand arrests were made every year under the pass laws (Beinart, 2001, p.158f). Table 1 displays the share of the black population living in urban and rural areas within South Africa and the homelands from 1950 to 1980. While the proportion living in urban areas in South Africa stayed roughly constant over the three decades, the proportion living in rural areas decreased by around 15%, while the homelands experienced a commensurate increase. These movements resulted in densely populated areas in the homelands that can be defined as urban in terms of population densities, but not in terms of public service delivery or industrial development. This 'dislocated urbanization' (Beinart,

⁴ It built on pre-apartheid legislation including the Natives Urban Areas Act from 1923 and Natives Urban Areas Consolidation Act from 1945, which forced every black man in urban areas to carry passes at all times.

⁵The Surplus People Project was a non-governmental organization that documented forced removals through the apartheid government.

2001), driven by government decisions instead of economic fundamentals, provides evidence of the substantial impact that the apartheid policies had on the distribution of population. Overall, while apartheid policies failed to reverse the level of urbanization of black South Africans, they were able to stop the trend towards increasing urbanization driven by economic growth and instead channel urbanization dynamics away from (white) cities and towards the homelands.

Table 1 shows the share of the population living in urban areas during apartheid by population group. The three non-black population groups were already far more urbanized in 1951 and by 1991 around 90% of the non-black population resided in urban areas. The black population was predominantly living in rural areas in 1951 and urbanized until 1991, but remained significantly less urbanized than the other three population groups. As previously emphasized, this urbanization was heavily influenced by government policies that kept the black population out of urban areas in ‘white’ South Africa and engineered urbanization in the homelands. During the 1990s, urbanization rapidly increased (see Figure 1). Since the non-black population was almost entirely urbanized in 1991, this is evidence of large domestic migration flows of the black population.

Given the historical context, two main concerns arise regarding the proposed research design, which uses distance to the nearest homeland as an instrument for migration. First, that the location of homelands is non-random and that these could have for instance been located nearer to large industrial centers to serve as labor reservoirs. Secondly, that the constraint on internal mobility was binding.

The homelands established under apartheid (see Figure 2) were confined to areas

designated as native reserves under the Native Land Act in 1913. This land comprised 7% of the overall area of South Africa and was already largely inhabited by the black population at the time, as the government was unwilling to expropriate white farmers. Hence the land allocation in 1913 failed to transfer large tracts of land between the different population groups and merely legally consolidated the distribution of land that had emerged predominantly through the European conquest of African land (Neame, 1962, p.40f). Since land was largely conquered for agricultural purposes, the African land reserves were of relatively low quality.

In 1913, South Africa was predominantly an agricultural economy with just two important industries - gold mining around Johannesburg and diamond mining around Kimberley. These industries established a system of migrant labor. Both found it optimal to change their entire workforce on a regular basis - every three to six months - and wanted workers' families to remain in reserves. This allowed firms to pay low wages since the workers' families were supposed to find alternative work in the reserves (e.g. subsistence farming) which also reflected the (very low) opportunity cost of the worker. Additionally, they were able to send sick or injured workers back to the reserves where their tribe would take care of them (Lapping, 1986, p.26). This suggests that there was no need for specifically located labor reservoirs when the homelands were established. Therefore, no significant economic considerations appeared to have motivated the location of homelands, except for perhaps agricultural factors.

The 1936 Land Act and subsequent Government initiatives aimed at consolidating native territories to make them viable as independent states. There were no attempts to relocate them for economic reasons. One possible economic reason would be the proximity

of cheap labor. Instead of relocating the homelands, the government created black townships such as Soweto to serve as labor reservoirs. If a homeland was conveniently located, many inhabitants commuted to work in white cities (KwaMashu and Umlazi in the homeland KwaZulu provide an example). There were therefore no incentives to relocate homelands as alternative ways to increase the pool of cheap labor proved more convenient.

A second concern when analyzing the switch from the constrained equilibrium for the black population under apartheid to the unconstrained equilibrium, is whether this constraint was binding. There are several observations that suggest that the constraint was indeed binding and that the switch to an unconstrained equilibrium was a significant shock to the distribution of population. First, the homelands were much poorer than other parts of South Africa. In 1985, GDP per capita in the homelands varied between 600 and 150 Rands, an order of magnitude below the 7,500 Rand estimated for the rest of South Africa (Christopher, 2001, p.93). Secondly, while more than 90% of whites and Indians lived in urban areas in 1986, less than 60% of blacks did, and we observe a large jump in urbanization starting in the 1990s. Thirdly, while keeping blacks out of urban areas was one of the major goals of apartheid policy, the absolute level of the black population in 'white' urban areas nevertheless increased. This suggests that strong urban attraction pulled blacks into urban areas, while apartheid reduced the rate of urbanization (Feinstein, 2005, p.157).

3 Related Literature

This paper relates to a number of literatures, in particular to the increased interest in cities and urban planning from the perspective of economic development. While urbanization already plays a central role in many of the seminal contributions in the early development economics literature (see for example Lewis (1954), Ranis and Fei (1961), Harris and Todaro (1970)), there have been a number of recent empirical and theoretical contributions studying the determinants of urbanization, as well as its effect on economic growth. Recent work by Henderson (2005) suggests that urban growth may be a necessary condition for GDP growth. Potts (2012) and Gollin et al. (2016) draw upon census data and economic theory to show the importance of natural resources as a determinant of city sizes in Africa, and raise questions about differences between urbanization in Africa and elsewhere.

We add to this literature by studying how the urban system in South Africa reacts to an exogenous population shock. The main policy question we address here is the degree to which population flows within a country can be managed in the medium to long run. To illustrate this policy question, consider a town of initial population N_0 , in a country with no population growth, that is given an exogenous population increase of Δ to $N_0 + \Delta$ people. There are only three ways in which the population of this town can respond in the long run. First, there could be mean reversion to the original relative population level, such that the long run population is smaller than $N_0 + \Delta$. Secondly, there could be a random walk process that generates path dependence, such that the long run expected value of the size of the town is now $N_0 + \Delta$. Thirdly, it could be that the additional population generates agglomeration effects and triggers a process in

which it gains a long run population greater than $N_0 + \Delta$.

These three possibilities can be captured in an economic model following Henderson (1974), as demonstrated recently by Bleakley and Lin (2015). Let us consider a simple version of these models here to illustrate the key point.

In this model, agents derive utility from locating in particular areas. In equilibrium, there cannot be any gains from mobility, such that the utilities of all agents have to be equal across locations. Utility stems from the difference between the agglomeration ($A(N)$) and the congestion cost ($C(N)$) curves that are both functions of population density (N).⁶ Spatial utility in region i is defined as: $U(N^i) = A(N^i) - C(N^i)$. The agglomeration curve summarizes the consumption gains from a greater number of varieties as well as higher wages resulting from productivity gains due to agglomeration effects. The congestion cost curve is determined by rents and commuting costs. The population allocation equilibrium is determined by the indifference condition that the spatial utility from locating in a certain area has to be equalized across all K areas: $U(N^1) = \dots = U(N^K)$. When assuming a particular functional form for one of the two functions, we can infer characteristics of the shape of the other function from the three hypotheses outlined above.

There are no intuitive guidelines as to the shape of the agglomeration curve as a function of population density $A(N)$. The agglomeration function could be non-monotonic, as new industries emerge to replace others when the population level crosses some threshold. This could result in significant changes in the structure of the local economy. For the congestion cost curve $C(N)$ on the other hand, given finite space, it is plausible to

⁶In the context of this stylized model, we use changes in the population level and changes in population density interchangeably, since we consider a fixed amount of space.

assume that it is increasing ($C'(N) > 0$) in population density, convex ($C''(N) > 0$) and tending to infinity after a certain population density threshold has been reached ($\lim_{N \rightarrow \bar{N}} C(N) = \infty$). Given these assumptions on the congestion cost function, different shapes for the agglomeration function follow from the three hypotheses outlined above.

The definition of equilibrium implies that the utility across locations has to be equal before the shock hits.⁷ Population movements reacting to the exogenous shock again have to equalize the utility across locations to attain a new equilibrium. In the empirical analysis, all areas are treated by a population shock with varying intensities that depend upon their geographical proximity to the homelands. The utility level in the initial equilibrium is denoted by $U(N_0)$. $U(N_S)$ is the utility level after the shock and $U(N_1)$ is the utility level of the new equilibrium after agents have adjusted their location decisions. By the definition of equilibrium, $U(N_0)$ and $U(N_1)$ have to be equal across all locations (treated and control), while $U(N_S)$ is not related to an equilibrium and can therefore vary across locations.

The population level mean reverts (Panel A in Figure 3)⁸ if the utility at the new population level $U(N_S)$ is below the utility in the initial equilibrium $U(N_0)$ that can be attained in the untreated areas. Agents move from treated areas to the control areas until the utilities are equalized across both types of locations $U(N_1^T) = U(N_1^C)$. This leads to a reduction of population below N_S . This implies that the slope of the agglomeration function has to be locally shallower than the slope of the congestion cost function. The

⁷We are implicitly assuming that ‘white’ South Africa was in spatial equilibrium before the positive population shock. However, this is obviously not the case given ‘urban apartheid’ and the movement restrictions imposed on the non-white population within South Africa. Since these restrictions were in place in all of ‘white’ South Africa they are orthogonal to the population treatment and so we abstract from them in the model for simplicity.

