

End of Apartheid, Not of Inequality: The Slow Transition in a Segregated Economy

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Abstract

Despite the formal end of Apartheid in 1994, South Africa remains one of the most unequal countries in the world. This paper investigates the mechanisms behind this persistence of inequality by developing a spatial dynastic model with heterogeneous agents, incomplete markets, and endogenous choices over education, occupation, savings, and location. Drawing on newly assembled micro-geographic data, we document a shift in inequality from being primarily across races to increasingly within the Black population, with spatial segregation—especially the legacy of Townships—playing a key role. Our model, disciplined by detailed spatial and socioeconomic data, captures the slow intergenerational convergence in education and occupational outcomes observed in post-Apartheid South Africa. It shows how inherited spatial disadvantages—through high commuting costs, disparities in school quality, and limited access to credit—continue to shape households’ educational, occupational, and locational choices, reinforcing inequality long after formal legal barriers have been removed. Quantitatively, we find that removing persistent spatial distortions in Townships accelerates the transition to a race-blind equilibrium by 40% and reduces income inequality by 10%.

Keywords: Township, Dual Economy, Inequality, Segregation, Human Capital.

JEL Codes: D5; D63; E24; J62; O11; O18; R23 .

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1 Introduction

Despite the end of Apartheid in 1994, South Africa remains one of the most unequal societies in the world. Institutionalized racial segregation during Apartheid denied Black South Africans access to most economic opportunities, reinforcing extreme disparities in income, wealth, and education.¹ Yet, perhaps surprisingly, inequality has not declined substantially in the post-Apartheid era. Recent data show that overall inequality remains exceptionally high (Chancel et al., 2021), with a striking shift in its composition: whereas inequality during Apartheid was overwhelmingly between racial groups, it is now increasingly concentrated within the Black population.

This paper investigates the mechanisms behind the persistence and transformation of inequality in South Africa. We focus on the legacy of racial spatial segregation and explore whether standard economic forces—operating through endogenous choices over education, occupation, location, and savings—can account for the observed inequality dynamics. Specifically, we analyze to what extent the structure of Apartheid cities, and especially the creation of Townships—urban living areas reserved for non-Whites under Apartheid and built on the periphery of cities, continues to shape opportunities and outcomes. We find that location-specific distortions slow the transition to a race-neutral equilibrium by 40 percent and raise inequality by 10 percent, highlighting the importance of accounting for spatial frictions in understanding inequality dynamics.

We begin by assembling new evidence on long-run spatial and socioeconomic inequality. An important contribution of this paper is bringing together historical and present data to study the dynamics of inequality in South Africa. We draw on a wide range of sources—including historical Censuses, household and labor force surveys, school data, and administrative geospatial records to document long-run changes in residential segregation, educational attainment, occupational sorting, and income. In particular, we undertake a major effort to systematically identify, classify, and geolocate Townships across time. As part of an extensive data collection effort, we compile and harmonize information from a wide range of sources to construct both a historically grounded definition of Townships—based on Apartheid-era spatial planning—and a broader, data-driven classification that extends into the post-Apartheid period. These Township definitions are linked to microdata across decades, allowing us to consistently measure inequality by location, race, and cohort.

Our data show that racial segregation intensified sharply during the Apartheid era, with Townships becoming increasingly spatially and economically isolated. Despite the formal repeal of segregationist legislation, today Townships continue to house the majority of Black urban residents and remain disconnected from economic centers. This persistent spatial isolation, combined with poor school quality and high com-

¹Apartheid refers to the period characterized by the harsh, institutionalized system of racial segregation in South Africa from 1948 to the early 1990s. In this paper, we have little choice but to follow the racial classification used in South Africa during the period of Apartheid. Those groups were defined by the Population Registration Act of 1950: Black (sometimes also referred to as Native, Bantu, or African), White, Coloured, and Indian. One can find the term ‘Black’ being used to refer to the entire non-White group in some contexts. In this paper, we combine Black, Indian, and Coloured groups as ‘non-White’. We also use capital letters to highlight this particular use.

muting costs, is associated with restricted access to high-return occupations and slower convergence in income and education. For example, real income among Township residents has barely increased since 1994, while incomes in urban cores have grown substantially. Similar patterns are evident in higher education attainment and entrepreneurship, both of which remain rare among Black South Africans, especially those residing in Townships.

Motivated by these facts, we develop a dynamic spatial general equilibrium model with overlapping generations, dynastic preferences, incomplete markets, and endogenous decisions over location, schooling, occupation, and savings. The baseline model integrates canonical mechanisms of slow transitions emphasized in the literature—such as wealth accumulation (Buera et al., 2011; Moll, 2014) and intergenerational human capital transmission (Becker and Tomes, 1994), alongside a spatial component whose importance is strongly supported by the data. Through the lens of our model, we assess to which extent the high level of inequality in present-day South Africa is accounted for by the slow transition path to a post-Apartheid equilibrium without race discrimination.² This exercise also allows us to shed light on whether other factors, such as government policies or lack thereof, as well as persistent spatial distortions, still affect the development path of South Africa after its first democratic election.

Our heterogeneous-agent spatial general equilibrium model accounts for imperfections in the credit market, as well as the trade-off between living, working, and studying in a Township or in a City. These two locations differ in housing costs, school quality, and offer access to segmented labor markets. The model features overlapping generations of households composed of a parent and a child with dynastic preferences over future generations. Households jointly decide on consumption and on educational and productive investments. During Apartheid, non-White households are forced to live and educate their children in Townships and commute to the City to work. After Apartheid, households are allowed to choose the location where they live, study and work freely.

Beyond its spatial dimension, model incorporates a rich environment for production and education to capture salient features of the data and mechanisms affecting the speed of transition, such as asset accumulation, human capital investments, and a trade-off between productive and educational investments. Households' occupational choices include working as low-skilled, high-skilled workers and entrepreneurs. Entrepreneurs can operate either modern or traditional technologies, capturing the observed vast differences in firm characteristics. Primary and secondary schooling is mandatory and free for all children, but school quality varies across locations. These differences in school quality are set exogenously to capture the differences in schooling inputs observed in the data, so that human capital after secondary school depends both on a child's talent and the location of the school attended. Children who do not attend college can work as low-skilled workers during part of their youth, while attending college entails a monetary and a time cost. Moreover, college returns depend on prior human capital, amplifying the gains from attending higher-quality schools. We assume that only college graduates can access high-skilled jobs,

²See Borat (2004) and Burger and Jafta (2006) for a discussion on discrimination in labor markets.

and that college also boosts the productivity of entrepreneurs operating the modern technology.

In the presence of imperfect markets, households make joint decisions over location, human capital accumulation, and productive investments. Thus, choices about where to live, whether to become an entrepreneur, and how much to invest in education are closely intertwined. Our quantitative model is designed to capture these interdependencies and to evaluate their role in shaping South Africa's persistent inequality. The richness of this framework provides a powerful tool for policy and counterfactual analysis, as it closely mirrors key features of the country's inequality dynamics. However, this realism comes at a computational cost, particularly when solving for transitional dynamics in such a high-dimensional setting.

Our quantification strategy consists of four steps. First, we calibrate an "Apartheid" steady state to match the South African economy in the early 1990s, relying on the 1991 Census data. Second, we compute a counterfactual "race-blind" steady state in which we remove all racial restrictions. Third, we compute the transition between the two and assess the evolution of inequality along the transition path relative to the one observed in the data. This transition captures most of the observed patterns of inequality, including racial income convergence and inequality dynamics, but it fails to account for persistent spatial disparities. Therefore, we lastly use the model to identify other mechanisms that shape the evolution of inequality in South Africa today and are not captured by the standard economic forces of our model. We find that it is necessary to incorporate persistent distortions in Townships to account for its slow catch up with the City. We validate the model with location-specific distortions by leveraging heterogeneity in Townships outcomes as a function of their distance to the City and showing that our extended model can account for these differences. We conclude by discussing how our analysis can shed light on the role of public policies aiming to mitigate the negative consequences of past discriminatory policies and to bring the economy faster to a new lower inequality steady state.

As discussed above, the model with only standard economic mechanisms successfully captures key features of post-Apartheid inequality along most of the moments documented in the data, especially the slow and staggered rise of educational and entrepreneurial opportunities for Black households. Constrained asset accumulation and spatial segregation delay entry into college and access to high-return occupations (be it entrepreneurship or jobs requiring a college degree). As a result, inequality within the Black population initially rises before gradually falling—generating an inverted U-shaped pattern. Crucially, however, our model implies that the decline in within-Black inequality is very mild. As a result, inequality within Blacks remains substantially higher than within Whites across many generations. Moreover, along the transition, highly productive Blacks select into living in the City, generating a substantial income gap between Blacks living there and in the Township—as implied by the data.

This quantified model reveals a critical role for geography. It implies that Townships—due to their low housing costs and abundant labor supply—should be a place of great economic opportunity. In fact, in the baseline calibration Townships appear as an overly attractive location along the transition, leading

the model to predict an unrealistic surge in Township-based economic activity. This, in turn, generates counterfactual predictions about spatial convergence that are not borne out in the data. To reconcile this, we extend the model to allow for persistent, race-neutral spatial frictions associated with the Township, both for business operation and residence—capturing differences across locations, such as infrastructure or access to credit, that remain even after the end of formal segregation. We calibrate these persistent distortions by matching the share of work commuters from Township to the City, and the share of Blacks and the total population residing in the City in the first period of the transition.

This model with location-specific distortions aligns more closely with observed inequality trends, particularly the persistent income gap between Township and City residents, despite not being targeted in the estimation of spatial frictions. Moreover, we validate the model by simulating transitions of Townships at varying distances from Cities. We show that those further away experience slower growth in income and educational attainment—mirroring empirical findings. These results underscore the central role of spatial frictions in amplifying inequality and delaying convergence. Our simulations suggest that reducing these location-specific distortions—through improvements in Township school quality, infrastructure, or access to credit—could substantially accelerate convergence and lower inequality. For example, removing these residual location frictions cuts the transition time to a low-inequality steady state by nearly 40 percent, halves the persistent income gap between Township and City residents and reduces overall income inequality and within Black inequality by around 10% (as measured by the variance in log-income). In sum, our findings support the view that spatial frictions significantly hinder upward mobility and economic convergence.

While our focus is on South Africa, the interaction between geography, human capital formation, and market frictions is central to understanding inequality dynamics in many developing and developed economies. By embedding these forces in a unified framework, our analysis contributes to the broader literature on intergenerational mobility, place-based inequality, and the long-run effects of historical institutions.

Related Literature We contribute to the large theoretical and, to a lesser extent, quantitative literature on inequality and local externalities, beginning with the seminal insights of [Benabou \(1993\)](#), [Durlauf \(1996\)](#), and [Fernandez and Rogerson \(1998\)](#), who emphasize the role of segregation in educational access and the persistence of inequality. Our dynamic spatial general equilibrium model with overlapping generations, endogenous schooling decisions, and persistent locational frictions builds on this tradition and is calibrated to the South African context.

Our work is closely related to recent efforts to quantify the long-run effects of spatial exclusion. [Eckert and Kleineberg \(2021\)](#) develop a dynamic model in which modest initial segregation leads to persistent spatial inequality through sorting and feedback effects.³ [Monge-Naranjo et al. \(2018\)](#) study the impact of

³Regarding determinants of neighborhood formation, our paper also relates to [Lee and Lin \(2018\)](#), who study the role of natural

slums on mobility and urban development in Brazil using an overlapping-generations framework with endogenous location and investment decisions. We extend these approaches by incorporating dynastic preferences, credit constraints, and endogenous occupational choice, and by using historical racial segregation as an initial condition for a transitional analysis. Similarly, Fogli et al. (2025) construct a structural model of dynastic households with endogenous residential and schooling choices, emphasizing how location shapes mobility outcomes. While their setting is the U.S., we adapt and extend related mechanisms to a context with more binding structural constraints and a legacy of institutionalized spatial exclusion.⁴

We further contribute to a growing literature on racial inequality using structural or macroeconomic approaches.⁵ Gregory et al. (2023) model persistent segregation and racial disparities in education in U.S. cities. Boerma and Karabarbounis (2023) and Ashman and Neumuller (2020) study the racial wealth gap in quantitative frameworks that emphasize intergenerational transmission. Similarly, using structural approach Hsieh et al. (2019) show that removing barriers to occupational mobility for Black workers would raise aggregate productivity by improving talent allocation. In contrast, Derenoncourt (2022); Derenoncourt et al. (2023) and Albright et al. (2021) provide empirical evidence on the historical roots and labor market consequences of racial inequality in the U.S. Our model complements these findings by highlighting how spatial and educational frictions—rather than overt legal barriers—can delay talent reallocation and dampen convergence.

