8

Follow the data: computing the algorithmic periphery with credit scores and property values

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Digital technologies are transforming cities. Urban peripheries such as South African townships – the archetype of state-enforced segregation (Western 1981) – reflect the reconfiguration of urban economies and everyday lives in the era of digital capitalism: it takes a couple of clicks to notice the presence of these areas on property portals such as PrivateProperty or Property24. Every month, around 50 million users browse these online marketplaces, filtering properties by price, location and features. Networking buyers, properties and real-estate agents, these platforms integrate luxury neighbourhoods and impoverished townships into a single architecture, where abundant information comes in all data shapes: myriad numbers, rich textual descriptions, and piles of pictures and statistical widgets showing local market trends.

The technical possibility of seamlessly navigating this digital rendering of the post-apartheid city contrasts with the urban history of South Africa, where the housing market was harshly instrumentalised since the colonial era to separate and enforce racial segregation, generating long-lasting wealth inequalities. Under apartheid, Black South Africans were denied property rights in urban areas, and people of colour were forcefully relegated into urban peripheries; tasked with fostering White homeownership, building societies and banks mostly catered for the demographic minority while redlining townships. Nowadays racial discrimination is banned, and these same banks purchase marketing banners on property portals to advertise their three-minute online mortgage applications.

Like other sectors such as financial services and logistics, the housing market has been deeply reconfigured by the centrality of data and the rise of the platform economy in South Africa (Migozzi 2024a; Pollio and Cirolia 2022). Yet how this roll-out of digital technologies by both state and non-state actors affects the reconfiguration of urban spaces remains overlooked, despite the powerful role of housing markets in shaping urban forms and hierarchies. How do the conversion of land, housing and people into digital data, and the market practices associated with the information they convey, affect geographical inequalities and urban marginality? How are these informational flows, backed up by an avalanche of data yet inherently socially and spatially selective, producing informational peripheries through the networking of the material and digital worlds (Datta 2024)?

To answer these questions, this chapter adopts 'follow the data' as a method to investigate the digitisation and informational flows of the post-apartheid housing market, characterised by the large-scale circulation of consumer and property data. My contribution is twofold. First, I propose 'follow the data' as a method to examine the infrastructural anatomy, regimes of value creation and mechanisms of stratification that characterise urban geographies under digital capitalism (Birch 2023; Burrell and Fourcade 2021; Galster 2023; Sadowski 2020). Second, since informational flows play a key role in the production of informational peripheries (Datta 2024), I use follow the data to study the content, directionality and selectivity of these flows. Seeing and following data as 'digitally encoded information' (Ash et al. 2024) opens up empirical and theoretical ways to both disentangle the infrastructural plumbing and techno-political economy of informational flows and explain how they articulate inequalities of knowledge, wealth and power in the reconfiguration of urban spaces.

This chapter investigates the political economy and stratifying effects of informational flows that govern the post-apartheid housing market, following two data streams respectively fed by the credit reporting system and the digitisation of title deeds. Following these streams illuminates the daily functioning and calculative turn of the housing market, to reveal how homeseekers and homes become unequally seen and categorised by real-estate actors through the extraction, circulation and assetisation of data. The output of these informational flows – that is, credit scores and property values – shapes urban segregation and hierarchies: in the context of racialised indebtedness and extreme housing inequalities (James 2014; Migozzi 2020), these metrics are used on an everyday basis by real-estate agents and banks to sort out customers, assess mortgage applications

and categorise neighbourhoods. Informational flows therefore enforce a new regime of visibility across the post-apartheid city: under the formal market's algorithmic gaze, people and homes need to be identified and 'available for measurement' (Fourcade and Healy 2017, 19). Yet these flows are the product of racialised dispossession and inequalities, they come with data gaps, and their output consequently perpetuate biases towards precariousness and informality. Poor and indebted citizens, along with properties located in townships and informal settlements, are cast in the algorithmic periphery – ranked at the bottom of data-driven, ordinal categories (Fourcade and Healy 2024) that either exclude from the housing market or include on unfavourable terms. While integrated into the market's stack through their conversion into digital data (Masiero 2023), people associated with urban marginality are reframed by informational flows as digital outcasts, categorised as 'incalculable', 'invisible' or 'disqualified'.