⁸Note that the graphs only display the evolution of population in treated areas.

evolution of population is path dependent (Panel B) if the utility at the population level after the shock is equal to the utility in the initial equilibrium $U(N_0) = U(N_S)$. This implies that there are no gains from moving between control and treatment areas and that therefore there is no endogenous adjustment of location decisions, such that the new population level is an equilibrium population level: $N_S = N_1$. Since the difference between the agglomeration and congestion functions at N_0 is equal to the difference at N_S , the slopes of the two functions between N_0 and N_S have to be equal. If this property holds globally, then there are infinitely many equilibria of the spatial distribution of population. In the case of agglomeration (Panel C), agents move from control areas to treated areas. This implies that gains from migration exist, such that the utility level after the shock has to be greater than the utility in the initial equilibrium: $U(N_0) < U(N_S)$. Utility could not be strictly increasing in population between N_0 and N_S however, because that would imply the existence of gains from migration at N_0 . The existence of such gains would contradict the definition of an equilibrium, such that N_0 could not be an equilibrium. For N_0 to be an equilibrium therefore, utility has to be non-monotonic, implying the existence of multiple equilibria for the spatial distribution of population. In order for the utility function to be non-monotonic, the slope of the agglomeration function has to be non-monotonic.⁹ This model demonstrates the three possible cases between which we aim to distinguish in this paper. Since the *local* slope of agglomeration and congestion function determine which case applies, the model also suggests that the reaction might be different at towns of different initial population densities and motivates us to study heterogeneity along this dimension. It is clear that understanding the slope of these curves is of central importance to policy makers trying

⁹Note that the functional form displayed in Panel C is just one example of a broad class of possible agglomeration functions. In particular, it is not necessary for the slope of $A(N)$ to be locally negative for the existence of multiple equilibria.

to adjust the size of cities and towns.

This setup relates to a large empirical literature that studies how exogenous shocks to cities affects the long-run development of affected areas. Studying the population of Japan, Davis and Weinstein (2002) find that population tends to mean-revert after a shock thereby concluding that location fundamentals play an important role. Studies by Brakman et al. (2004) for post-war Germany and by Miguel and Roland (2011) for Vietnam arrive at similar results using destruction resulting from wars. Bleakley and Lin (2012) analyse path dependence by studying the development of towns that experienced a negative shock to their fundamentals. Their main result is that former portage cities maintained their historical importance, a finding consistent with recent results from local positive population shocks from German refugees after World War II that were highly persistent and could not be explained by location fundamentals (Schumann, 2014). Using the same natural experiment, Peters (2017) shows that income per capita, overall manufacturing employment and the entry of new plants are positively correlated with refugee inflows in Germany after World War II.

We contribute to this literature in several ways. First, our study is the first to analyze a large scale and indeed positive population shock. The aforementioned studies analyzing the effects of war, find evidence of path-dependence but cannot isolate whether this is driven by natural fundamentals, sunk investments, social networks, capital unaffected by shocks, or gains from agglomerations. Bleakley and Lin (2012) provide evidence that it is not driven by location fundamentals, but cannot distinguish between other factors. Since we analyze a positive population shock in which incoming migrants have neither social networks nor private sunk investments, we are able to isolate the effect of gains

from agglomeration. Second, we provide evidence from a credible natural experiment that is well-identified and are able to draw upon a much larger sample in comparison with most studies in this literature. Third, we are the first to provide evidence from Africa, a region that is amongst the most rapidly urbanizing regions in the world, the continent in which such policies related questions matter most. Fourth, many of the previous studies focus solely upon urban areas, whereas we are able to look at both rural and urban areas and the differences between the two.

There are other studies that exploit the exogenous variation resulting from apartheid policies to study the development of South Africa after 1994, see for example de Kadt and Sands (2016), de Kadt and Larreguy (2018) and Dinkelman (2011, 2017). We are the first to use this natural experiment to study the causal economic effect of internal migration and how it effects the distribution of population across space. This paper, thereby, adds quasi-experimental evidence to the literatures that examine the determinants of the uneven distribution of population across space and the relationship between city size and population growth (e.g. Black and Henderson (2003), Eeckhout (2004), Duranton (2007), Rauch (2013) and Rossi-Hansberg and Wright (2007)). After Auerbach (1913) observed that the size distribution of cities follows a power law, there have been many attempts to explain this persistent empirical regularity (often referred to as Zipf's Law, after Zipf (1949)). Following the theoretical work by Gabaix (1999) who showed that Zipf's Law emerges naturally if cities have equal relative growth rates (Gibrat's Law), an extensive empirical literature on the distribution of population has developed. The majority of empirical studies find urban systems tend to obey Gibrat's Law and that city size is uncorrelated with population growth, while others find departures from Gibrat's Law even for cities (Soo (2007), González-Val et al. (2013), and

Holmes and Lee (2010)). Michaels et al. (2012) emphasize the importance of structural transformation for urbanization. In their long-run study of population growth in the United States from 1880 to 2000, they find that areas with high initial population density obeyed Gibrat’s Law, i.e. subsequent population growth was uncorrelated with initial population density. Our research contributes to this literature by demonstrating the heterogeneous reaction of towns of different size to a population shock.

4 Empirical Analysis

Data

In order to empirically test the three hypotheses, we make use of a unique geographically referenced South African census dataset. It contains observations for the years 1991, 1996, 2001 and 2011 at the ward level and hence bridges across the democratic transition in 1994. This dataset consists of two parts. First, it contains publicly available census data aggregated to the ward level for the censuses in 1996, 2001 and 2011 provided by Statistics South Africa. This allows us to distinguish between the short-, medium- and long-run effects of the exogenous population shock. Secondly, it contains data from the last census under the apartheid government in 1991. De Kadt and Sands (2016) matched a partial enumerator area map from the census in 1991 with the 100% sample of the individual level census data made available by DataFirst at the University of Cape Town and aggregated it to the 2011 ward level. This last census was implemented in March 1991. This timing is crucial as the Native Land Act, the Population Registration Act and the Group Areas Act were repealed in June 1991.

While the Pass Laws Act had already been repealed in 1986 and although identification would be cleaner if data from before 1986 were available, this timeline does not pose a major threat to our identification strategy. This is because the Group Areas Act and the Population Registration Act were still in place, and as such the black population was still severely constrained in its choice of residence until June 1991.¹⁰

Identification

Distance to the nearest homeland is used as an instrument for migration flows in order to causally identify the effect of migration on population distribution. Figure 4 shows that the relationship between this distance and population growth between 1991 and 2011 is strongly negative, both at short and longer distances. In this figure we pool neighboring observations into discrete bins to improve clarity. We specify 100 bins in total, which puts around 20 observations into each bin. The log linear specification seems a good fit for the data. The validity of the instrument relies on the conditional quasi-random allocation of homelands, which has been argued for in Section 2. The assumption may be violated for areas adjacent to the homelands however, as they are likely to be affected by economic spillovers from the neighboring homeland in a variety of ways that are not related to the cost of out-migration from the homelands. To adjust for this problem, we exclude areas within 10 km from the homelands as a robustness

¹⁰The data from 1991 does not cover the entirety of South Africa. One general drawback of the dataset is that it does not cover the homelands. This does not affect the analysis since we only look at areas outside the homelands. Another more relevant drawback is that there are a few areas that are not covered within South Africa (see Figure 7 in appendix B). This is due to two reasons. First, Statistics South Africa only has a partial map of the census enumeration areas in 1991. Therefore, part of the census data cannot be geographically referenced. Secondly, due to violent turmoil at the time, some areas could not be visited by enumerators and no data are available on a granular level. This is potentially beneficial for our analysis since we exclude areas with high racial tension, which could otherwise bias our results. So, while this reduces the number of observations and therefore the statistical power in the empirical analysis, our parameter estimates will remain consistent.

check to ensure that the estimates are not driven by local economic spillovers.

For our instrument to be informative, the cost of migration has to increase substantially with distance, which would imply that a town located nearer to the homelands *ceteris paribus* receives more migrants than a town further away. This assumption, consistent with the gravity framework, is a common assumption in the migration literature and the informativeness can be tested empirically by looking at the partial correlation between the instrument and the endogenous variable.¹¹ The informativeness of distance as an instrument crucially depends upon the level of fixed effects chosen, which affects the variation in the data. As shown in Table 9 in appendix B, the informativeness of the instrument decreases almost monotonically in the granularity of the fixed effects.¹² A trade-off therefore exists between accounting for local unobservables and retaining sufficient identifying variation, in order to ensure that our instrument remains informative. We include province level fixed effects in order to account for different trends and policies across provinces while allowing for sufficient spatial variation.¹³

Estimation

To estimate the causal effect of migration on the distribution of population, the following system is estimated using two-stage least squares (2SLS):

¹¹For example, Peri (2012) uses distance to the Mexican border as an instrument for the intensity of migration to different US states.

¹²This is intuitive, since for example when using municipality level fixed effects, the identifying variation of the instruments explains in which part of Johannesburg migrants are going to settle. This is likely to be uncorrelated with distance to homelands especially for urban areas.