We also relate to work examining the long-run effects of institutionalized spatial exclusion. A growing empirical literature, rooted in the spatial mismatch hypothesis (Glaeser and Gyourko, 2005), documents how redlining (Aaronson et al., 2021; Faber, 2021), exclusionary zoning (Shertzer et al., 2016), and colonial land policies (Dell et al., 2018) generate durable spatial inequality. Our analysis extends this literature by quantifying how inherited spatial disadvantage continues to shape inequality through persistent frictions in migration, education, and labor market access.

Finally, we contribute to the literature on entrepreneurship and inequality under incomplete markets. Our framework builds on models of endogenous occupational choice, financial frictions and human capital investments (Buera et al., 2015; Mestieri et al., 2017; Castro and Sevcik, 2016), while incorporating spatial heterogeneity and modeling transition dynamics. Empirically, we are motivated by studies of post-Apartheid South Africa documenting persistent structural barriers to Black entrepreneurship despite formal deregulation (Banerjee et al., 2008; Charman et al., 2017; Herrington et al., 2010).

amenities in neighborhood dynamics in the US, and Heblich et al. (2021), who examine the effects of temporary disamenity during the Industrial Revolution in England.

⁴We also relate to Rivera-Padilla (2021), Hsiao (2022), and Cavalcanti et al. (2019), who study spatial selection and infrastructure in developing economies, and to broader work on spatial general equilibrium with migration and place-based policy (e.g., Bryan and Morten, 2019; Bilal and Rossi-Hansberg, 2021)

⁵This quantitative literature is informed by a large body of empirical work on neighborhood effects and spatial mobility, most notably the work of Chetty et al. (2016); Chetty and Hendren (2018a,b), which documents how childhood location shapes long-run outcomes in the United States. See also Chyn and Katz (2021) for a recent summary of this literature. While their context is markedly different, this evidence reinforces the idea that residential location has lasting effects on mobility, which we incorporate structurally into our model.

2 Stylized Facts on Inequality in South Africa

In this section, we use data collected pre-, during, and post-Apartheid to establish stylized facts about the development of inequality in South Africa across time and space. We start by providing an overview of the data used in our analysis. A description of the historical context of segregation in South Africa follows, focusing on how Townships were used as a tool of systematic segregation and control. We then proceed with documenting the evolution of inequality along different dimensions. Specifically, we examine how inequality interacts with educational, occupational, and residential choices. These insights inform our modeling approach and guide the quantitative analysis.

2.1 Data

Our empirical analysis is based on data from various sources. First, we use geospatial data of Townships to examine their role in today's economic outcomes. Second, we use a number of household surveys to examine how urban segregation policies during Apartheid affect today's economic outcomes of households. Third, we use Census data to examine the evolution of households' spatial allocation and dynamics of various economic outcomes during Apartheid and post-Apartheid. As this paper focuses on segregation policies in urban areas, we restrict our analysis to locations that belong to Metropolitan Municipalities or Districts. Furthermore, our empirical analysis as well as the structural model focus only on Black and White population of South Africa. We do it for two main reasons. First, these two groups formed the majority of Metropolitan population – 80 percent according to the 1996 Census. Second, while Coloureds and Indians were severely discriminated during Apartheid period, their access to opportunities was less limited compared to Blacks and varied by region of South Africa. Below we briefly describe key aspects of the data.⁶

Township Data. Geography, and particularly urban segregation in a form of Townships, continue to shape economic outcomes in South Africa. To document that, we define a Township and then generate a variable that identifies Townships in the geographical space of South Africa according to this definition. The key challenge is the emergence of new Townships and informal settlements as a result of the urbanization process observed since the country's independence. To address this issue, we rely on information from various sources, including historical records and maps.

As a “broad” definition of a Township, we rely on the data from the SA Township Opportunity Atlas provided by AfricaScope. They define Townships as formal or informal urban residential areas where there is a predominance of previously disadvantaged people. In other words, residential areas where more than 80 percent of residents classify themselves as either Black, Coloured, or Indian. This broad

⁶A more detailed description of data sources and variables used is in Section ?? in the Appendix.

definition includes not only Townships formed during the Apartheid period but also those formed post-independence and informal settlements.

To address concerns related to endogenous location choice of post-Apartheid Townships in our model validation exercise, we also construct a Township identifier using a “narrow” historical definition. For the narrow definition of a Township, we use historical records and maps to manually identify those formed as a result of an Apartheid segregation policy rather than as a result of the urbanization process that took place after the first democratic elections. In addition to separating historical and post-Apartheid Townships, we also identify Townships in the Metropolitan areas that are not included in the AfricaScope list but appeared in the historical maps. Due to the lack of systematic records across the whole country, we focus only on Metropolitan areas, which accounted for 40 percent of all population in South Africa in 2011. We define “City” in our empirical analysis as any urban Metroarea that is not classified as Township.

Our list includes a total of 575 Townships using our broad definition for the entire country. For eight Metropolitan areas the list includes 232 Townships based on the broad definition, and 205 based on the narrow definition. In addition, we collect information on whether a Township belongs to a former Bantustan area as well as the name of the respective Homeland, the current and historical dominant ethnicity “classification” of a Township, and the distance to the nearest Metropolitan area (including major cities).⁷ The average distance of Townships in Metropolitan areas to the closest major city is 27 kilometers.

Household data. For the data on household socioeconomic outcomes we rely on a number of sources. Our main analysis uses data from Population Censuses conducted around the end of the Apartheid period in 1991 and in a more recent period – 2011.⁸ For the 1991 Census we are able to observe all individuals and their socioeconomic characteristics surveyed in South Africa and three independent Homelands – Bophuthatswana, Venda, and Ciskei.⁹ To obtain geospatial information of the districts in the 1991 Census, we use the [Giraut and Vacchiani-Marcuzzo \(2009\)](#) database which harmonizes and interrelates over time the maps of the districts, provinces, and urban areas for South African localities from 1911 to 2001. We limit our sample to Metropolitan districts in 1991, excluding the ones that were located in the Orange Free State to ensure consistency of the Metropolitan locality definition between 1991 and 2011 and focus on the main urban areas only.¹⁰ Given limited geographical data availability for 1991, we assume that all Black households reside in Townships and all Whites in the core of a City.¹¹

In Censuses conducted after the first democratic elections the lowest level of data aggregation that is available to researchers and enables mapping socioeconomic outcomes to Township variables is Enumeration Area (EA) for the 1996 Census, and Small Area Location (SAL) for the 2001 and 2011 Censuses. Those

⁷The list of Townships and their characteristics is available [here](#).

⁸The most recent Census in South Africa was conducted in 2022, but data are yet unavailable.

⁹Data for Transkei are not available, but since we focus on major Metropolitan areas non of which are part of Transkei, this does not compromise our analysis.

¹⁰Map of South Africa, including Homelands and Metroareas, using districts of '91 is depicted in Figure ?? in the Appendix.

¹¹Indeed, the share of different groups across Enumeration Areas depicted in Figure ?? represents a bimodal distribution with most of the mass being either at 0 or 100 percent indicating almost full racial segregation.

areas contain approximately 500-600 people on average. To map EAs and SALs to the Township variables we use geolocation.¹² To ensure, that our mapping captures the spatial allocation of different ethnic groups during the Apartheid period we compute the share of non-White population in the non-Township part of Cities and Townships (Figure ??). Indeed, the SALs identified as Townships are predominantly non-White.

In addition, to compare other socio-economic outcomes across decades, we use individual level data, which are available for 10% of population and are representative of the overall population. However, given the rich set of variables available for each individual, Statistics South Africa does not provide a sufficient level of geographic aggregation to map individuals to Township data due to confidentiality issues. Finally, we compliment our analysis with the data collected by Statistics South Africa in the General Household Surveys and Labour Force Surveys.

Commuting data. To obtain information on the location of work and school choices relative to the place of residence, as well as commuting data we use a representative household survey collected by the City of Cape Town in 2013. The survey contains household and personal information on more than 22 thousand households. In addition to demographics, income and asset ownership, the survey records the addresses of residence and work or place of study. We geocode respective addresses using Google Geocoding API and map those addresses to our Township data. This allows us to obtain information on the model moments, such as the share of households that live in Townships and work or send their kids to school in the City, and whether distance and cost affect various socioeconomic outcomes of households. Finally, we use data collected as part of the Project for Statistics on Living Standards and Development (PSLSD) in 1993 to estimate the cost of commuting to work during the Apartheid period used in the model estimation.

Education data. We use data from the the Department of Basic Education of South Africa. The education data provide information on the number of students and teachers for the universe of schools in South Africa across a number of years in the 2000s. In addition, the geographical location of schools is available, so we can identify whether the school belongs to a Township.¹³

2.2 Historical Background: Emergence of Townships in South Africa

The Apartheid regime in South Africa, established by the National Party in 1948, pursued complete racial segregation—social, political, and spatial—between Whites and non-Whites (Blacks, Coloureds, and Asians). Yet, the White economy remained heavily dependent on low-wage Black labor, as Whites largely avoided manual work and domestic service. This tension produced a range of institutional responses, including the establishment of ethnically defined rural “Homelands” (or Bantustans),¹⁴ industrial decentralization to

¹²The amount of SALs in one Township ranges from 1 to 1442 (Soweto), with the median of 39 in studied Municipalities.

¹³Overview of available education datasets is provided in van Wyk (2017).

¹⁴The terms “Homeland,” or “Bantustan” (also “Reserve” in pre-Apartheid period) have been officially applied to the African areas by the central government in South Africa, referring to the ethnic political constructions created based on former reserves.

draw labor from these regions, forced removals and relocations, strict urban influx controls, and comprehensive segregation in White-designated areas. This paper focuses on the urban dimension of this system: the creation and evolution of Townships,¹⁵ which typically occurred in White areas outside of former rural "Homelands."¹⁶

The formation of Townships accelerated as South Africa's Black urban population grew rapidly during the 1940s, driven by agricultural mechanization and land dispossession from Black South Africans.¹⁷ In response, the state implemented legislation that formed the legal basis for internal segregation. First, the Black (Urban areas) Consolidation Act of 1945 highly restricted the number of Blacks allowed to stay in White urban areas and limited their residential options to Townships.¹⁸ Second, the system categorized the population along narrow ethnic lines.¹⁹ Third, the Group Areas Act of 1950 and Prevention of Illegal Squatting Act of 1951 provided the legal foundation for separating Blacks (also further divided based on ethnicity), Coloureds and Indians into different segregated urban Townships outside of the core of Cities according to their racial classification by often forcefully removing people from their houses.

While there was extensive development of Townships initially, from 1960 their development slowed down and was formally discontinued outside the Homelands in 1967. Beginning in the 1960s, the state initiated large-scale deproclamation of African Townships and their incorporation into nearest Bantustans, either through forced relocation or administrative boundary adjustments. Despite increasingly restrictive movement controls, the 1970s witnessed renewed urban in-migration, leading to the proliferation of informal settlements on the peripheries of existing Townships. Although some elements of influx control were gradually relaxed—culminating in the repeal of the Natives (Urban Areas) Act in 1986 and the formal end of racial zoning in 1991—urban residence remained contingent on access to approved housing, reinforcing socio-spatial stratification. In particular, as [Davies \(1981\)](#) describes, the Apartheid city took on a highly ordered structure: (i) a dominant White central business district; (ii) a White-controlled industrial sector; (iii) strictly segregated residential zones separated by buffers; and (iv) Black communities relegated to the urban periphery or the borders of Homelands.

The Apartheid period was characterized not only by spatial segregation, but also by segregation in the provision of public goods. The Bantu Education Act (1953) and Extension of University Education Act (1959) institutionalized racially separate and inferior education for non-Whites.²⁰ Labor laws restricted access to skilled occupations and prohibited African entrepreneurship. As a result, Townships were not only spatially but also economically and socially isolated from Cities. The political disenfranchisement of non-

¹⁵SPP (1983) define Townships as "residential areas set aside for African, Indian, or Coloured occupations, usually adjacent to or within commuting distance of a White urban area on which they are economically dependent."

¹⁶More details on the historical context can be found in Section ??.

¹⁷Between 1946 and 1951, the Black urban population rose from 1.7 to 2.3 million, according to Census data.