¹³Provinces are equivalent to states in the US.

$$\Delta N_{i,t-1991}^B = \alpha_2 + \log(\text{distance}_i)\pi + \mathbf{X}_{i,1991}\gamma_2 + \delta_p + \nu_m \quad (1)$$

$$\Delta N_{i,t-1991} = \alpha_1 + \widehat{\Delta N_{i,t-1991}^B}\beta + \mathbf{X}_{i,1991}\gamma_1 + \delta_p + \epsilon_m \quad (2)$$

where $\Delta N_{i,t-1991}$ denotes overall population growth in ward i between 1991 and t and $\Delta N_{i,t-1991}^B$ denotes black population growth.¹⁴ Our controls include: population groups, population density, education, the gender ratio, employment and income ($\mathbf{X}_{i,1991}$) and province-level fixed effects (δ_p) (see Table 2). The errors are clustered at the municipality level.¹⁵ The ward level is the lowest geographical level that can be tracked consistently over time and municipalities are the lowest level of local government. Distance is defined as the distance to the nearest homeland measured from centroid to centroid. Since no measure of domestic migration is available in the census data, black population growth conditional on fixed effects and covariates is used as a proxy for black migration.¹⁶ A dummy variable for Cape Town is also included as the municipality is a special case in terms of location, politics and demographics and hence migration patterns. The Western Cape was the only province where the African National Congress did not come first in the general elections in 1994. Until today, it has not achieved the political dominance in the province or the municipality of Cape Town that it has in the rest of the country. In terms of demographics, there is a much higher white and especially colored population in Cape Town, more than anywhere else in the country. Most importantly, there is a

¹⁴ $\Delta N_{i,t-1991}^B$ is defined as absolute growth of the black population from 1991 to year t divided by the overall population in t , where t corresponds to 1996, 2001 or 2011. $\Delta N_{i,t-1991}$ is defined similarly using overall instead of black absolute population growth.

¹⁵Using Conley (1999) standard errors to account for spatial correlation yields similar results.

¹⁶As has been used previously as a proxy for migration status, see for example Czaika and Kis-Katos (2009).

lot of circular migration from the Eastern and the Northern Capes into Cape Town. These migration dynamics potentially distort our identification strategy such that we include a dummy for Cape Town, which significantly increases the predictive power of our instrument. The results are robust to not including a dummy for Cape Town.

Linking theory and the variable of interest in the empirical estimation

In order to test the three competing hypotheses outlined in Section 3, it proves crucial to link the predictions from the hypotheses to the parameter of interest β . If the underlying process was driven by mean reversion, then the effect of the exogenous population shock as measured by β would be less than one and decreasing over time, as the shock dissipates through the urban system. In the case of path dependence, β would be expected to be equal to one in all periods. In the agglomeration scenario, β would be significantly greater than one.

In order to assign these theoretical interpretations to the estimated parameters, we have to avoid using percentage growth rates in the endogenous variable and in the dependent variables in the second stage. Using percentage growth would make the shock a function of the share of black population that already lives in the area, which makes the interpretation we are looking for impossible. Therefore we instead define our variables of interest as absolute growth rates relative to the overall population in period t where t corresponds to 1996, 2001 and 2011. We incorporate this normalizing factor since the size of the population shock should be measured relative to the overall population rather than in absolute terms to get a good understanding of its impact.

Pre-trends

Given the empirical setting of this exercise we expect the population growth effects to take place after 1994, but not before. A natural test is to see if indeed population growth is independent of the distance to homelands before 1994. Our dataset does not cover any year other than 1991 in the period pre-1994, and so we can't use it for this purpose. Instead we use the Dysturb dataset (Giraut and Vacchiani-Marcuzzo, 2013), a dataset that maps population in comparable units over time in South Africa. Dysturb provides data at two different levels of aggregation, 'urban agglomeration' (UA) and 'magisterial district' (MD). We use the UA dataset because unlike the MD the units used here are defined consistently over time. In Table 3 we regress population growth on the distance to homelands variable. In columns 4, 5 and 6 we control for initial population, in the first three columns we do not. In columns 1 and 4 we use all units with non-missing data in 1980 and 1991. In columns 2 and 5 we use all units with non-missing data in 1991 and 2001. In columns 3 and 6 we use all units with non-missing data in 1980, 1991 and 2001 to make sure the difference in coefficients between columns is not driven by sample selection. The table shows that we find the expected negative correlation between distance to the homeland and population growth for 1991-2001, but not for 1980-1991.

5 Results

Baseline results

Table 4 summarizes the main results and Table 5 provides further results from different sub-samples as robustness checks. Each cell of the tables summarizes one regression.¹⁷

Before moving on to interpreting the estimated coefficients of interest, we will discuss a number of results. The Angrist and Pischke (2009) F-statistic of the first stage is well above the rule of thumb threshold of 10 for all specifications for the medium and long horizon.¹⁸ Weak instrument problems only arise for the short period between 1991-1996 and we will not discuss these parameter estimates. The increased explanatory power over the longer time horizons is consistent with the fact that migration decisions only adjust intermittently to a change in policy, such as the end of apartheid.

In the OLS regression (Table 4, Column 1), we cannot reject the null hypothesis that the coefficient is different from one in the short-run (1991-1996). For the two subsequent periods on the other hand, the coefficient estimates are well below one. This suggests that black population growth occurred in areas with low population growth of the incumbent population and vice versa, since if there was no reaction by the incumbent population an increase in population by one would lead to a coefficient of one mechanically. These results should not be assigned a causal interpretation however, since the result could be driven by unobserved shocks that induce black in-migration and white out-migration or vice versa jointly. The baseline results from the two-stage

¹⁷I.e. each cell in the first row of Table 4 summarizes the causal partial effect of exogenous migration of black population between 1991 and 1996 on the overall population growth rate between 1991 and 1996.

¹⁸The corresponding first stage regressions for Tables 4 and 5 as well as the other main tables shown here are reported in the online appendix.

least squares estimation suggest that the coefficient is not different from one at any horizon such that there is no causal effect from exogenous black migration on aggregate migration decisions of non-black incumbents. This is evidence that an exogenous population shock is absorbed without an endogenous reaction of the population level. The results suggest that the effect of an exogenous population shock on the aggregate long-run equilibrium of the population distribution is consistent with the theoretical notion of path-dependence (Hypothesis 2). We note that coefficients estimated for 1991-2001 and 1991-2011 are not statistically different from one another, which could suggest that the migration transition period had converged to a new steady state not long after 2001.

In addition to the baseline regressions, we report several regressions based on different sub-samples as robustness checks (Table 5). We include a dummy for Johannesburg in Column 1 as the largest metropolitan area and industrial center to ensure that it is not driving the results. In Column 2 we remove the dummy variable for Cape Town that we usually include, which does not significantly affect results. In Column 3 we include separate fixed effects for all the metropolitan areas in our sample, which again does not seem to change our results significantly. As outlined above, we exclude areas close to the homelands, since for these localities, distance to the nearest homeland could affect them not only through migration, but also through local economic spillovers (Column 4). We also exclude areas with a low white population share in 1991 because the migration restrictions under apartheid might have been less binding for these areas (Columns 5 and 6). As a further robustness check, we exclude the areas in the upper tail of the distance distribution in Column 7 to ensure that the high number of observations in the upper tail of the distance distribution does not skew the results. In Column 8 we

report results using district instead of province fixed effects. We also aggregate wards up to the municipality level and run a separate regression to test whether the results are robust to using a different level of aggregation (Column 9). These robustness tests using different sub-samples as reported in Table 5 corroborate our baseline findings since none of the coefficients significantly deviates from one. When comparing the timing of the effect, both the coefficients and statistical power seem fairly similar for the periods 1991-2001 and 1991-2011. The short run result for 1991-1996 is weaker, both in the first stage statistical power and in the magnitude of the second stage result. This might suggest that the migration took longer than the first year after apartheid to converge, while the new equilibrium was largely reached by 2001, and so did not change to 2011.

One concern is that fertility or mortality differences may influence these results. To investigate these concerns we repeat the entire exercise from in Table 5 for people of working age population only. These results are in Table 6. Here we define working age as the population that is aged between 15 and 64. All coefficients are similar to their counterpart in Table 5.

In our main regressions we measure population growth on the right hand side in the same time period as on the left hand side. This may be measured with noise if the incumbent population only reacts to the population shock with a lag as opposed to instantaneously. In order to make sure that these potential dynamics do not distort our results, we test for them in an alternative specification. Table 7 reports the result of a specification where we run the first stage for black population growth for the period 1991 to 2001 and the second stage for overall population growth for the period 2001 to 2011. Intuitively, this regression picks up whether an exogenous population shock

during the period 1991 to 2001 affects overall population growth in the subsequent period. In this specification a coefficient equal to 0 indicates path dependence while a coefficient smaller or larger than 0 indicates mean reversion or multiple equilibria. The fact that none of the coefficients in Table 7 is significantly different from 0 indicates that the dynamic response is also consistent with path dependence.

Overall, the empirical results provide strong evidence for path dependence (Hypothesis 2). These results suggest that, in the aggregate, there is no evidence for multiple equilibria and a non-monotonic agglomeration curve or mean-reverting behavior. The evidence in favor of path-dependence is consistent with an agglomeration function that has the same slope as the congestion function or high costs of migration as found by Imbert and Papp (forth) for temporary labor migration in India. This corroborates the dynamics found by Bleakley and Lin (2012) for fall line cities in the US and Michaels and Rauch (2018) for Roman cities in France and Britain.

Heterogeneity

This Section discusses how the causal effect of migration on population growth varies across two dimensions, the initial population density or level of urbanization of an area, and the size of the exogenous population shock.

First, we are interested in how the causal effect varies with initial population densities. In this case, theory does not provide clear guidance. Due to the convexity of the cost curve, the causal effect of migration could be decreasing in initial population density because the additional costs generated by new migrants reduce the utility level of

incumbents. At the same time, Michaels et al. (2012) show that long-run population growth in the US is smaller for low initial population densities and increases with population density after a cut-off of 7 people per km². Such a result would be consistent with an agglomeration curve that is much steeper in urban than in rural areas. This could suggest that in densely populated areas, exogenous migration leads to a larger increase in population than in less densely populated areas.

In order to estimate how the effect of a positive population shock varies across initial population densities, we define dummy variables for high initial population densities and for high initial shares of urbanized households. The results reported in Table 8 show that there is a positive and significant interaction between high initial densities and population shocks. This suggests that areas with high initial densities experience a significant endogenous inflow of population as a reaction to the exogenous population shock while others do not. This effect exists in the medium and long-run but is economically stronger in the medium run for population density. It loses significance in the long-run for the share of urbanized households. The results of both specifications indicate that the population dynamics induced by a positive population shock differ between less densely populated rural areas and highly populated urban areas. While we cannot reject path dependence for rural areas, there is a significant and positive effect in urban areas suggesting that an exogenous population shock leads to endogenous immigration. This is suggestive evidence for the existence of multiple equilibria within urban areas.

We show the effects graphically in Figure 5, which corresponds closely to Panel C in Table 8. We aggregate observations into bins to increase clarity, we specify 100 bins

in total for each of the two plots. While low density places show no reaction to the migration shock, and so follow path-dependence, in high density places we see evidence of agglomeration economies: Inflows of people lead to the rest of the population to positively react.

We next consider the size of the population shock as an additional dimension of heterogeneity. So we estimate how overall population growth varies with the size of the shock and initial population density. In order to do so, we combine the deciles of the two distributions and estimate 100 distinct conditional means:

$$\begin{aligned} \Delta N_{i,2011} = & \sum_{j=1}^{10} \sum_{k=1}^{10} \beta_{j,k} \left[1[\text{if } Popden_{i,1991} \text{ in decile } j] \times 1[\text{if } distance_i \text{ in decile } k] \right] \\ & + \gamma' X_{i,1991} + \delta_p + \epsilon_m \end{aligned} \quad (3)$$

The $\beta_{j,k}$ s are the coefficients of interest and estimate how conditional population growth varies by the deciles of the initial population density distribution and the size of the shock distribution. The size of the shock is measured using the reduced form, i.e. distance to the nearest homeland. While the estimates do not provide the same clear cut causal evidence as the two stage least squares approach they are indicative as to how the effect of the exogenous population shock varies with the size of the shock and the initial density. The results displayed in Figure 6 suggest that for a given initial density an increase in the size of a shock results in a higher population growth rate. This is in line with the idea that it requires a substantial shock to switch between equilibria.

The fact that the population of more densely populated areas increases relative to less

densely populated areas could be interpreted as a ‘Matthew effect’¹⁹ of an exogenous population shock, where areas rich in population gain over-proportionally from a positive population shock.

In the context of the modified Henderson model presented in Section 3, this result suggests that the shape of the agglomeration function is different between urban and rural areas for the relevant population levels. In rural areas, the gains from agglomeration are below the increased congestion cost if the population increases exogenously. In urban areas, the gains from an increase in population seem to be equal to the additional costs. The gains from agglomeration therefore seem to be much larger in urban areas than in less densely populated rural areas.

While the simple model easily accommodates this heterogeneity in the agglomeration and congestion cost curves across different initial population densities, it remains silent on its origin. There a number of ways this heterogeneity can be microfounded. Such an agglomeration function emerges naturally in a two-sector economic geography model or labor market models that distinguish high- and low-skilled workers with different production technologies in urban and rural labor markets. Consider a simple economic geography model where the agricultural sector produces food using a fixed endowment of land and labor under a technology with decreasing returns to labor. The industrial sector, consisting of manufacturing and services, produces consumption goods using capital and labor with external agglomeration economies. Labor is perfectly mobile across sectors and locations. Areas with low population densities are predominantly agricultural, while urban areas are predominantly industrial. If an exogenous population

¹⁹‘For unto every one that hath shall be given, and he shall have abundance: but from him that hath not shall be taken even that which he hath.’ Matthew 25:29, (American Bible Society, 1999).

shock hits both urban and rural areas, the marginal product of labor decreases in rural areas and generates displacement effects because the real wage decreases. This dynamic arises naturally from the assumption that there is only a fixed amount of land available for agricultural production. In urban areas, an increase in the labor force generates higher investment in capital (assuming a constant real interest rate set in world markets). Therefore, the marginal product of labor does not fall and might even increase due to external economies of scale. This generates agglomeration effects or a path-dependent evolution of population in urban areas.

A similar result emerges in a standard model used in the migration literature (e.g. Borjas (1999) and Kremer and Watt (2006)) that distinguishes between low- and high-skilled labor used in production in urban areas. The production in rural areas only uses low-skilled labor and the fixed amount of land as inputs with the same technology as above. In urban areas, low- and high-skilled labor are used as complements in production with a constant returns to scale technology. In this framework, the population shock we analyze in the data is best approximated by an increase of unskilled labor, since the apartheid government only provided a bare minimum of schooling to the black population (Feinstein, 2005, p.159f). In the model, an increase in unskilled labor increases the wage for high-skilled labor and the rents for capital. If the supply of capital is elastic, this leads to an increase in capital and an inflow of skilled workers such that all factor prices return to their initial equilibrium values. Therefore, an exogenous increase in the number of unskilled workers attracts skilled workers such that the population level of urban areas experiences agglomeration and a shift towards a new equilibrium.

6 Conclusion

We study the effect of an exogenous migration shock generated by the abolition of migration restrictions for the black population on the distribution of population in South Africa. There are three ways in which an area can react to an exogenous population shock that arise from different theories describing the distribution of population in space. The population level of an area could mean revert towards its initial level, it could remain at the new population level (path dependence) or it could grow further, i.e. agglomerating population, suggesting the existence of multiple equilibria. The empirical results presented in this paper suggest that in the aggregate, the reaction of the population level to an exogenous population shock is consistent with path dependence. This potentially has important policy implications. If the population level of a region is path dependent, a temporary policy measure that induces migration can permanently change the distribution of population.

Additionally, we find that the reaction of an area to an exogenous population shock varies with the initial population density. In rural areas with low initial population densities, the effect of an exogenous population shock is significantly smaller than in urban areas with high population densities. In urban areas, the dynamics of the population level are consistent with agglomeration. We provide evidence that for a given initial population density a larger exogenous population shock leads to more endogenous immigration. In the context of the modified Henderson model, this result shows that the agglomeration curve in rural areas is much more concave than in urban areas and it also suggests that its slope is non-monotonic. These results are consistent with a simple economic geography model in which production in rural areas features

decreasing returns to labor due to a fixed endowment of land usable for agricultural purposes. A steeper agglomeration function in urban areas also emerges in a standard model from the migration literature that features complementarities between low- and high-skilled labor in urban, but not in rural areas. If an exogenous population shock hits both rural and urban areas, these differing dynamics increase the share of the population living in cities.

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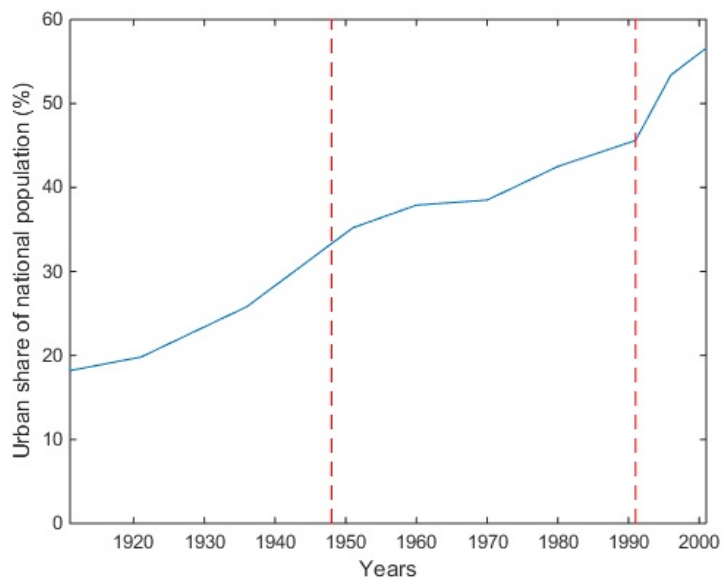
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A Tables and figures

A.1 Figures

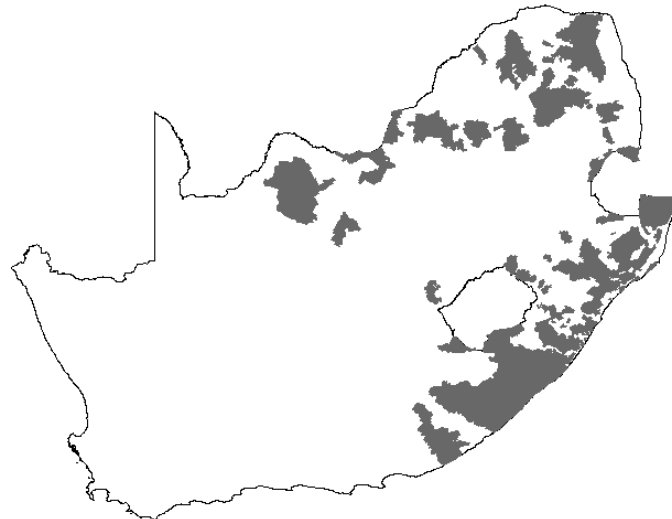
Figure 1: URBAN SHARE OF THE NATIONAL POPULATION (PERCENT), 1911-2001



Source: Authors' own work based on data from Turok (2012).