¹⁸Only those meeting Section 10 criteria—such as being born and continuously residing in the area, long-term employment (10 years), continuous lawful residence (15 years), or holding short-term permits (up to one year)—were allowed to stay in urban areas. Africans without Section 10 rights stayed in urban areas under the risk of arrest, conviction, and deportation.

¹⁹The Population Registration Act of 1950 codified the population into three groups: White, Coloured, or Black (Indians were added later). Every Coloured and Black person was further classified according to their ethnic or other group to which they belonged.

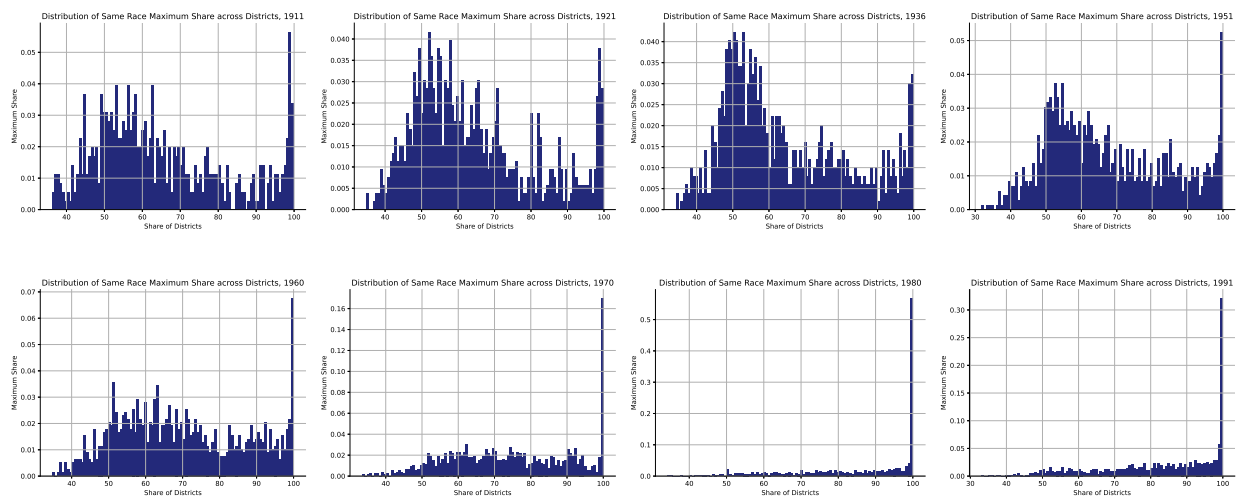
²⁰Universities for Blacks were located in Bantustans; notable exception—the University of Western Cape.

Whites further entrenched these inequalities. Black South Africans had no representation on City councils and only limited advisory roles in Township governance. Urban Bantu Councils, created to manage Township affairs, lacked real authority or resources (Smith, 1992). White administrations retained control over planning, services, and rents, ensuring a skewed distribution of public goods in both quality and quantity.

In sum, Townships emerged as a central pillar of the Apartheid state’s urban policy—deliberately marginalized, under-resourced, and disconnected from opportunity. Although many legal structures were dismantled by 1994, the spatial legacy of Apartheid-era Township planning continues to shape South African cities today, as the following sections illustrate.²¹

Racial Segregation in Historical Perspective. Before presenting our main stylized facts, we first highlight that the extent of racial segregation institutionalized under Apartheid was historically unprecedented—even by earlier South African standards. While key features of Apartheid-era policy, such as limited access to urban areas, racial separation, and movement restrictions, had roots in earlier segregationist practices of the 19th and early 20th centuries, the Apartheid regime implemented them with far greater rigidity, systematization, and enforcement. To establish that present-day patterns of segregation are primarily a legacy of Apartheid-era policies, we draw on decennial Census data spanning the 20th century.

Figure 1: Historical Race Distribution Across Districts: 1911 & 1991



Notes: Each plot depicts the distribution of the levels of maximum share of one racial group within one district. 100 percent implies fully homogeneous district in terms of racial composition. There are four racial groups used in the analysis: Whites, Blacks, Coloureds, and Indians. A similar picture is observed if the sample is restricted to the same geographical definition of individual districts (Figure ??).

Specifically, we use historical Population Census records from 1911 to 1991 to trace the evolution of racial composition across Metropolitan districts. As illustrated in Figure 1, the spatial sorting of racial groups intensified sharply during the Apartheid period. In contrast, earlier decades exhibited a more het-

²¹See Table ?? in the Appendix for a timeline of key developments.

erogeneous racial distribution across districts.²² By 1951, fully racially homogeneous districts had become dominant, and by 1980, more than half of all districts were racially uniform.

Segregation in the last Apartheid-era Census. The 1991 Census further reveals that racial mixing was rare under Apartheid, with Townships largely comprising racially homogeneous populations. Enumeration Areas (EAs) – the smallest geographical unit available, each containing roughly 220 households – exhibited minimal racial diversity (see Figure ?? in the Appendix). This segregation is further reinforced by ethno-linguistic zoning, which concentrated households by language: among Black South Africans, 72.6% of households within an EA spoke the dominant local language, compared to only 40% across the broader population.²³

Following the partial relaxation of movement restrictions in the mid-1980s, migration from Homelands to Townships accelerated, exacerbating housing shortages and fueling the expansion of informal settlements and perpetuating Apartheid-era spatial patterns. Despite the legal dismantling of Apartheid institutions, urban spatial patterns remained deeply entrenched. Townships were still located far from economic centers, isolating residents and forcing long commutes. This spatial mismatch was not merely a residential phenomenon but also a key channel of economic exclusion: high commuting costs translated into reduced access to jobs and education. According to [Shah and Sturzenegger \(2023\)](#), transport costs—including time—can be as large as 57% of net wages for employed workers.

As we document later in the paper, most Township residents are employed in City centers. In the context of high commuting costs, this erodes disposable income and constrains investment in human and physical capital. The persistence of spatial inequality—rooted in the design of Apartheid Cities—motivates our focus on the contrast between Township and City and informs our strategy for model validation.

2.3 Urban Inequality in South Africa: Stylized Facts

We start our empirical investigation by documenting a number of stylized facts regarding the evolution of inequality in South Africa starting from the final years of Apartheid till today. More specifically, we look at the trend in overall inequality, as well as the inequality across individuals and households conditional on a number of socioeconomic characteristics. Those stylized facts will guide our modeling choices in the next section.

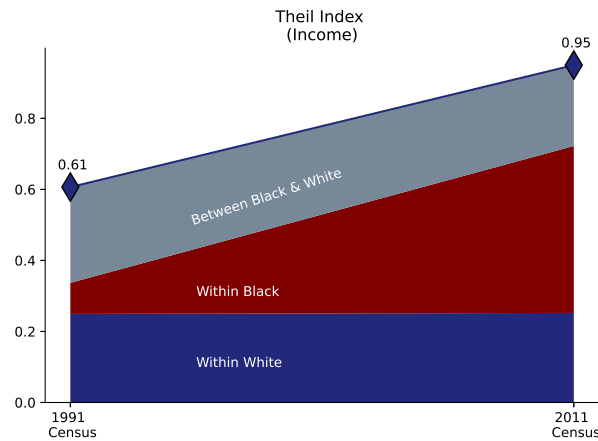
1. *Race and Inequality.* Inequality in South Africa has remained staggeringly high and even increased since the end of Apartheid, despite the removal of all legal barriers in terms of residential, occupational, and educational choices for the non-White population. At the same time, we observe that the income gap between races has been declining since the end of Apartheid as depicted in Figure ?? and documented in [Chatterjee et al. \(2023\)](#), suggesting that inequality within racial groups has been driving the recent increase

²²[Christopher \(1990\)](#) reports similar trends for urban areas using segregation indices constructed from 1911-1985 Censuses.

²³Major languages include Zulu, Xhosa, South and North Sotho, Tswana, Tsonga, and Venda.

in inequality. Indeed, as shown in Figure 2, all increase in income inequality between 1991 and 2011 is driven by an increase in inequality within Blacks. Moreover, over this period of time, income inequality between Blacks and Whites (and within Whites) has not changed, and it has even declined for the working population.

Figure 2: Within and Across Race Income Inequality Evolution



Notes: Inequality is measured by the Theil index, which is further decomposed into the part that is due to inequality between Blacks and Whites and within two races. Data is restricted to eight Metropolitan areas. The sample is restricted to employed household heads of working age (25-50). We observe a similar picture if we use the entire population or only those with positive income from any sources (see Figure ??).

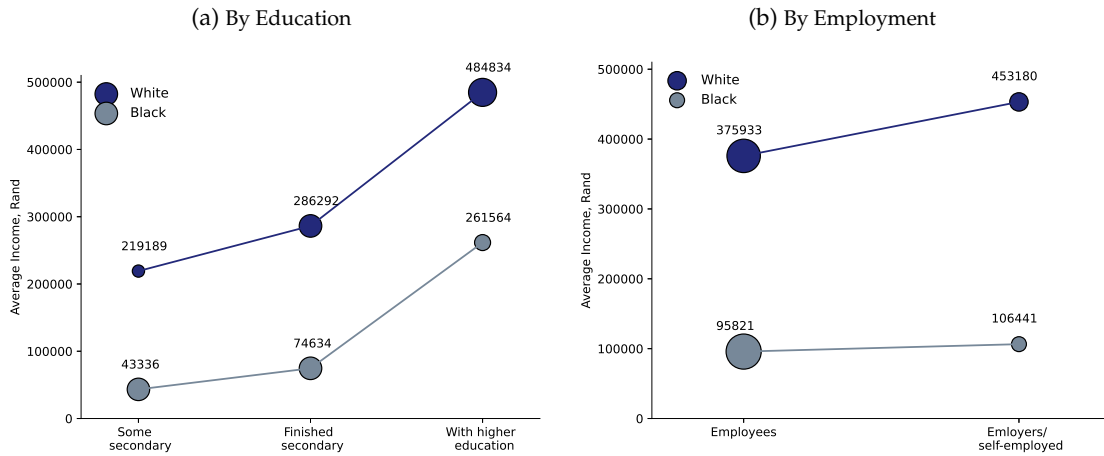
2. *Education and Inequality.* Apartheid policies generated substantial education gaps between the White and non-White population not only due to allocation of children into schools based on their race, with substantially lower amounts of funds available for non-White schools, but also due to limited opportunities for higher education for the non-White part of the population. By the end of the Apartheid period virtually no Black individual had a college degree.²⁴ At the same time, the return to higher education is extremely high in South Africa as depicted in Figure 3a. While South Africa experienced some convergence in terms of educational levels between racial groups post-Apartheid, such high returns to tertiary education is among one of the major sources of rising inequality within the Black population. In addition, the quality of school education depends on the location of the school, with schools in Townships being substantially worse. For example, learner to instructors ratio is 28.1 in City schools, compared to 34.1 in Townships schools.²⁵

3. *Occupational Choice and Inequality.* Next we look at the evolution of income dynamics based on the primary occupation of individual. We find substantial income difference between individuals who are employed compared to those who run their own business or are self-employed. Importantly, the gap is particularly pronounced for Whites, while there is only minor differences for Black entrepreneurs. At the

²⁴Some Universities existed for Black population during Apartheid, but almost all of them were located in Bantustans. The only exception was the University of Western Cape, which was mostly available for Coloureds.

²⁵We use data on location, number of learners, and instructors for all public ordinary schools in South Africa in 2014.

Figure 3: Income Dynamics across Racial Groups in 2011



Notes: Each plot represents the average annual nominal income of a given group of individuals. Markers for income by education and employment reflect the size of a given category within respective racial group. Data is restricted to eight Metropolitan areas. The sample is restricted to employed household heads of working age (25-50). All outcomes, including those for 1991 are depicted in Figure ??.