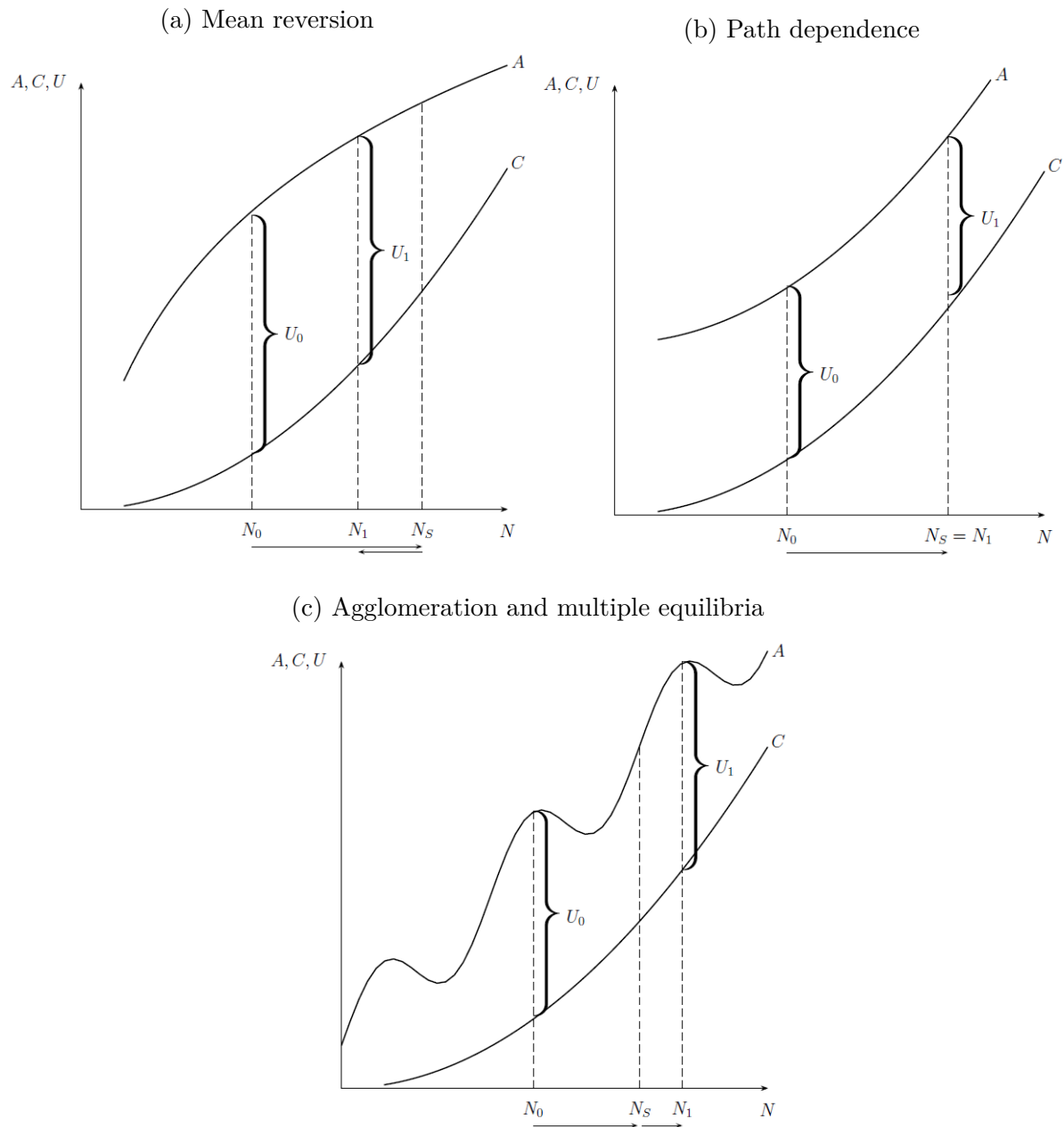
Note: Vertical dashed lines mark the apartheid regime of the National Party (1948-1991)

Figure 2: HOMELANDS (BANTUSTANS) ESTABLISHED UNDER APARTHEID



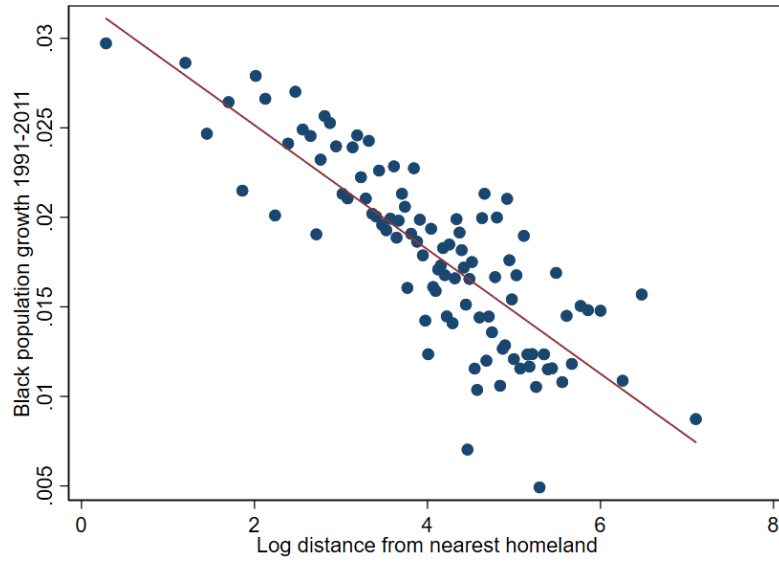
Source: Authors' own work. Bantustan boundary data from the Directorate: Public State Land Support via Africa Open Data

Figure 3: MODIFIED HENDERSON MODEL WITH GAINS FROM AGGLOMERATION AND CONGESTION COSTS



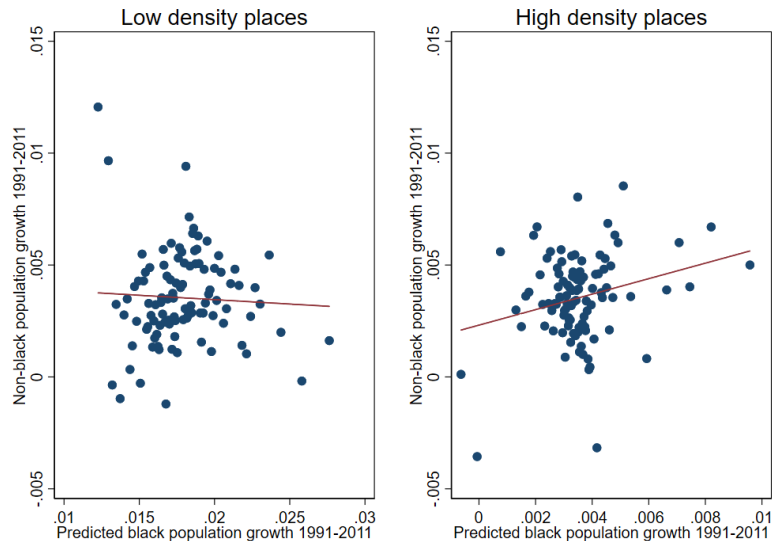
Source: Authors' own work.

Figure 4: FIRST STAGE



Note: Relationship between distance to the homelands and black population growth, conditional on controls for education, income, population group, population density and employment in 1991 and province fixed effects. Data are collapsed into 100 bins, representing roughly 20 wards each.
Source: Authors' analysis based on South African census data.

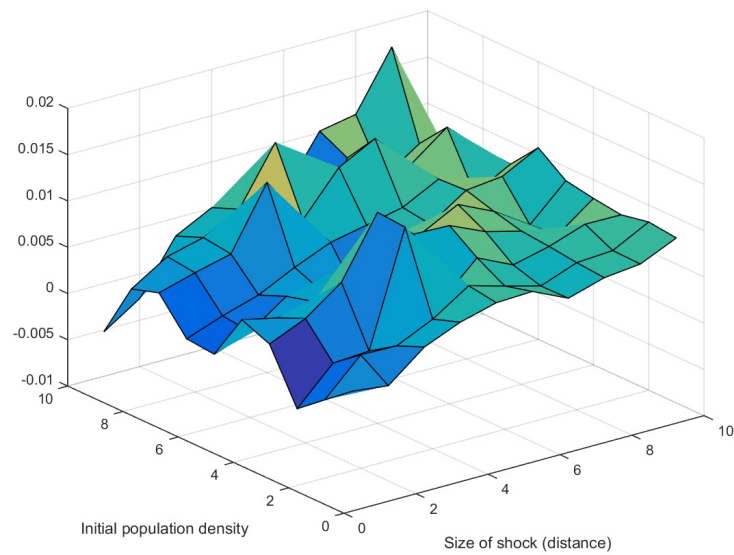
Figure 5: POPULATION REACTION FOR HIGH AND LOW DENSITY PLACES



Note: The figure displays the relationship between the predicted growth in the black population between 1991 and 2011 and its impact on non-black population growth over the same period, distinguishing between initially low and high density locales. These results are analogous to the results in Panel C of Table 8.

Source: Authors' analysis based on South African census data.

Figure 6: THE EFFECT OF INITIAL DENSITY AND SIZE OF SHOCK FOR POPULATION GROWTH



Note: This figure displays the $\beta_{j,k}$ coefficients resulting from estimating equation (3) in the main text. The size of the shock increases along the x-axis. It starts off with the highest decile of the distance distribution going to the decile with the lowest values (i.e. those closest to a homeland). Similarly, the first value on the y-axis corresponds to those wards in the lowest decile of the initial population density distribution while the last one contains the highest decile. The z-axis displays differences in the conditional mean of population growth in the period 1991-2011.

Source: Authors' analysis based on South African census data.

A.2 Tables

Table 1: DESCRIPTIVE STATISTICS ON THE POPULATION DISTRIBUTION (IN PERCENT)

Distribution of black population across area types				Share of urbanised population across population groups				
Year	Urban	Rural	Homelands	Year	White	Colored	Indian	Black
1950	25.4	34.9	39.7	1951	78	65	78	27
1960	29.6	31.3	39.1	1960	84	68	83	32
1970	28.1	24.5	47.4	1980	88	75	91	49
1980	26.7	20.6	52.7	1991	91	83	96	58

Source: Surplus People Project (1985, p.18)

Table 2: SUMMARY STATISTICS OF INCLUDED VARIABLES

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
EXCLUDED INSTRUMENT					
log distance	2,093	4.092	1.564	0.0529	6.746
ENDOGENOUS VARIABLES					
Δ Black Population (1991-1996)	2,093	-1.081	20.75	-615.4	0.200
Δ Black Population (1991-2001)	2,093	0.0310	0.0381	-0.200	0.100
Δ Black Population (1991-2011)	2,093	0.0179	0.0207	-0.168	0.0499
DEPENDENT VARIABLES					
Δ Total Population (1991-1996)	2,093	-1.787	29.81	-829	0.200
Δ Total Population (1991-2001)	2,093	0.0348	0.0417	-0.358	0.1000
Δ Total Population (1991-2011)	2,093	0.0214	0.0213	-0.168	0.0500
Δ Nonblack Population (1991-1996)	2,093	-0.709	18.51	-773.8	0.192
Δ Nonblack Population (1991-2001)	2,093	0.00380	0.0211	-0.294	0.0960
Δ Nonblack Population (1991-2011)	2,093	0.00354	0.00989	-0.0669	0.0425
PROVINCE FIXED EFFECTS					
Eastern Cape	2,093	0.100	0.301	0	1
Free State	2,093	0.0994	0.299	0	1
Gauteng	2,093	0.172	0.378	0	1
KwaZulu-Natal	2,093	0.145	0.352	0	1
Limpopo	2,093	0.0674	0.251	0	1
Mpumalanga	2,093	0.102	0.302	0	1
North West	2,093	0.0726	0.260	0	1
Northern Cape	2,093	0.0717	0.258	0	1
Western Cape	2,093	0.170	0.375	0	1

Source: Authors' analysis based on South African census data.

Table 2 - continued

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
CONTROL VARIABLES (FROM 1991 CENSUS IN LOGS)					
Male share	2,093	0.506	0.0826	0	1
Population group ratio	2,093	0.275	0.321	0	1
Population density	2,093	4.647	2.478	0.0148	10.40
Total population	2,093	8.282	1.197	0.693	10.45
Black population	2,093	6.712	1.997	0	9.944
Employed	2,093	7.261	1.306	0	9.635
Unemployed	2,093	4.977	1.389	0	8.183
Not economically active	2,093	7.665	1.258	0	9.925
No schooling	2,093	6.864	1.154	0	9.317
Some primary schooling	2,093	6.807	1.188	0	9.135
Finished primary school	2,093	5.414	1.168	0	8.255
Some secondary schooling	2,093	6.792	1.333	0	9.585
Finished secondary school	2,093	5.952	1.578	0	9.404
Higher education	2,093	3.442	1.899	0	8.283
No income	2,093	7.618	1.250	0	9.932
Income: R1-499	2,093	3.655	1.391	0	7.349
Income: R500-699	2,093	3.266	1.285	0	6.852
Income: R700-999	2,093	3.775	1.246	0	6.952
Income: R1000-1499	2,093	4.610	1.246	0	7.594
Income: R1500-1999	2,093	4.604	1.228	0	7.489
Income: R2000-2999	2,093	5.188	1.302	0	7.856
Income: R3k-4k	2,093	5.111	1.280	0	7.953
Income: R5k-6k	2,093	4.706	1.259	0	8.084
Income: R7k-9k	2,093	4.786	1.396	0	8.357
Income: R10k-14k	2,093	4.874	1.498	0	9.125

Source: Authors' analysis based on South African census data.

Note: Log distance is the distance to the nearest homeland in logs. All population growth variables are defined as absolute population growth in the relevant time period divided by overall population. Male share is the share of males in the overall population and population group ratio the share of white population. All other demographic variables are the log of the number of people falling within a given category (e.g. "Finished primary school" is the log of the size of the population that has finished primary school and no further education).

Table 3: PRE-TREND REGRESSIONS

	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta pop_{80,91}$	$\Delta pop_{91,01}$	$\Delta pop_{91,01}$	$\Delta pop_{80,91}$	$\Delta pop_{91,01}$	$\Delta pop_{91,01}$
$log(dist)$	-0.002 (0.0095)	-0.017*** (0.0066)	-0.018** (0.0072)	-0.001 (0.0096)	-0.018*** (0.0066)	-0.020*** (0.0071)
$log(pop_{80})$				0.009 (0.0097)		
$log(pop_{91})$					-0.020*** (0.0072)	-0.023*** (0.0080)
Observations	160	207	158	160	207	158

Source: Authors' analysis based on South African census data.

Notes: Sample varies according to data availability for different periods. The sample in columns 3 and 6 consists of observations with data for both periods. Robust standard errors in parentheses. Coefficients that are significantly different from *zero* at the 90% level of confidence are marked with a *, at the 95% level, a **; and at the 99% level, a ***. *dist* measures the distance to the nearest homeland in km, *pop* measures population and Δpop measures absolute population growth divided by population in the latter period.

Table 4: OLS AND 2SLS BASELINE REGRESSIONS

	(1) OLS	(2) 2SLS
	Population growth	Population growth
<i>Panel A: Population growth rates (1991-1996)</i>		
Δ Black Population	1.126 (0.0814)	0.360 (0.862)
FS AP F-Stat	-	2.52
<i>Panel B: Population growth rates (1991-2001)</i>		
Δ Black Population	0.899* (0.0393)	1.061 (0.115)
FS AP F-Stat	-	29.98
<i>Panel C: Population growth rates (1991-2011)</i>		
Δ Black Population	0.895*** (0.0236)	0.993 (0.0873)
FS AP F-Stat	-	42.95
Province fixed effects	Yes	Yes
Controls	Yes	Yes
Observations	2093	2093

Notes. This Table displays estimates of equation (2) in the text. Each cell presents estimates from a separate regression. The baseline sample consists of all wards inside South Africa for which 1991 data is available. The standard errors are clustered on the municipality level and presented in parentheses. There are 201 clusters. The outcome variable is absolute overall population growth in the relevant time period divided by overall population. Δ Black population is defined as absolute growth of the black population from 1991 to year t divided by the overall population in t . The relevant time periods t are 1991-1996 in Panel A, 1991-2001 in Panel B and 1991-2011 in Panel C. Controls include variables on education, income, population group, population density and employment in 1991. There are nine provinces for which fixed effects are included. The estimated coefficients for the first stage regressions are reported in appendix B. Coefficients that are significantly different from *one* at the 90% level of confidence are marked with a *; at the 95% level, a **; and at the 99% level, a ***.

Source: Authors' analysis based on South African census data.

Table 5: 2SLS REGRESSIONS USING DIFFERENT SUB-SAMPLES

	(1) Dummy for Johannesburg	(2) No dummy for Cape Town	(3) Dummies for all metro areas	(4) Drop within 10 km	(5) Drop < 5% white	(6) Drop < 10% white	(7) Drop distance ≥ 6	(8) District FE	(9) Municipality level
<i>Panel A: Population growth rates (1991-1996)</i>									
ΔBlack Population	0.360 (0.861)	0.373 (0.850)	0.315 (0.909)	0.615 (0.442)	23.37 (32.85)	20.75 (25.53)	0.345 (0.853)	-0.652 (1.926)	0.814*** (0.058)
FS AP F-Stat	2.52	2.53	2.32	1.36	0.25	0.31	2.61	1.67	10.27
<i>Panel B: Population growth rates (1991-2001)</i>									
ΔBlack Population	1.069 (0.112)	1.072 (0.132)	1.034 (0.134)	1.066 (0.189)	1.169 (0.144)	1.231 (0.173)	1.008 (0.108)	0.948 (0.084)	1.039 (0.154)
FS AP F-Stat	32.23	22.96	26.65	12.51	30.67	25.55	30.55	34.68	11.17
<i>Panel C: Population growth rates (1991-2011)</i>									
ΔBlack Population	1.000 (0.086)	1.007 (0.0992)	0.957 (0.115)	1.046 (0.131)	1.049 (0.139)	1.062 (0.146)	0.9726 (0.088)	0.870 (0.077)	0.926 (0.151)
FS AP F-Stat	44.67	32.52	31.28	20.69	31.09	28.89	42.81	36.59	12.91
District fixed effects	No	No	No	No	No	No	No	Yes	No
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2093	2093	2093	1790	1374	1137	1730	2093	203

Notes. This Table displays estimates of equation (2) in the text for different sub-samples. Column headings denote sub-sample used in each specification. Each cell presents estimates from a separate regression. The standard errors are clustered on the municipality level and presented in parentheses. There are 201 clusters. All columns are estimated using 2SLS where the natural log of distance to the nearest homeland is used to instrument for absolute black population growth in the relevant time period divided by the overall population. The outcome variable is absolute population growth in the relevant time period divided by the overall population. ΔBlack population is defined as absolute growth of the black population from 1991 to year t divided by the overall population in t . The relevant time periods t are 1991-1996 in Panel A, 1991-2001 in Panel B and 1991-2011 in Panel C. Controls include variables on education, income, population group, population density and employment in 1991. There are nine provinces for which fixed effects are included. The estimated coefficients for the first stage regressions are reported in appendix B. Coefficients that are significantly different from *one* at the 90% level of confidence are marked with a *; at the 95% level, a **; and at the 99% level, a ***. 95% confidence intervals are in brackets.