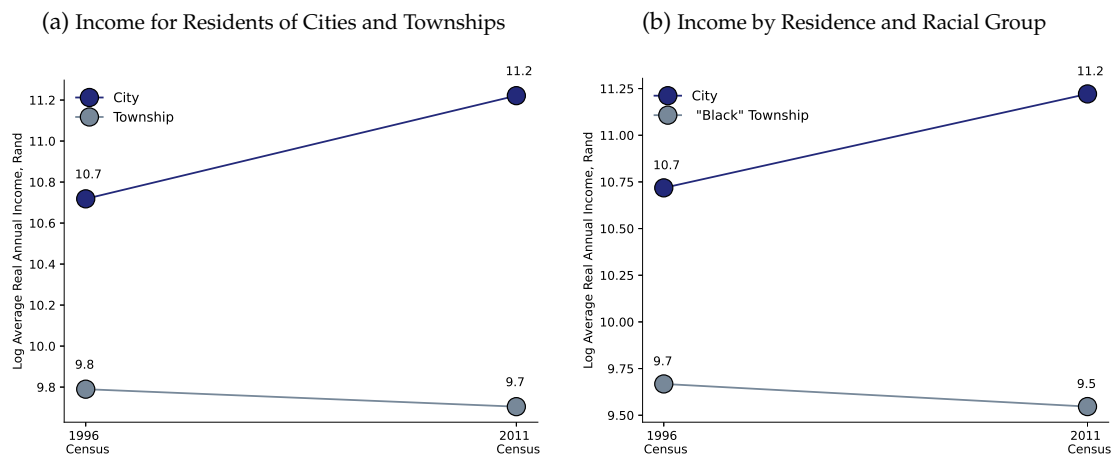
same time the share of business owners among Blacks has increased as entrepreneurship was forbidden for this group during Apartheid. The difference in entrepreneurship premium across racial groups can be attributed to the difference in business size. According to the Labour Force Survey conducted in 2011, one third of Black entrepreneurs operated in the informal sector, while the same is true for only 6.5% of White entrepreneurs. Importantly, more than 70 percent of Black entrepreneurs are self-employed, with only 3.9% operating businesses with more than 10 employees. For White entrepreneurs the respective numbers are 34.3 percent and 20.9 percent. This suggests that it is important to differentiate large and small business owners when studying the dynamics of inequality.

Additionally, we find that there is an important interaction between education and entrepreneurship as depicted in Figure ?? in the Appendix. Returns to entrepreneurship are substantial for Blacks, but only if they have higher education. On the contrary, for those without tertiary education, income from self-employment, on average, is practically the same as for the wage job. The same does not hold for Whites, who earn more being an employer or self-employed on average for any level of education. Documented facts suggest that there might be some market incompleteness, for example financial or capital constraints, that prevents Black entrepreneurs with little financial wealth from realizing their potential. Also, heterogeneous returns to entrepreneurship conditional on the level of education observed in the data introduce a possibility of different technologies.

4. *Spatial Sorting and Inequality.* Finally, we look at the difference of various groups based on the location of their residence. The comparison of current and historical urban maps suggest that modern urban areas are still to a large extent shaped by Apartheid's urban policies, not only location-wise but also with respect to a given ethnic group (Figure ??). Moreover, while some mixing takes place in urban cores, Townships

remain almost entirely non-White. Data from the 2011 Census show that the share of non-White population remains stubbornly high in Townships at almost 100 percent, while the share of non-White population in Cities rises compared to 1996, but remains well below the total share of this group in the general urban population (Figure ??). Regarding economic outcomes, while the income gap between racial groups declined, the income gap between those residing in a City and in a Township substantially increased since the end of Apartheid as depicted in Figure 4. We observe similar patterns in terms of educational outcomes, where the gap for completed schooling narrowed markedly between races, but much less between Cities and Townships (Figure ??).

Figure 4: Real Income Dynamics across Locations



Notes: Each plot represents the average annual real income of a given group of individuals. Price index is normalized to 1 for year 1996. We define “Black” Township, as the Township where majority of residents are Black. We use broad definition of Townships, but results are similar to a narrow one. Sample is restricted only to individuals with non-zero income. We report results for all population in Figure ??.

The widening of income gaps between Cities and Townships, as well as the persistence of the racial composition in Townships, suggest that spatial sorting in post-Apartheid South Africa plays an important role in shaping the dynamics of inequality. Moreover, we find that the role played by Townships is not limited to residential choice, but also determines access to labor and educational markets. Using commuting data from the Cape Town area we document work and education location choices of individuals relative to the location of their residence. First, we find that while those residing in the City primarily work and study in the City as depicted in Table 1, the picture is strikingly different for those who live in Townships. Specifically, the majority of individuals residing in Townships commute to work in the City, but primarily study in the Townships. Importantly, decomposing education by levels, Township residents mostly commute to the City for tertiary education (Table ??). Those results suggest that labor market and educational opportunities are different in Townships and Cities.

In Section 3, we incorporate the facts documented in this section into a general equilibrium macro model to better understand the contribution of each factor to inequality dynamics in South Africa. More

Table 1: Share of Individuals by Location of Home and Work/Education

	Live in City		Live in Township	
	work	education	work	education
Work/School in City	93.2%	91.5%	72.9%	25.9%
Work/School in Township	6.8%	8.5%	27.1%	74.1%

Notes: If we restrict the sample to those 25-50 years old, the patterns for work do not change. Numbers are computed using data from the Commute Survey collected in the Cape Town area in 2013. We use the broad definition of Townships. Using the narrow definition of Townships results in even stronger patterns of those presented here.

specifically, guided by our findings, we incorporate spatial differences, educational choices, as well as occupational decisions in an environment with incomplete markets.

3 Model

Motivated by the previous empirical evidence, we build a heterogeneous-agent, incomplete-markets, overlapping generations, dynastic model with two locations, a Township and a City center. The model integrates canonical mechanisms emphasized in the literature as drivers of slow transitions—such as wealth accumulation (Buera et al., 2011; Moll, 2014) and intergenerational human capital transmission (Becker and Tomes, 1994), alongside a spatial component whose importance is strongly supported by the data.

Specifically, the model features occupational, spatial and educational choices. The economy is populated by households that are heterogeneous in terms of their race, wealth, educational level, innate talent, and location. The talent and education affect agents’ productivity, which in turn determines their occupational choices. The location of a household affects access to schooling and working opportunities. Each household consists of one parent and one child who collectively make decisions. Each household decides on the parent’s occupation – worker or entrepreneur, the child’s level of education, and whether the child joins the labor force. Due to borrowing constraints, these decisions are not independent. Instead, they are jointly determined and the level of household assets plays a role in shaping these choices. Finally, the race of the household is of no fundamental economic significance: talent draws are independent of race. Still, race is used during Apartheid to discriminate against Black households, limiting their choices and opportunities. We therefore use race as a state variable to compare economies during and post-Apartheid.

3.1 Demographics, Life Cycle, Endowments and Preferences

Demographics and Life Cycle. A population of mass one is composed of two types of households: Black, B , and White, W , with mass m_B and m_W , respectively. Each household consists of a kid, k , and a parent, p . In the subsequent period the kid becomes a parent and has a kid of his own, while the previous parent in the household dies. Thus, household size is constant and equal to two. In the benchmark model, we

assume that childhood is between 0 and 25 years old, corresponding to when a kid receives his education. The parent phase is between 26 and 50 years old, corresponding to the adult age when an agent works. We assume that no further education is possible during this time. When a kid becomes an adult and a new kid is born, the household jointly makes the occupational choice of the parent, the educational choice for the newborn kid, savings, and location decisions in that period.

Endowments. Each agent is born with innate talent z . Innate talent is stochastic but persistent across generations. The logarithm of innate talent across generations follows a first-order autoregressive process

$$\log z_k = \rho \log z_p + \varepsilon, \quad (1)$$

where z_k and z_p are innate talents of a kid and a parent, respectively, $|\rho| < 1$ is the persistence of the talent process, and ε is a white noise term drawn from a random normal distribution with variance σ_ε , representing the idiosyncratic talent component. The innate talent of an individual is fixed over time. The race of an agent is of no consequence for innate talent: all newborn agents draw from the same distribution.

Each household is endowed with financial wealth, a , accumulated by households endogenously. Borrowing across periods is not allowed, so financial wealth must be non-negative, i.e., $a \geq 0$. However, we allow for within-period borrowing, as discussed below when describing financial markets.

Preferences. Households derive utility U from goods consumption of the parent, c_p , and from goods consumption of the kid, c_k , according to

$$U = \lambda \frac{c_p^{1-\sigma}}{1-\sigma} + (1-\lambda) \frac{c_k^{1-\sigma}}{1-\sigma}, \quad (2)$$

for $\sigma > 0$ and $\lambda \in (0, 1)$ denoting the Pareto weight of the parent.

Remark. (*Aggregate representation of household preferences*). Let $c = c_p + c_k$ denote total household consumption. The allocation of consumption within the household maximizing Equation (2) subject to $c = c_p + c_k$ satisfies maximizing the following

$$U = \frac{c^{1-\sigma}}{1-\sigma} \left[\lambda^{\frac{1}{\sigma}} + (1-\lambda)^{\frac{1}{\sigma}} \right]^\sigma. \quad (3)$$

Households are forward-looking and discount future per-period utility at rate $\beta \in (0, 1)$. To fix ideas, given the description of the model so far, we can establish that the total value of the utility of a household can be expressed recursively as

$$V(a, z_p, z_k, h_p) = \max_{\dots} U(c_p, c_k) + \beta \mathbb{E}_{z'_k, \varepsilon'} \left[V'(a', z'_p = z_k, z'_k, h'_p = h_k | z'_k, \varepsilon') \right] + \chi \varepsilon, \quad (4)$$

where variables with subscript p and k without prime denote characteristics of a parent and a kid at time t , respectively; and with a prime, at time $t + 1$. The term ϵ denotes a household-specific utility shock for living in a given location. This shock is received each period. The term $\chi > 0$ parametrizes the importance of this idiosyncratic shock. We come back to Equation (4) after having introduced the rest of the model elements and fully describe it.

Households are subject to the budget constraint

$$c_p + c_k + e_H + e_{educ} + a' \leq a(1 + r) + y_p + y_k, \quad (5)$$

where c_p and c_k are consumption of a parent and a kid in the household, respectively; e_H and e_{educ} are household expenditures on housing and education, respectively; a is the level of assets; and y_p and y_k are labor income of a parent and a kid, respectively.

3.2 Geography

There are two locations in the economy: Township and non-Township urban areas, denoted by $loc \in \{T, NT\}$. When a household decides where to live, they must purchase one unit of housing at price P_{loc} .

Housing Supply. The housing supply differs across locations. We assume an infinite housing supply in Townships, ensuring that the equilibrium price of housing is always zero. By contrast, following Hsieh and Moretti (2019), we assume an isoelastic housing supply in the non-Township urban area

$$HS_{NT,t} = \alpha_{NT,h} P_{NT,t}^{\frac{1}{\gamma_h}}, \quad (6)$$

with a parameter $\alpha_{NT,h} > 0$ and the parameter γ_h standing for the inverse elasticity of the housing supply.

Commuting costs. If an agent supplies labor or obtains an education in a location that is different from where this household resides, the household incurs an additive commuting cost, τ .

Residence Preference Shocks. Households experience idiosyncratic residential preference shocks. As already anticipated in (4), we introduce an additively separable utility shock to living in any given location. Each household independently draws this shock each period from a standard Gumbel distribution. This shock captures idiosyncratic reasons beyond our model for why households may desire to live in any given location. Note, however, that since these shocks are iid across locations and over time, this assumption does not introduce any reason for households to prefer on average one location over another. Moreover, we assume that this shock does *not* differ across household characteristics, such as race.

3.3 Technologies

Education Technology. Schooling allows kids to increase their human capital given their innate talent and schooling choice. In terms of schooling, a household makes two choices: i) the location of a kid's school, $loc^S \in \{T, NT\}$; ii) whether to send a kid to college after finishing school or to let him join the labor force. It is mandatory for a kid to attend school, which is free irrespective of the school's location. Note, that if a household decides to send the kid to a school that is located not where the household resides, they must pay a commuting cost, τ . The human capital obtained by a kid of innate talent z after attending school in location $loc^S \in \{T, NT\}$ is

$$h^{s,loc} = z(\underline{h} + h^{NT} \mathbb{1}_{school=NT}), \quad (7)$$

for some exogenous parameter h^{NT} that reflects higher quality of schools in non-Townships.²⁶

College is only offered in non-Township urban areas and requires a college fee, P_c , paid by all households that decide to send their kids to college.²⁷ Kids that do not go to college can join the labor force as low-skilled workers in the location of their residence after finishing compulsory schooling. College serves two purposes. First, college enables agents to be employed in high-skilled jobs. Second, college increases the level of human capital obtained during school

$$h^c = \left(h^{s,loc} \right)^\eta, \quad (8)$$

with $\eta > 1$. In the model, we assume that human capital affects the productivity of modern entrepreneurs and the wage of hired workers, as described below.