Source: Authors' analysis based on South African census data.

Table 6: 2SLS REGRESSIONS USING WORKING-AGE POPULATION ONLY

	(1) Baseline	(2) Dummy for Johannesburg	(3) No Cape Town dummy	(4) Dummies for metro areas	(5) Drop within 10 km	(6) Drop < 5% white	(7) Drop < 10% white	(8) Drop dist. ≥ 6	(9) District FE	(10) Municipality level
<i>Panel A: Population growth rates (1991-1996)</i>										
ΔBlack Population	1.311 (0.206)	1.339 (0.212)	1.305 (0.227)	1.175 (0.242)	1.480 (0.383)	1.433 (0.315)	1.694 (0.479)	1.272 (0.206)	1.026 (0.182)	1.128 (0.361)
FS AP F-Stat	17.27	17.76	14.07	14.45	7.06	14.05	8.46	15.91	18.01	4.46
<i>Panel B: Population growth rates (1991-2001)</i>										
ΔBlack Population	1.070 (0.120)	1.076 (0.118)	1.085 (0.139)	1.048 (0.143)	1.060 (0.196)	1.189 (0.157)	1.254 (0.185)	1.020 (0.116)	0.945 (0.0862)	1.032 (0.187)
FS AP F-Stat	30.50	32.49	22.85	27.03	11.84	28.83	24.73	30.84	34.50	9.32
<i>Panel C: Population growth rates (1991-2011)</i>										
ΔBlack Population	0.990 (0.0803)	0.996 (0.0787)	1.006 (0.0919)	0.947 (0.107)	1.021 (0.125)	1.055 (0.134)	1.067 (0.140)	0.931 (0.0805)	0.876 (0.0788)	0.918 (0.175)
FS AP F-Stat	42.36	43.38	31.55	31.37	19.32	31.24	28.54	41.98	36.75	11.53
District fixed effects	No	No	No	No	No	No	No	No	Yes	No
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2093	2093	2093	2093	1790	1374	1137	1730	2093	203

Notes. This Table displays estimates of equation (2) in the text using working-age population rather than overall population for different sub-samples. This includes everyone aged 15 to 64. Column headings denote sub-sample used in each specification. Each cell presents estimates from a separate regression. The standard errors are clustered on the municipality level and presented in parentheses. There are 201 clusters. All columns are estimated using 2SLS where the natural log of distance to the nearest homeland is used to instrument for absolute black population growth in the relevant time period divided by the overall population. The outcome variable is absolute population growth in the relevant time period divided by the overall population. ΔBlack population is defined as absolute growth of the black population from 1991 to year t divided by the overall population in t . The relevant time periods t are 1991-1996 in Panel A, 1991-2001 in Panel B and 1991-2011 in Panel C. Controls include variables on education, income, population group, population density and employment in 1991. There are nine provinces for which fixed effects are included. The estimated coefficients for the first stage regressions are reported in appendix B. Coefficients that are significantly different from *one* at the 90% level of confidence are marked with a *; at the 95% level, a **; and at the 99% level, a ***. 95% confidence intervals are in brackets.

Source: Authors' analysis based on South African census data.

Table 7: ALTERNATIVE SPECIFICATION USING DIFFERENT TIME PERIODS

	Full sample		Working-age population	
	(1) Δ Overall population	(2) Δ Non-black population	(3) Δ Overall population	(4) Δ Non-black population
Δ Black Population (1991 - 2001)	0.167 (0.139)	0.0319 (0.484)	0.246 (0.153)	-0.035 (0.045)
FS AP F-Stat	29.97	29.97	30.50	30.50
Province fixed effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	2093	2093	2093	2093

Notes. This table reports 2SLS results. In the second stage we regress different population growth measures for the period 2001 - 2011 on predicted black population growth in the previous period (1991 - 2001). In the first stage we instrument black population growth using distance to the nearest homeland as in the baseline specification. The outcome variable is absolute population growth in the relevant time period divided by the overall population. Δ Black population is defined as absolute growth of the black population from 1991 to 2001 divided by the overall population in 2001. Controls include variables on education, income, population group, population density and employment in 1991. There are nine provinces for which fixed effects are included. Standard errors are clustered at the municipality level and presented in parentheses. Coefficients that are significantly different from zero at the 90% level of confidence are marked with a *; at the 95% level, a **; and at the 99% level, a ***. 95% confidence intervals are in brackets.

Source: Authors' analysis based on South African census data.

Table 8: HETEROGENEITY WITH RESPECT TO THE INITIAL POPULATION DENSITY AND LEVEL OF URBANIZATION

	(1) High population density dummy	(2) High urban share dummy
<i>Panel A: Population growth rates (1991-1996)</i>		
Δ Black Population	1.026 (1.425)	-6.333 (11.35)
High initial urban share dummy \times Δ Black Population		7.589 (11.56)
High initial population density dummy \times Δ Black Population	0.509 (1.133)	
FS AP F-Stat: Δ Black Population	0.81	0.07
FS AP F-Stat: Urban interaction	-	0.07
FS AP F-Stat: Density interaction	0.45	-
<i>Panel B: Population growth rates (1991-2001)</i>		
Δ Black Population	1.106 (0.138)	1.002 (0.111)
High initial urban share dummy \times Δ Black Population		0.178** (0.084)
High initial population density dummy \times Δ Black Population	0.681** (0.284)	
FS AP F-Stat: Δ Black Population	26.54	36.98
FS AP F-Stat: Urban interaction	-	23.70
FS AP F-Stat: Density interaction	18.71	-
<i>Panel C: Population growth rates (1991-2011)</i>		
Δ Black Population	0.957 (0.092)	0.986 (0.082)
High initial urban share dummy \times Δ Black Population		0.040 (0.062)
High initial population density dummy \times Δ Black Population	0.348** (0.152)	
FS AP F-Stat: Δ Black Population	44.53	46.50
FS AP F-Stat: Urban interaction	-	27.49
FS AP F-Stat: Density interaction	17.67	-
Province fixed effects	Yes	Yes
Controls	Yes	Yes
Observations	2093	2093

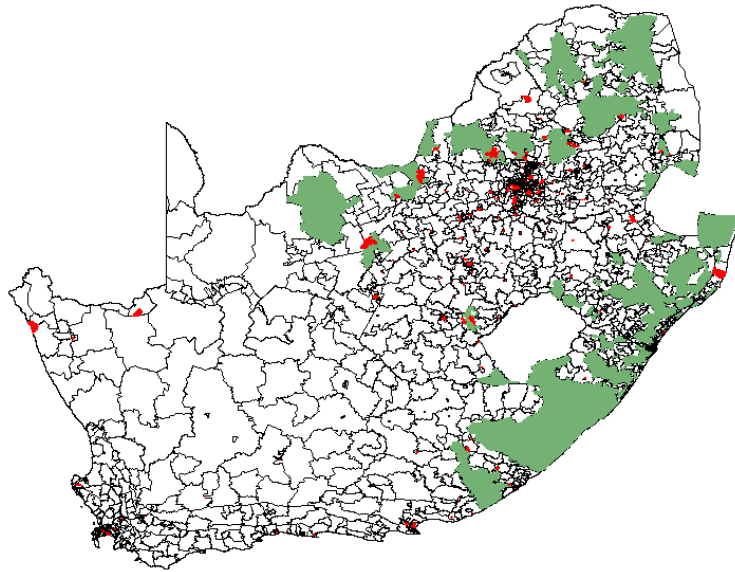
Notes. This Table displays estimates of equation (2) in the text with an additional interaction term. Each column displays one specification. The standard errors are clustered on the municipality level and presented in parentheses. There are 201 clusters. All columns are estimated using 2SLS. Absolute black population growth divided by the overall population and the same term interacted with a dummy for high population density in 1991 or for high urban share of households are the endogenous variables. Log distance to the nearest homeland and log distance to the nearest homeland times a dummy for high population density in 1991 or high urban share of households are used as instruments for the endogenous variables. An area is defined as having a high initial population density if it is among the 25% most dense areas. An area is defined as having a high urban share if it is among the areas with the 75% highest share of urban households in 1991. The outcome variable is absolute population growth in the relevant time period divided by the overall population. Δ Black population is defined as absolute growth of the black population from 1991 to year t divided by the overall population in t . The relevant time periods t are 1991-1996 in Panel A, 1991-2001 in Panel B and 1991-2011 in Panel C. Controls include variables on education, income, population group, population density and employment in 1991. There are nine provinces for which fixed effects are included. The estimated coefficients for the first stage regressions are reported in appendix B. Coefficients on the interaction terms that are significantly different from zero at the 90% level of confidence are marked with a *; at the 95% level, a **; and at the 99% level, a ***. 51

Source: Authors' analysis based on South African census data.

B Additional tables and figures

This appendix contains all the first stage regressions corresponding to the tables in the main paper, as well as one graph discussed briefly in the main text.

Figure 7: MISSING WARDS



Note: This map displays all wards in South Africa outside of the former homelands. Those wards with in red are missing. The former homelands are colored in green.

Source: Authors' own work using data from the Directorate: Public Sate Land Support via Africa Open Data.