Production Technologies. All firms in the economy produce a final good, which can be freely traded across locations and whose price is normalized to one. There are two technologies for production: modern and traditional. Modern technology employs both low-skilled and high-skilled workers, while traditional technology only employs low-skilled workers. An entrepreneur with human capital, h , operating a modern technology produces output according to

$$y_M(h) = A_e h k^{\alpha_M} \left(l_H^\omega l_L^{1-\omega} \right)^{\gamma_M}, \quad \text{with} \quad \alpha_M, \gamma_M, \omega \in (0, 1), \quad (9)$$

$\alpha_M + \gamma_M < 1$, and $A_e > 0$. The input l_i with $i \in \{H, L\}$ denotes the total number of effective units of high- and low-skilled labor used in production, and k denotes the amount of capital. An entrepreneur

²⁶Using data on schools characteristics in South Africa, we find that schools in Cities have lower student to teacher ratios, but at the same time this ratio does not vary across Townships based on their proximity to the city, so the quality difference is independent of the location of a Township relative to City, i.e. independent of τ . We used other functional forms for human capital accumulation when calibrating the model. The choice of the functional form was determined by the best match to the observed data.

²⁷The college fee is assumed to be exogenous, so that the supply of college is completely elastic with respect to its price. Households that reside in a Township also have to pay commuting cost, τ , to attend college.

operating traditional technology produces output according to

$$y_T(z) = A_e z k^{\alpha_T} l_L^{\gamma_T}, \quad \text{with} \quad \alpha_T, \gamma_T \in (0, 1), \quad (10)$$

with $\alpha_M > \alpha_T$ and $\alpha_T + \gamma_T < 1$.²⁸ Note that the traditional technology does not require high-skilled workers, and it is less capital intensive (since $\alpha_M > \alpha_T$).²⁹

3.4 Occupational Choice, Financial Markets, and Household Problem

Occupational Choice. At the beginning of each period, households choose whether the adult should operate their own business or work for an outside business as low- or high-skilled worker and the location where he works or operates his business. Each firm is run by one entrepreneur. All occupational choices are mutually exclusive within period t .

The income of a hired worker, both low- and high-skilled, depends on the level of his human capital, so that he receives the wage per efficiency unit of the chosen occupation times human capital. A kid that is not in college joins the labor force as a low-skilled worker for the time period between school and adulthood *only*, while free to choose any occupation as an adult. This corresponds to 5 years in the model—a fifth of the time period. He receives 20 percent of the low-skill-wage in the location he resides, irrespective of the level of his human capital.

Financial Markets. Agents have access to a perfectly competitive financial intermediary that receives deposits from households and makes loans to finance capital and college expenses. We assume that South Africa is a small open economy and that financial intermediaries can borrow or save without affecting the world interest rate, r . Competitive financial intermediation implies that loan contracts to finance college are made at a rate r , while loans to finance capital are made at a gross interest rate, $r^k = r + \delta$, where δ denotes the depreciation rate of capital.

We assume, however, that financial markets are incomplete. First, state-contingent bonds are not available, meaning that households do not have the opportunity to get insurance against kids' talent risk. Second, borrowing for consumption smoothing across periods is not allowed, i.e., $a_t \geq 0$. Finally, in the spirit of Moll (2014) and Buera et al. (2015), any amount of capital k and college expenses P_c that exceeds the current level of assets owned by a household must be financed before income realization. Due to the limited enforceability of debt contracts, the amount of household borrowing is limited by a collateral constraint on household's assets, a . Thus, the amount of capital and college spending are constrained and are thus not

²⁸Given the transition process for talent, to ease notation, we assume that $z \equiv e^z$ described in Section 3.1

²⁹It can be verified that the slope of profits at $\theta = 0$ is higher for the traditional technology, but that the derivative of profits in θ is increasing in α (i.e., there is a positive cross partial). This implies that, under perfect markets, for large $h(z)$, α_M would be preferred.

independent from one another. The tightness of the constraint is proportional to household's wealth:

$$k + P_c \leq \lambda_k a, \quad \text{with } \lambda_k \geq 1. \quad (11)$$

Thus, households with low wealth levels desiring to run a firm or send their children to college may be prevented to do so due to borrowing constraints. Moreover, talented entrepreneurs with low levels of wealth might face a trade-off between firm expansion and the education for their kids.

Household Problem. Having described the occupational choices and the operation of financial markets, we can fully describe the household problem. Households maximize the discounted value of utility, as described in (4),

$$V(a, z_p, z_k, h_p) = \max_{c, a', loc_H, educ, loc_{educ}, occ, loc_{occ}, l^L, l^H, k} \left[\lambda^{\frac{1}{\sigma}} + (1 - \lambda)^{\frac{1}{\sigma}} \right]^\sigma \frac{c^{1-\sigma}}{1-\sigma} + \quad (12)$$

$$+ \beta \mathbb{E}_{z'_k, \epsilon'_{lH}} [V'(a', z_k, z'_k, h_k | z'_k, \epsilon')] + \chi \epsilon,$$

subject to the household budget constraint

$$c + e_H(loc_H) + e_{educ}(educ, loc_{educ}) + a' \leq a(1 + r) + y_p(occ, loc_{occ}, h_p) + y_k(educ, loc_H), \quad (13)$$

the credit constraint (11),

$$k + P_c \leq \lambda_k a, \quad \text{with } \lambda_k \geq 1, \quad (11)$$

and $a' \geq 0$, where c denotes total household consumption, $c = c_p + c_k$, $loc \in \{T, NT\}$ denotes the two possible locations in the model, Township and non-Township, e_H denotes housing expenditures in location loc_H (a dichotomous decision, $loc_H \in \{T, NT\}$) and e_{educ} denotes educational expenditures which, as discussed, can be attending school in T or NT or college in NT and include any transportation costs, τ , associated with the education choice and its location relative to the location of the household residence. The income of the parent, y_p , is a function of the occupation of the parent (low-skilled worker, high-skilled worker, traditional entrepreneur or modern entrepreneur), the location where the parent works (Township or non-Township), and the level of human capital (except for traditional entrepreneur which depends on a raw talent). If the location of work is not that of the residence, an additively separable transportation cost τ is incurred. The child's income y_k is only positive if the child does not attend college. Appendix ?? spells out the problem in its full mathematical detail.

3.5 Market Clearing

Let $\mathcal{F}_t(a, z_p, z_k, h_p)$ denote the joint distribution of wealth, talent of a parent and a kid, and the level of human capital of a parent over all households at time t .

The labor market clearing condition. Labor markets are segmented by skills and location. Therefore, labor market clearing conditions imply that labor demand for low- and high-skilled workers from entrepreneurs at each location should be equal to the supply of respective workers at each location. Abusing notation for that location and skill level, the labor market clearing condition is

$$\int_{occ=entrep} l_{loc,i} d\mathcal{F}_t(a, z_p, z_k, h_p) = \int \mathbb{1}_{occ=worker} h_i^{loc} \mathcal{F}_t(a, z_p, z_k, h_p), \quad \forall i \in \{H, L\} \quad \text{and} \quad loc \in \{T, NT\} \quad (14)$$

with the understanding that the indicator function also comprises whether a kid supplies labor and that h_i^{loc} denotes the human capital of type i and location loc that is relevant in each case.

The asset market clearing condition. We assume that South Africa is a small open economy and takes interest rate as given, hence the asset market clears by receiving or supplying financial capital from or to the rest of the world.

The housing market clearing condition. The total demand for housing in each location should be equal to the supply. Since we assume that supply of housing in Township is infinitely elastic, we only have housing market clearing condition for non-Township.

$$\int \mathbb{1}_{l=NT} d\mathcal{F}_t(a, z_p, z_k, h_p) = HS_{NT}. \quad (15)$$

3.6 Competitive Equilibrium

Given the initial distribution of state variables $\mathcal{F}_t(a, z_p, z_k, h_p)$ and a sequence of wages for low- and high-skilled labor in Township and non-Township, interest rate, and price of housing in non-Township urban area, $\{w_t^{L,T}, w_t^{H,T}, w_t^{L,NT}, w_t^{H,NT}, r_t, p_t^{H,NT}\}_{t=0}^{\infty}$, the competitive equilibrium is given by a sequence of allocations $\{c_t^p(g), c_t^k(g), a_t(g), k_t(g), l_t^H(g), l_t^L(g)\}_{t=0}^{\infty}$, where $g \equiv (a, z_p, z_k, h_p)$, occupational choices $\{occ_t(g) = \{Worker^L, Worker^H, Entrepreneur^T, Entrepreneur^M\}\}_{t=0}^{\infty}$, educational choices $\{e_t(g) = \{School, College\}\}_{t=0}^{\infty}$, and choices of locations for residence, work and school $\{loc_t(g) = \{Township, non-Township\}\}_{t=0}^{\infty}$ such that: (i) households maximize utility by solving value function maximization problem subject to a budget constraint, within- and across-period borrowing constraints, (ii) the financial intermediary makes zero profit, $r_t^k = r_t + \delta$, and (iii) market clearing holds in all labor markets and housing markets.³⁰

³⁰All derivations are in Section ?? of the Appendix. The computational algorithm is described in Section ??.

Stationary competitive equilibrium A stationary competitive equilibrium requires that the joint distribution over the state space is a fixed point of the equilibrium mapping and prices are constant over time,

$$\mathcal{F}(a, z_p, z_k, h_p) = \mathcal{F}_t(a, z_p, z_k, h_p) = \mathcal{F}_{t+1}(a, z_p, z_k, h_p) \quad \text{for all } t.$$

Before turning to the quantification, we note that the model’s richness comes at a computational cost. The model consists of four state variables, five endogenous prices, and two different distributions for Blacks and Whites. Therefore, solving the model requires tracking a high-dimensional distribution of heterogeneous agents over assets, talents of parents and kids, human capital, and race, while simultaneously solving for equilibrium prices, discrete occupational and location choices, and policy functions across multiple markets and locations. We adopt a backward–forward shooting algorithm to solve the transitional dynamics (detailed in Appendix ??), which is computationally intensive but necessary to capture the slow-moving dynamics of inequality and spatial sorting observed in the data.

4 Calibration and Model Quantification

In this section, we present the quantification of our baseline model. Our quantification strategy consists of several parts. First, we calibrate the model to a steady state that captures the South African economy at the end of Apartheid in the first half of the 1990s characterized by severe restrictions. Second, using the calibrated model, we compute a race-blind steady-state equilibrium in which all Apartheid restrictions are lifted. By construction, outcomes are independent of race in this steady-state. Third, we compute the transition from one steady state to another and investigate the evolution of the overall economy and that of Blacks and Whites along several dimensions. We show that while the model’s transition replicates key features of the data—such as the rise in within-Black inequality—it counterfactually predicts a rapid racial and spatial convergence.

Finally, in Section 5, we use the model to identify persistent spatial distortions as an additional important mechanism that shapes the evolution of inequality in South Africa today. In particular, we find that introducing a Township-specific profit tax and City amenities is crucial for replicating spatial labor market patterns and the dynamics of income gaps observed in the data. We also validate our model by showing that the dynamics of income and education for various pairs of Cities and Townships that differ in their distance align well in the model and in the data.

4.1 Calibration to the Apartheid Era

We start by describing the calibration strategy of our model to the Apartheid era. We assume that the economy is in a steady-state and calibrate it matching data during the first half of the 1990s. Importantly, we calibrate a variant of the model described above that incorporates the restrictions on the Black and

White populations imposed during Apartheid.³¹ To this end, we segment the population between Blacks and Whites. Similarly to the data, we do not focus on Coloureds and Indians due to the relatively small size of these groups and because these groups were subject to somewhat different treatment during Apartheid compared to Blacks.³² To capture Apartheid’s discrimination policies described in Section 2.2, we impose additional constraints relative to the model described in Section 3:

1. Housing and education markets are completely segmented. The White population is restricted to live and study in Cities, while Blacks are restricted to live and study in Townships. Therefore, the residence preference shocks are irrelevant during the Apartheid era.
2. Blacks are not allowed to become entrepreneurs or high-skilled workers.
3. Blacks are not allowed to attend college.
4. Blacks are excluded from financial markets.
5. Whites can only work in Cities.

These restrictions capture in a stylized way the policies during Apartheid and have substantial implications for the workings of our model.³³ Under Apartheid, the problem of Black households reduces to

$$V(a) = \max_{c, a'} \left[\lambda^{\frac{1}{\sigma}} + (1 - \lambda)^{\frac{1}{\sigma}} \right]^{\sigma} \frac{c^{1-\sigma}}{1-\sigma} + \beta [V'(a')], \quad (16)$$

subject to the household budget constraint

$$c + a' \leq a(1 + r) + \underline{hz} \cdot w_L + 0.2 \cdot w_L - 2\tau, \quad (17)$$

and $a' \geq 0$. Note that we can ignore the within-period borrowing constraint for Blacks because they are forbidden to access college or entrepreneurship. Moreover, there is no occupational choice problem, since they are forced to be low-skilled workers. There is also no location problem, since they are limited to live and study in Townships, while working in Cities as there are no entrepreneurs in Townships. Since Townships are assumed to have an infinitely elastic housing supply, the housing expenditure is zero.

By contrast, the problem of Whites is less constrained. White households can freely choose their occupation and the education of their offspring – they are, however, constrained not to live, work or study in Townships, and face the borrowing constraints. While the full mathematical details of the household problem are relegated to Appendix ??, we want to emphasize that given the Apartheid constraints, only White households can run businesses, work as high-skilled workers, and enroll their offspring in college.

³¹We use a steady state for our calibration as Apartheid spanned almost fifty years with decades of its segregation policies.

³²The share of Whites and Blacks was around 83 percent among 25 to 50 years old heads of household in urban areas.

³³We observe in the data that during Apartheid the Black and White population did not reside in the same areas, almost no Black people had higher education or has been self-employed or employer.

In Apartheid equilibrium, this creates a large gap in earnings and assets relative to Blacks, as we document in the data. As a result, when all racial restrictions are lifted, a combination of very different initial conditions for Blacks and Whites and incomplete markets slows the transition to the new steady state.

To quantify the Apartheid steady-state, we need to specify twenty-two parameters. We take a hybrid approach. We take some of the more standard parameters from the literature, estimate some parameters from the data before simulating the model, and jointly calibrate the rest to match aggregate moments in the data. To this end, we mostly leverage the South Africa 1991 Census, which contains rich information, including individual and household identifiers, location, race, income, occupation, and education. In addition, given our assumptions on residence locations for each population group for the Apartheid period, both house supply and housing price do not change equilibrium outcomes. Therefore, we set the housing supply to be equal to the share of White population and we set the price of housing to ensure equilibrium on the residential market.

Invariant parameters directly calibrated from the literature. We take parameters relating to preferences directly from the literature. These preference parameters are assumed to remain stable over time. These are the coefficient of relative risk aversion, adults’ Pareto weight in the utility function, talent persistence, the depreciation rate for capital, the variance of the location preference shocks, and the housing supply inverse elasticity.³⁴ Table 2 summarizes them. In addition, we set the 25-year discount factor at 0.36, corresponding to an annual level of 0.96.

For the production technology, we calibrate the labor share to be twice the capital share as in Buera and Shin (2013) and use the calibrated results in Mestieri et al. (2017) that $\alpha_T + \gamma_T = 0.61$ for traditional entrepreneurs. Since modern entrepreneurship is assumed to be more capital intensive, we set α_M to 0.3 matching estimates in advanced economies. We also assume that the labor intensity is the same for both types of entrepreneurs, $\gamma_T = \gamma_M$. Finally, we follow Gregory et al. (2023) to set our location preference shock, which is identical for all households, irrespective of their race.

Table 2: Calibrated Parameters: Parameters Set Ex-ante

Param.	Value	Description	Source
σ	1.5	Coeff. Relative Risk Av.	Buera and Shin (2013)
λ	0.7	Household Pareto Weight	Krueger and Ludwig (2013)
ρ	0.47	Talent Persistence	Mestieri et al. (2017)
δ	0.06	Yearly Depreciation	Buera and Shin (2013)
γ_h	0.5	Housing supply inverse elasticity	Cavalleri et al. (2019)
α_T	0.20	Capital Share Traditional Tech.	Mestieri et al. (2017)
$\gamma_{T,M}$	0.41	Labor Share Trad./Modern Tech.	Mestieri et al. (2017)
α_M	0.30	Capital Share Modern Tech.	US estimates
ω	0.65	Low-skill Share in Mod. Wage Bill	Machin and van Reenen (1996)
κ	0.12	Variance location pref. shock	Gregory et al. (2023)

³⁴We also set $\alpha_{NT,h} = 1$, so that $HS_{NT,t} = P_{NT,t}^{\frac{1}{\gamma_h}}$.

Parameters directly estimated from the data. We leverage household surveys conducted during and post-Apartheid to compute a number of parameters that we can directly match to parameters in the data. We set the share of Black population, m_B , in the model to be equal to 80 percent, which represents the share of households residing in Metropolitan Districts in the 2011 Census, where the head of household belongs to a Black population group and is between 25 and 50 years old.³⁵ We set the borrowing constraint to match a collateral to loan value of 115.4% obtained from the World Bank Enterprise Survey conducted in South Africa in 2020, $\lambda_k = 1.87$.³⁶ To set the value of transportation cost for those commuting from Township to the City we use data from Project for Statistics on Living Standards and Development (PSLSD) collected in 1993. We compute the average cost of commute to work incurred by Black heads of household relative to their income – 10.3%.³⁷ Finally, we set a 2.5% real interest rate r , which is the real interest rate of South Africa in 1993 according to the World Bank.³⁸ Table 3 summarizes these choices.

Table 3: Parameters Directly Estimated using Household Data

Parameter	Value	Description	Source
m_B	80%	Share of HH where the head is Black	Census (SA, 2011)
τ	$0.103 \cdot w_L$	Transportation cost	PSLSD (SA, 1993)
λ_k	1.87	Collateral constraint	WB Enterprise Survey (SA, 2020)
r	2.5%	Real Interest Rate	World Bank (1993)

Parameters calibrated by matching moments. The rest of the parameters are internally calibrated by jointly matching moments that inform the remaining parameter values. To inform the parameters of the talent distribution, we use information on occupational choices of the White population. To inform the production function of human capital, \underline{h} and η , as well as the price of college, P_c , we leverage data on the share of high-skilled White entrepreneurs,³⁹ the ratio of income for college and non-college graduates, and the share of Whites with college degree. We also use information on the average income difference for workers with no college education across Blacks and Whites to inform the parameter governing school difference across two locations, h^{NT} . As described above, most of the data moments capture variation within the White population. This strategy allows us not to embed discriminatory policies into the model parameters coming from variation between Blacks and Whites during Apartheid which subsequently can impact the outcomes of the race-blind equilibrium. Table 4 summarizes the calibrated parameter values as

³⁵The share of Blacks in Metropolitan areas was lower during Apartheid compared to 2011 due to influx control. We use the latter to ensure that none of the transition results are mechanically driven by a higher share of Black population given differences in initial conditions across races. Importantly, using share as observed in 2011 should not impact our calibration much as almost all moments we match are computed for White population, i.e. using variation within Whites.

³⁶We derive λ_k assuming that all households use credit up to their maximum value. The data from earlier surveys reports similar levels of collateral to loan value.

³⁷Those costs include only the monetary cost of commute, i.e. if individuals walk, the costs are equal to zero. In the data we also observe time spent on the commute, which can also be used to calibrate the parameter.

³⁸See <https://data.worldbank.org/indicator/FR.INR.RINR?locations=ZA>.

³⁹The share reflects the share of high-skilled entrepreneurs among all entrepreneurs. We define high-skilled entrepreneurs as employers or self-employed with income higher than high-skilled workers in the data.

well as the targeted moments.

Table 4: Parameters Calibrated Jointly by Matching Moments

Description	Moments		Model Parameters		
	Target	Model	Var.	Value	Description
Ratio Income College/School	1.9	1.9	η	1.035	Return to College
Share of College Educated	4.8%	3.3%	P_c	0.69	Price of College
Ratio Income Entr./Worker	1.5	1.9	A_e	2.01	Entrep. productivity
Share of Low-Skilled Entrepreneurs	3.1%	7.2%	σ_ε	0.32	Variance of a Talent
Share of High-skilled Entrepreneurs	1.5%	3.2%	\underline{h}	1.42	Returns to Skill
Ratio Income White/Black	4.9	6.0	h^{NT}	0.61	School quality diff.

Notes: Statistics computed for household heads using 1991 South Africa Census data.

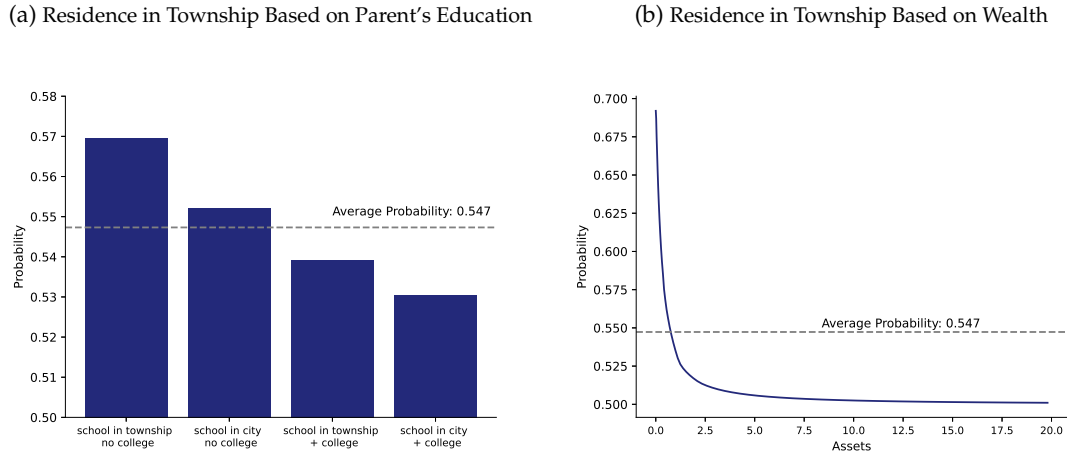
4.2 Race-Blind Steady State and Model Mechanics

After calibrating the Apartheid steady-state, we compute a race-blind equilibrium in which all race-based constraints described in the previous section are removed. In this equilibrium, households choose their residence, occupation and child’s education freely, based solely on their abilities, assets and parent’s education—regardless of race. We next describe how the model operates along different margins by analyzing the resulting race-blind steady state.

Location Choices. The main forces affecting residential choice are the exogenous quality and availability of education, as well as endogenous differences in housing prices and income opportunities. Importantly, occupational opportunities in equilibrium differ not only by the income they generate, be it wages or profit for entrepreneurs, but also by their availability. For instance, high-skilled employment in a given location is limited by the extent of modern-technology entrepreneurs operating in that location. As a result, in the race-blind steady state, where all restrictions are lifted, households sort across locations based on wealth and human capital.

We find that in the race-blind steady state wealthier households or households with more educated parents are less likely to reside in Townships, as depicted in Figure 5. While the model correctly predicts sorting based on income and wealth, Townships remain attractive along the transition path, with the two locations becoming close substitutes in the absence of location-based constraints. As a result, the importance of assets or wealth in determining residential locations is relatively modest. At the same time, differences in educational opportunities between the two locations also shape residential choices. For wealthy households, Figure ?? shows that the probability of living in a City increases with the level of the kid’s talent. However, for poorer households the relationship between kid’s talent and residential choice is non-linear: the probability of living in a Township increases for families with very talented children. This reflects a trade-off between current household income and future returns from better schooling.

Figure 5: Location Choices Based on Education and Wealth



Notes: Both plots depict average probability of residing in the Township across residual households' state variables by parent's education (a) and wealth (b). The full distribution across the entire state space is shown in Figure ??.

For low-income families with a very talented kid, the opportunity cost of postponing consumption is very high since even if they do not invest in the kid's education, his future earnings are going to be relatively high and therefore they decide to smooth consumption by not investing in kid's education.

While most households work where they live, residential sorting still emerges based on income opportunities shaped by household wealth (i.e., access to working capital) and productivity. As a result, average income is higher among City residents. The model predicts a higher concentration of traditional entrepreneurs in Townships, where they rely on abundant low-skilled labor to reduce wage costs and raise profits. In contrast, entrepreneurs using modern technology tend to locate in Cities, where high-skilled labor is more readily available.