Table 9: SUMMARY OF FIRST STAGE REGRESSIONS FOR THE BASELINE SPECIFICATIONS WITH DIFFERENT FIXED EFFECTS

	(1)	(2)	(3)	(4)
	No FE	Province FE	District FE	Municipality FE
<i>Panel A: Population growth rates (1991-1996)</i>				
log distance	0.308	-0.940	-0.936	-1.148
	(0.365)	(0.593)	(0.723)	(0.993)
<i>Panel B: Population growth rates (1991-2001)</i>				
log distance	-0.007***	-0.007***	-0.006***	-0.003**
	(0.001)	(0.001)	(0.001)	(0.001)
<i>Panel C: Population growth rates (1991-2011)</i>				
log distance	-0.004***	-0.004***	-0.004***	-0.002**
	(0.000)	(0.001)	(0.001)	(0.001)
Level of Fixed effects	No	Province	District	Municipality
Controls	Yes	Yes	Yes	Yes
Observations	2093	2093	2093	2093

Note: This Table displays estimates of equation (1) in the main text. Column headings denote different specification. Each cell presents estimates from a separate regression. The standard errors are clustered on the municipality level and presented in parentheses. There are 201 clusters. All columns are estimated using OLS where the natural log of distance to the nearest homeland is the variable of interest. The outcome variable is absolute black population growth in the relevant time period divided by the overall population. The relevant time periods are 1991-1996 in Panel A, 1991-2001 in Panel B and 1991-2011 in Panel C. Controls include variables on education, income, population group, population density and employment in 1991. Fixed effects at varying levels are included. Coefficients that are statistically significant at the 90% level of confidence are marked with a *; at the 95% level, a **; and at the 99% level, a ***. Standard errors in parentheses.

Source: Authors' analysis based on South African census data.

Table 10: FIRST STAGE REGRESSIONS CORRESPONDING TO TABLE 4

(1)	
Black population growth	
<i>Panel A: Population growth rates (1991-1996)</i>	
log distance	-0.940 (0.593)
<i>Panel B: Population growth rates (1991-2001)</i>	
log distance	-0.007*** (0.001)
<i>Panel C: Population growth rates (1991-2011)</i>	
log distance	-0.004*** (0.001)
Fixed effects	Yes
Controls	Yes
Observations	2093

Notes. This Table displays estimates of equation (1) in the main text. Each cell presents estimates from a separate regression. The standard errors are clustered on the municipality level and presented in parentheses. There are 201 clusters. All columns are estimated using OLS where the natural log of distance to the nearest homeland is the variable of interest. The outcome variable is absolute black population growth in the relevant time period divided by the overall population. The relevant time periods are 1991-1996 in Panel A, 1991-2001 in Panel B and 1991-2011 in Panel C. Controls include variables on education, income, population group, population density and employment in 1991. There are nine provinces for which fixed effects are included. Coefficients that are statistically significant at the 90% level of confidence are marked with a *; at the 95% level, a **; and at the 99% level, a ***. Standard errors in parentheses.

Source: Authors' analysis based on South African census data.

Table 11: SUMMARY OF FIRST STAGE REGRESSIONS CORRESPONDING TO TABLE 5

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dummy for Johannesburg	No dummy for Cape Town	Dummies for all metro areas	Drop within 10 km	Drop < 5% white	Drop < 10% white	Drop distance ≥ 6	District FE	Municipality level
<i>Panel A: Population growth rates (1991-1996)</i>									
log distance	-0.949 (0.592)	-0.951 (0.591)	-1.109 (0.722)	-0.806 (0.687)	0.0761 (0.152)	0.106 (0.189)	-1.004 (0.616)	-0.945 (0.719)	-0.948 (0.700)
<i>Panel B: Population growth rates (1991-2001)</i>									
log distance	-0.007*** (0.001)	-0.006*** (0.001)	-0.006*** (0.001)	-0.006*** (0.002)	-0.008*** (0.001)	-0.007*** (0.001)	-0.007*** (0.001)	-0.007*** (0.001)	-0.006*** (0.001)
<i>Panel C: Population growth rates (1991-2011)</i>									
log distance	-0.004*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.004*** (0.001)	-0.003*** (0.001)	-0.004*** (0.001)	-0.003*** (0.001)	-0.004*** (0.001)	-0.003*** (0.001)
District fixed effects	No	No	No	No	No	No	No	Yes	No
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2093	2093	2093	1790	1374	1137	1730	2093	203

Notes. This Table displays estimates of equation (1) in the main text. Column headings denote different specification. Each cell presents estimates from a separate regression. The standard errors are clustered on the municipality level and presented in parentheses. There are 201 clusters. All columns are estimated using OLS where the natural log of distance to the nearest homeland is the variable of interest. The outcome variable is absolute black population growth in the relevant time period divided by the overall population. The relevant time periods are 1991-1996 in Panel A, 1991-2001 in Panel B and 1991-2011 in Panel C. Controls include variables on education, income, population group, population density and employment in 1991. There are nine provinces for which fixed effects are included. The estimated coefficients for the first stage regressions are reported in the appendix. Coefficients that are statistically significant at the 90% level of confidence are marked with a *; at the 95% level, a **; and at the 99% level, a ***. Standard errors in parentheses.

Source: Authors' analysis based on South African census data.

Table 12: SUMMARY OF FIRST STAGE REGRESSIONS CORRESPONDING TO TABLE 6

	(1) Baseline	(2) Dummy for Johannesburg	(3) No dummy for Cape Town	(4) Dummies for all metro areas	(5) Drop within 10 km	(6) Drop < 5% white	(7) Drop < 10% white	(8) Drop distance ≥ 6	(9) District FE	(10) Municipality level
<i>Panel A: Population growth rates (1991-1996)</i>										
log distance	-0.003*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.004* (0.002)
<i>Panel B: Population growth rates (1991-2001)</i>										
log distance	-0.007*** (0.001)	-0.007*** (0.001)	-0.006*** (0.001)	-0.006*** (0.001)	-0.006*** (0.002)	-0.007*** (0.001)	-0.007*** (0.001)	-0.007*** (0.001)	-0.006*** (0.001)	-0.008** (0.003)
<i>Panel C: Population growth rates (1991-2011)</i>										
log distance	-0.004*** (0.001)	-0.004*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.004*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.004*** (0.001)	-0.004*** (0.001)
District fixed effects	No	No	No	No	No	No	No	No	Yes	No
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2093	2093	2093	2093	1790	1374	1137	1730	2093	203

Notes. This Table displays estimates of equation (1) in the main text using working age population. Column headings denote different specification. Each cell presents estimates from a separate regression. The standard errors are clustered on the municipality level and presented in parentheses. There are 201 clusters. All columns are estimated using OLS where the natural log of distance to the nearest homeland is the variable of interest. The outcome variable is absolute black population growth in the relevant time period divided by the overall population. The relevant time periods are 1991-1996 in Panel A, 1991-2001 in Panel B and 1991-2011 in Panel C. Controls include variables on education, income, population group, population density and employment in 1991. There are nine provinces for which fixed effects are included. The estimated coefficients for the first stage regressions are reported in the appendix. Coefficients that are statistically significant at the 90% level of confidence are marked with a *; at the 95% level, a **; and at the 99% level, a ***. Standard errors in parentheses.

Source: Authors' analysis based on South African census data.

Table 13: FIRST STAGE REGRESSIONS OF SPECIFICATION WITH INTERACTION TERM CORRESPONDING TO TABLE 8

	(1)	(2)	(3)	(4)
	Δ Black pop growth	Δ Black pop growth \times high population density dummy	Δ Black pop growth	Δ Black pop growth \times high urban share dummy
<i>Panel A: Population growth rates (1991-1996)</i>				
log distance	-1.250* (0.727)	-0.821 (0.656)	-1.426* (0.846)	-1.388 (0.841)
log distance \times high population density dummy	1.426 (1.130)	1.564 (1.253)	- -	- -
log distance \times high urban share dummy	- -	- -	0.710 (0.736)	0.815 (0.707)
<i>Panel B: Population growth rates (1991-2001)</i>				
log distance	-0.007*** (0.001)	0.001*** (0.0003)	-0.009*** (0.001)	0.004** (0.002)
log distance \times high population density dummy	0.002* (0.001)	-0.004*** (0.001)	- -	- -
log distance \times high urban share dummy	- -	- -	0.003*** (0.001)	-0.009*** (0.002)
<i>Panel C: Population growth rates (1991-2011)</i>				
log distance	-0.004*** (0.001)	0.000 (0.000)	-0.004*** (0.001)	0.002* (0.001)
log distance \times high population density dummy	0.001 (0.001)	-0.002*** (0.001)	- -	- -
log distance \times high urban share dummy	- -	- -	0.001** (0.001)	-0.005*** (0.001)
Province fixed effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	2093	2093	2093	2093

Notes. This Table displays estimates of equation (1) in the main text with an additional interaction term. Column headings denote different specifications. The standard errors are clustered on the municipality level and presented in parentheses. There are 201 clusters. All columns are estimated using OLS where the natural log of distance to the nearest homeland and the same term times a dummy for high initial population density or high initial urban share of households are the variables of interest. The outcome variable are absolute black population growth divided by the overall population times a dummy for high initial population density or high initial share of urban households in 1991 and absolute black population growth divided by the overall population. The relevant time periods are 1991-1996 in Panel A, 1991-2001 in Panel B and 1991-2011 in Panel C. Controls include variables on education, income, population group, population density and employment in 1991. There are nine provinces for which fixed effects are included. The estimated coefficients for the first stage regressions are reported in the appendix. Coefficients that are statistically significant at the 90% level of confidence are marked with a *; at the 95% level, a **; and at the 99% level, a ***. Standard errors in parentheses.

Source: Authors' analysis based on South African census data.