Occupational Choices. Occupational choices are primarily determined by parental human capital, productivity, and wealth, as shown in Figure ?. Parents without a college degree predominantly decide to become low-skilled workers. Only those with high productivity choose to become traditional entrepreneurs. In contrast, parents with a college degree, predominantly become high-skilled workers, while the most productive prefer to operate their own business using modern technology. However, due to incomplete financial markets, limited household wealth prevents some households from realizing their entrepreneurial talent, adopting the optimal technology or operating at the optimal scale.

Educational Choices. Wealthy parents always send their kids to a school in the City, as depicted in Figure ?. More talented kids are more likely to go to college as returns are higher for them. Also, as returns to college depend on the level of human capital obtained in school, parents who can afford to send their kids to college never choose a Township school in equilibrium—to avoid the lower quality of education in

Townships. Importantly, children only attend schools in the Township when their household financial assets are low. Moreover, the presence of borrowing constraints generates in some cases a trade-off between physical and human capital accumulation, preventing some parents to realize their full entrepreneurial potential for a better education opportunities for their kids.⁴⁰ Overall, both the model and data suggest that children’s education decisions are closely tied to parental income, wealth, and residential location.

Savings Decision. The savings behavior, depicted in Figure ??, is highly heterogeneous across households and it is explained by the occupational and educational choices of households. For example, everything else equal, intergenerational trade-offs lead to lower savings when children are highly talented, as parents anticipate higher future earnings of the next generation and thus see less need for bequests. In some cases, households also favor leaving a bequest over investing further in education, particularly when the child’s level of human capital is low or intermediate.

4.3 Post-Apartheid Race-Blind Transition: Model and Data

In this section, we compute the transition between the Apartheid and the race-blind steady states. We proceed by lifting all of Apartheid’s race-based discrimination policies discussed in Section 4.1, starting with an economy endowed with a distribution of assets and education that corresponds to the Apartheid steady state.

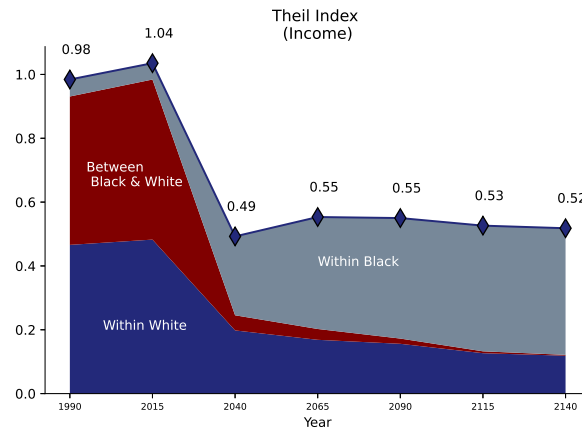
4.3.1 Main Outcomes Along the Transition Path to a New Steady State

The quantified model implies a relatively slow transition to the race-blind steady state, characterized by convergence in average income between Black and White households. This convergence typically occurs through the gradual accumulation of wealth by Black families—initially as traditional entrepreneurs, and later, as their income and wealth grow, by investments in their children’s education and/or modernizing their businesses. This convergence is enabled by the freedom to choose where to live, work and study. However, financial frictions, combined with the fact that most Black households start the transition with very low wealth, hinder many from realizing their full potential in the early stages of development. These racial disparities in wealth accumulation and access to education delay entry into entrepreneurship for Black households, especially modern entrepreneurship, a space that remains predominantly White in the initial periods of the transition. In sum, the “access to opportunity” of Blacks is staggered and prolonged.

As a result of the process of convergence to opportunity, we observe an increase in income inequality primarily driven by the rising inequality within Blacks. The evolution of income inequality, estimated with the model and measured by the Theil index, is similar to the one observed in the data and depicted in Figure 6. Initially, all Blacks are equally poor, and therefore their inequality is low. As they start accumulating

⁴⁰For example, the difference in schooling choice observed in households with the same kids in terms of their talent, as well as the education of parents, but different occupational choices – worker vs entrepreneur. Mestieri et al. (2017) provide household-level evidence consistent with these patterns.

Figure 6: Within and Across Race Income Inequality Along Transition Path



assets and obtaining access to education, inequality increases. This reflects access to opportunity for (*some*) Black households. In the first periods post-Apartheid, since savings are very low for all Blacks, talent draws play the most important role for occupational choices, asset accumulation, and ultimately inequality. In the following periods, Blacks with a high talent draw in the first period continue benefiting from all opportunities, while those with lower ability draws are now more limited than before as housing in the City becomes more expensive due to higher demand. At the same time, most Whites are quite wealthy at the beginning of the transition and, therefore, are not much affected by higher housing prices. As a result, the inequality within the Black population increases, while it remains quite stable within Whites. Once the transition converges to a new race-blind steady state, the difference in income across races vanishes as everyone has access to the same opportunities. However, the convergence in wealth between Blacks and Whites is slower relative to that of income, so even in a distant future the model still predicts differences in average wealth between these two groups.

Although the model qualitatively captures the main patterns of racial inequality observed in the data, Figure 6 reveals that it predicts a more protracted evolution. In particular, the rise in inequality within the Black population unfolds gradually and only sharply accelerates between the second and third generations. This delayed “explosion” of inequality is driven by the slow pace of asset accumulation during the transition from the Apartheid steady state to the first post-Apartheid period. In the model, agents cannot save, reinvest, or re-optimize within a period—which spans 25 years. In reality, individuals adjust their choices within such time frames, and we conjecture that this flexibility becomes especially relevant at the beginning of transition from the Apartheid-era conditions.

4.3.2 Stylized Facts on Inequality: Contrasting Data and Model

So far, we have focused on the evolution of key variables along the transition path. In this section, we evaluate the model's performance by comparing its predictions for the first period of the transition to the corresponding inequality moments observed in the data. We do that to assess whether the economic forces embedded in the model can account for the observed inequality patterns documented in Section 2.

Race and Inequality. The model predicts a decline in the income gap across racial groups as in the data, although it does so at a slightly slower rate: it predicts that in the first period the income gap between Whites and Blacks closes by 20%. Therefore, the model generates declining inequality between racial groups. The model also implies an increase in overall inequality within Blacks in the first period, albeit the magnitude is muted relatively to the data (15% increase in the model vs four-fold in the data) and instead increases five-fold in the second period. Also, similarly to the data, the model predicts a more persistent gap between races in terms of the wealth.

Inequality, Education and Occupational Choices. The model does a good job at predicting the substantial income gap between those with college degree and those without, both for Black and White households. Similarly, the model generates substantial returns to entrepreneurship, particularly for Whites as in the data, driven by higher initial human capital of Whites and a higher level of assets (the model predicts Whites making six times more profits than Blacks in the first period for 4.5 times in the data).

Spatial Sorting and Inequality. While a substantial income gap between Township and the City persists, the level is below the one observed in the data. Indeed, while in the data the gap in average income does not close and even increases slightly, the model predicts a drastic closing of the income gap by a factor of 2.5. If instead we look at the income gap between Blacks and Whites residing in the City, similarly to the data, the model predicts more racial income convergence compared to the overall population. On average, Whites in the City earn 44% more than Blacks residing in the City in the first period. The selection mechanism into the City also generates substantial spatial inequality within Blacks. Those in the City earn, on average, 2.4 times more.

In summary, the transition to a race-blind equilibrium replicates most of the observed patterns of racial inequality, including gaps in educational returns and occupational outcomes. However, the model generates counterfactual predictions regarding spatial reallocation.

The main reason for such difference is a faster mixing of races in Townships. Figure ?? depicts the location choices by race over the transition path. By construction residence location is predetermined in the Apartheid steady state. Once race-based restrictions are lifted, the model predicts a sharp drop in the number of Whites in the City, with the share of the total population living in a City eventually stabilizing at around 30%. This sharp change in the residence location is a result of the housing price difference between the Township (zero) and the City. As a result, relatively unproductive or low-wealth White households relocate to save the cost of living in the City (despite worse schooling and work opportunities, and the

potential need to incur a transportation cost). Conversely, highly talented Blacks move to the City to take advantage of higher wages and better educational opportunities. Over time, the income and wealth gaps between Township and the City shrink. Moreover, the model predicts a rise in business activity in Townships primarily led by White entrepreneurs, who hold the wealth needed to operate business early in the transition. This contrasts with the data, which documents that most of the jobs are still in the City core thirty years after the Apartheid regime fell.

Thus, the model links business relocation and racial mixing as mutually reinforcing dynamics—both of which are counterfactual. Townships appear overly attractive due to their low housing and labor costs. As a result, the model predicts a surge in firm activity in Townships and a rapid narrowing of the income gap between two locations – an outcome that is not supported by the data. These discrepancies point to location-specific barriers to residential and firm relocation—an issue we explore in the next section.

5 Location-Specific Distortions: Business “Tax” in Townships and City Amenities

While the baseline model captures most of the observed patterns of inequality in modern South Africa, including racial income convergence and inequality dynamics, it fails to account for persistent spatial disparities. In particular, it predicts excessive firm entry into Townships and too rapid income equalization across space—both counterfactual. Motivated by these discrepancies in terms of spatial predictions along the transition path, we extend our model to incorporate a persistent spatial distortion to entrepreneurship in Townships, modeled as a tax on profits, and a utility amenity for living in the City. Importantly, our analysis remains race-blind, in the sense that we do not introduce any race-specific distortion.

5.1 Model Setting and Estimation

We proceed by introducing two permanent exogenous differences between the City and Township. First, we introduce an amenity value to living in the City to capture the fact that most Whites continue to reside in the City despite its higher housing cost. Second, we introduce a distortion that reduces the profits made when operating a business in the Township. More concretely, the amenity enters in an additively separable way in the utility function. Entrepreneurs face a wedge imposed on their profit when operating in the Township, so that their income is a fraction of their actual profit when running a business. In particular, the profits on hand if operating in the Township are

$$\tilde{\pi}^T = (1 - \tau)\pi^T.$$

While the nature of the amenity and the wedge can be purely economic, i.e. lack of infrastructure in

Townships, they can also stand in for other unmodeled aspects. In this paper, we do not take a stance on the nature of these location-specific distortions, but rather conduct a positive analysis of what their implications are.

We estimate these two parameters by targeting three key moments in the first period of the transition that inform us about persistent differences between the City and the Township. First, we use the information on commuting patterns to the City reported in Table 1. In particular, we require that 73% of the adults living in the Township commute to the City to work. Second, we also require the model to match the share of Blacks living in the City, as well as the total number of people residing in the City. We proceed by simulating the transition of our model under different values of the amenities and tax distortion, until we can match our targets.

By setting the additively separable utility value of living of the city of 0.7 and a tax to 14.35% to earned profits in the Township, we can exactly jointly match the share of commuters to the city (72.9%), the share of Blacks living in the city (25%) and total share of those residing in the City (35%). Intuitively, introducing a City amenity value makes living there more appealing regardless of whether a household wants to access the better education or job opportunities it provides, as long as they can afford it. In particular, this makes wealthy Whites decide to remain in the city, driving housing prices up and preventing Blacks to move on the margin. A profit tax in the Township reduces the number of firms operating there, which increases the number of commuters.

5.2 Model Validation: Distance to the City

Before analyzing the model's predictions in more detail, we first show that the quantified model generates patterns consistent with those observed in the data regarding how Township's education and income vary with the distance to the nearest city. To do so, we simulate the transition path under two commuting cost levels, and compare the resulting outcomes to those in the data for Townships above and below the median distance to the city.

For the empirical analysis, we exploit variation in the distance from each Township to the closest Metropolitan area. As previously discussed, the original allocation of the Black population across Townships during Apartheid was based on ethnolinguistic characteristics, and this allocation has remained largely stable until today.⁴¹ More importantly, using Census data on birthplace and residence, we find that migration across Townships is limited and substantially lower than migration from Townships to Cities, which accounts for the bulk of population flows originating in Townships. This is a crucial finding because the model focuses on the tradeoff between residing and/or working in the City versus the Township, while abstracting from inter-Township migration. Thus, we view our comparison of transition paths across Townships with varying proximity to the City as directly targeting the core tradeoff captured in the data.

⁴¹As shown in Figure 1, spatial sorting occurred as a result of Apartheid policies, while periods before and at the beginning of Apartheid were characterized by heterogeneous geographic allocation of population in terms of race. Christopher (1990) shows similar patterns for urban areas by computing indices of segregation using Census data from 1911 to 1985.

Table 5: Township Outcomes: 1996 vs 2011 Difference

	Education		HH Income	
	(1)	(2)	(3)	(4)
Above median Distance to City Dummy	-2.722 (1.047)	-2.109 (0.931)	-0.131 (0.052)	-0.124 (0.066)
City FE		✓		✓
Observations	148	148	148	148

Notes: Columns (1), (2) use the change in share of individuals with completed secondary and higher education. Columns (3), (4) use the change in average household income and control for change in average education level. All columns include dominant language as control. Distance to city is a dummy for Townships with higher than median distance to the city. Std. errors (in parenthesis) are clustered at the municipality level.

We use the 1996 and 2011 Censuses, aggregating data at the Township level.⁴² Therefore, each City – Township pair is an observation. For each observation, we compute the growth in average income and change in the share of individuals with completed secondary and tertiary education between 1996 and 2011. To ease our analysis and comparability to the model exercise, we divide all City – Township pairs according to whether they are above or below the median distance to the closest Metropolitan area. Table 5 shows that Townships located further away from the City center (above median) exhibit slower income growth, as well as less educational improvement on average. The estimated coefficient remains significant and of a similar magnitude when we introduce City fixed effects (columns 2 and 4) and therefore we only use within City variation.⁴³

We next turn to our quantified model and perform an analogous exercise to the empirical analysis. We simulate transition dynamics under two values of transportation costs, τ , which proxy for the effective distance between City and Township. We vary τ to reflect the range observed in the data. We compare two counterfactual transitions: one with our baseline, relatively conservative transportation costs (10.3% of a low-skill salary) and another with a higher cost (30% of the low-skill salary), which lies towards the upper end of the estimated monetary commuting expenses (Morisset, 2023). In line with the empirical findings, in the first transition period residents of the more distant Township are 12.2% poorer on average relative to those in a closer Township. This number is close to the estimated values -13.1% and -12.4% in columns (3) and (4). Moreover, the model predicts that this income gap widens in subsequent periods up to around 31%, suggesting that in the long run residents of more distant Township would be lagging behind in terms of income and human capital not only relative to the City, but also relative to a closer Township.

For education, we compute the average human capital of residents in the Townships as measured by their efficiency units to proxy for the share of residents with completed secondary or higher education. Comparing the transitions, we find that the residents in the more distant Township have, on average,

⁴²We are using data for the entire South Africa and not only Cape Town, so that the sample size is sufficient given aggregation at a Township level.

⁴³If we use a continuous measure for distance, we find similar results in magnitude and significance.

4.96% less efficiency units of human capital and this gap also widens along the transition up to 27%. While these units do not map directly to completed education levels shares, we find that they are of comparable magnitude with the estimates of -2.7 and -2.1 in columns (1) and (2).

These results highlight the role of spatial segregation in our framework. Higher transportation costs increase isolation between the City and the Township. Since economic opportunities initially remain concentrated in the City, higher commuting costs lead more households to relocate to the City to avoid incurring them. For instance, in the first period, 35% of the population lives in the City under the relatively low-cost scenario, compared to 40% under higher transportation costs. As a result, marginal migrant to the City is less productive for more distant Township, given positive selection into the City. As a result, the average productivity z and human capital h of Township residents are lower under the high transportation cost transition. For example, we already saw that residents in the more distant Township have 5% less efficiency units on average. We also find that their average productivity z is 6% smaller. Consequently, this naturally lowers average income in the more distant Township. This selection mechanism can explain results obtained in the data – average income is lower in more distant Townships despite majority working in the same City. This pattern of selection has other broad implications: there are less commuters to the city and assets accumulate at a slower pace in the more distant Township, making transition of Blacks into opportunity slower.

5.3 Post-Apartheid Transition: Labor Market Transitions and Racial Inequality

By construction, the calibrated model makes living in the Township less attractive. Indeed, Figure ?? shows that the share of people living in the City increases over time, with Blacks gaining prominence throughout the transition. Under this calibration, in addition to matching the share of Blacks residing in the City and the commuting working behavior in the initial transition period, the model can replicate a pattern of spatial inequality similar to the one that we observe in the data.

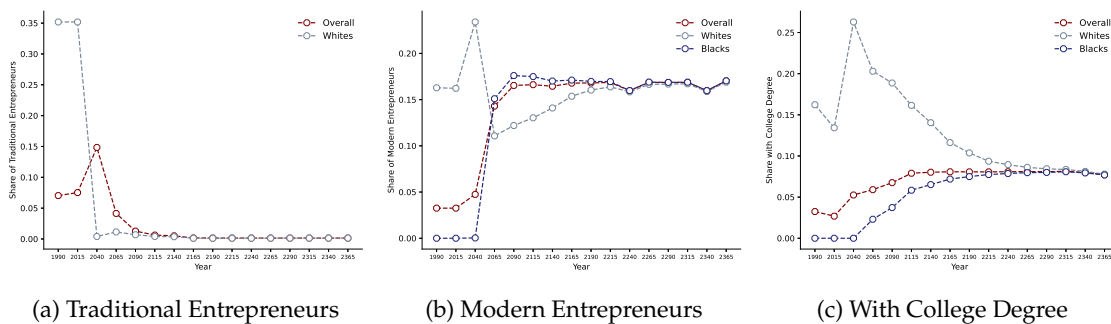
The path to opportunity for the Black population implied by the model is one in which they gradually accumulate wealth and education by first becoming entrepreneurs operating the traditional technology in the first period of the transition, as shown in Figure 7. As the income and wealth of these Black entrepreneurs increases, some expand their business and switch to modern technology, while in addition start to send their kids to college. As a result of this process, households move out of Townships, especially in the first periods of transition. Importantly, the presence of different business technologies in the model allows us to document this sequence of the transition for Blacks as observed in the data (Banerjee et al., 2008; Gordon, 2010). However, the transition predicted by the model is somewhat slower relative to the one observed in the data due to our assumption of one period being 25 years, and hence all households being at the same stage of a life-cycle. As a result, the wealth accumulation process, and changes in employment and education choices occur only once in 25 years.

By contrast, Whites start the transition with a much higher level of wealth and human capital, and

therefore we observe them operating modern technologies and sending their children to college at a much higher rate since the removal of Apartheid constraints. In the economy overall, as a larger share of the population is gaining access to higher education and accumulates enough wealth along the transition, we observe that most of the businesses move from traditional to modern technologies.

Along the transition path to a new steady state the average income and wealth of Blacks and Whites converges (Figure ??). However, the wealth gap across two groups is more persistent. Overall income and wealth inequality increases at the beginning of a transition followed by a decline in the subsequent periods, as the gap between racial groups is closing. Consequently, the model predicts similarly to the data that the main driving force of inequality over time becomes inequality within Black population compared to the inequality between Blacks and Whites that emerged during Apartheid.

Figure 7: Dynamics of Entrepreneurship and College

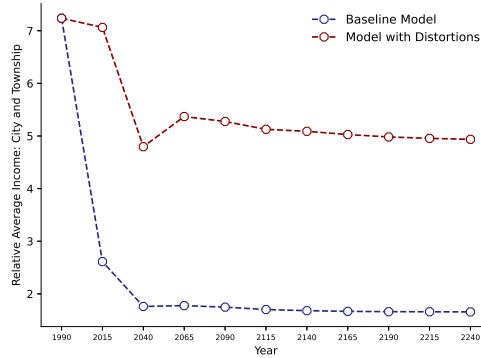


5.4 The role of Taxes and Amenities: Comparison of the Two Transitions

Relative to the baseline model, the profit tax sharply reduces the attractiveness of Townships for entrepreneurs, curbing business relocation and reinforcing the centrality of the City as a labor market hub. As discussed, this both prevents counterfactual firm migration and sustains observed in the data income gap between locations. In equilibrium, it also delays occupational and educational upgrading for Black entrepreneurs—slowing modern firm entry and reinforcing persistence in inequality across space and race.

The key difference between the two transitions is that Townships become less attractive in the distorted transition. A direct implication is that the average income gap between City and Township residents evolves very differently, as shown in Figure 8. In the undistorted, race-blind transition, this gap narrows rapidly. By contrast, in the model with location-specific distortions, the gap remains nearly flat in the first period and the gap persists in the long-run. This limited convergence results in more gradual asset accumulation of the Black population in the model with spatial distortions relative to the undistorted baseline. As a result, the average racial income gap persists longer since the majority of Township residents are Black. Importantly, a wider gap across locations also implies higher levels of income inequality along the transition path.

Figure 8: Income Gap Across Locations



To unpack the mechanisms making Townships less attractive, we start analyzing the fraction of entrepreneurs operating in the Township in the transitions predicted by the model with and without location-specific distortions. Figure ?? shows a natural consequence of the profit distortion in Townships: there are substantially fewer businesses operating in the Township. One important implication of this business reallocation is that labor demand drops substantially in Townships relative to the undistorted race-blind equilibrium. Therefore, the labor market for low-skill workers in the Township is depressed, limiting income-generating opportunities and asset accumulation for those who do not or cannot relocate to the City. Therefore, this reallocation of firm activity toward the City results in a sharper fragmentation of labor markets across space, with Townships increasingly functioning as low-employment, low-return peripheries.

The consequences of these spatial distortions are compounded by the amenity-driven housing market segmentation. Now, the presence of Whites and Blacks that can afford living in the City keeps housing prices there elevated relative to the baseline, crowding out poorer and less-wealthy Black households from relocating—even when they would benefit from better schools or job access. As a result, the process of selection of Blacks into the City is reinforced, preventing migration of the least productive and least educated as discussed above. These patterns sustain the slow convergence and the persistence of the spatial income gap, mirroring the data more closely than the baseline model, which predicts too rapid spatial and income convergence.

Crucially, these spatial barriers delay not just the geographic mobility of Black households but also their occupational and educational upgrading. Since entrepreneurship in Townships becomes less profitable, the traditional path to wealth accumulation through low-capital entrepreneurship is narrowed. And since access to high-return education and modern-sector jobs is concentrated in the City, this limits the transition of more disadvantaged Blacks into urban areas, reducing the intergenerational gains that come from better schooling and job opportunities. This implies that the spatial distortion not only limits income in the short run but dampens the prospects for income and skill upgrading over time, slowing down the convergence

in outcomes across races.

Ultimately, the spatial distortion imposed by the profit tax and amenity structure does not reverse the long-run path toward racial equality, but it slows the process substantially—particularly for lower-wealth, moderate-talent individuals who are left behind in Townships with low labor demand and limited access to human capital formation. However, the effects of selection across space are persistent in the sense that in the model with location-specific distortions the average income gap between City and Township in the race-blind steady state is larger, due to the fact that the marginal type migrating to the City is of lower ability.

6 Conclusion

We study the evolution of racial inequality in post-Apartheid South Africa, focusing on the role of Apartheid-era urban Townships on present-day inequality. We use historical data pre-, during, and post-Apartheid to establish some stylized facts about the evolution of inequality in South Africa across time and space. We show that spatially segregated cities became a salient feature of the South African geography during Apartheid and still shape the economic development of the country. We then investigate various factors, such as educational, occupational and residential choices, in the observed persistence of inequality.

Motivated by this evidence, we develop and quantify a model that features spatially segregated residential, educational, and labor markets to study the evolution of inequality and access to opportunity for Blacks within our calibrated model. The model accounts for general equilibrium and long-run effects that can complement the information given by micro studies. Moreover, the richness of our framework can be used to assess the impact of alternative policies to give access to opportunity.

Our findings underscore that improving labor market conditions in Townships is essential to fostering both spatial and racial economic convergence. We show how depressed labor demand in Townships generates limited capital and human capital accumulation, hindering income convergence and slowing down upward mobility. Addressing these frictions requires targeted place-based policies. For example, our analysis comparing transitions for high- and low-transportation costs suggests that improving (public) transportation infrastructure that reduces the effective cost of commute to the City labor markets can speed up racial and spatial convergence. Similarly, comparing the baseline and extended race-blind transition implies that making business operations more attractive in Townships, such as reducing corporate income tax rates (e.g., special economic zones) or extending advantageous loans to firms operating in Townships may increase labor demand there as well as their amenity value, and so speeding up convergence.

While South Africa's policy landscape has emphasized redistributive measures such as social grants and public employment programs (e.g., the Expanded Public Works Programme), these approaches often overlook the geographic and institutional barriers faced by Township residents. In contrast, our analysis suggests that place-based interventions tailored to Township-specific distortions—such as credit con-

straints, skill gaps, and spatial isolation—may offer more durable and equitable improvements in labor market outcomes. By directly addressing the structural barriers that limit economic participation, such interventions hold greater promise for reversing the enduring legacy of Apartheid geography.

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