The first section presents 'follow the data' as a method: by defining a starting point, a directionality and a sectoral scope, it becomes possible to sequence and model data flows across infrastructures and organisations, and identify crossing points and practices of data assetisation. The second section examines the identifiers that support the circulation of 'indexical data' (Kitchin 2014) – data that enable identification and linkages of datasets, underlining the informational legacies of colonialism and apartheid (Migozzi 2024a). I then unpack the institutional anatomy of two data streams – one for people, one for properties. At key crossing points, consumer and deeds data enter proprietary grounds: harvested, stored, analysed and commercialised, data are transformed into income-bearing assets for credit bureaus and analytics companies. The fourth section explains how the ensuing calculation of credit scores and property values constitutes the output of the market's informational flows, used every day by real-estate actors to sort customers and make lending decisions, affecting access to housing and residential mobilities. The fifth section examines how people and houses associated with urban marginality are cast in the algorithmic periphery of low scores and values, categorised by informational flows as 'invisible', 'incalculable' or 'disqualified'. Bringing into the conversation the scholarship on redlining (Aalbers 2005; Taylor 2019), the sixth and final section suggests a refinement of the empirical and theoretical lenses of the concept of the informational periphery, which needs to go beyond its focus on logistics and its definition of infrastructural redlining as bypassing or exclusion: I discuss how foregrounding the role of identification systems and the process of unequal inclusion is essential to better capture the making of informational peripheries.

Follow the data: starting and crossing points, sectoral scope and directionality

Following data flows across space and time opens up analytical possibilities to understand how digital technologies reshape urban spaces and livelihoods. Despite a wealth of studies on networks, platforms and big data, few studies, especially in in geography, offer a methodology to analyse how data actually circulate and affect practices, despite early calls to centre the role of big data (Kitchin 2013) and the wider infrastructural turn of the discipline (Graham and Marvin 2001). This might come as a surprise given that following 'things', such as commodities or financial flows, forms an integral part of the methodological toolkit to unpack the functioning of markets and disentangle power structures in relations of productions and exchanges (Cook 2004; Christophers 2011; Taffel 2023).

Yet following data generated by and circulated through digital technologies comes with significant empirical and definitional challenges. Data can be defined as a 'manufactured material that intrinsically has value' (Rob 2021), whose collection and analysis further drive people, firms and governments into the data-driven world of digital capitalism (Fourcade and Healy 2024). As data stand at the crossroads of manufacturing, valuation and decision making, follow the data opens up many questions: how are data generated and networked among actors and across infrastructures? How are data turned into economic assets? And, with regard to informational peripheries, how are data interpreted as legible information to shape the practices and imaginaries through which geographical inequalities are recomposed? Crucially, it is not only about *how*, but also about *where* and *when*: since data are inherently spatial (Dalton et al. 2016), the method of following needs to pay particular attention to places and temporalities in order to locate 'on what terms people are enrolled in regimes of data generation and collection' (Dalton et al. 2016), how these regimes affect processes of value creation, and, in return, how they affect organisation models, political governance and everyday lives.

Yet the nature of data in the twenty-first century might defy the most seasoned tracker. The volume and velocity of the digital traces left by human activities (Salganik 2017) make it impossible for a human eye to embrace big data – we can only see bits and parcels of the networked manufacturing process: small samples, extracts and queries, aggregated outputs, snapshots of lines of code. Big data are also 'always-on' – in a permanent state of production and circulation; access is difficult due to proprietary, multi-sited and relational databases; black-boxed algorithms and changing

engineering systems obfuscate the mechanisms of data creation – and the patterns they create (Salganik 2017). Since data are shapeshifting, found everywhere and always-on, one needs to adopt strategies to define the scope, directionality and perimeters of the investigation. In that regard, follow the data shares a methodological approach with 'follow the money', a common method in the discipline of geography. Since money too escapes clear-cut definitional boundaries, scholars use proxies to measure and map the volume and directionality of money flows, choosing a sectoral scope, and collecting digital traces of specific events: bond payments, mergers & acquisitions transactions, accounting lines etc. (Hughes-McLure 2022; Kass 2020; Wojcik et al. 2024).

Defining a starting point, a directionality and a sectoral scope opens up analytical potential to follow the data. Inspired by the scholarship on commodity chains, Akbari chooses the event of a personal video that failed to circulate during the 2009 uprising in Iran; following the traces left by the video, she reveals an 'intricate assemblage of organisations, policies, laws, code, software, people, and platforms' (Akbari 2020, 424). To unpack the political economies of internet infrastructures in Northern Europe, Flensburg and Lai follow data through the 'infrastructural layers of digital communication' (Flensburg and Lai 2023, 322), starting with 'the first stop' of the internet – local access networks such as optical fibre, mobile frequencies, satellites etc. Bates et al. introduce the concept of 'data journeys' (places of data production, processing, distribution and use) to map out the socio-material practices of UK weather data across sites and actors: starting from measuring instruments located in weather stations, they then trace how data moves across different 'sites of data practises' (Bates et al. 2016, 1–2). Common to the last two studies is the use of visuals to map and model data flows. What is, however, missing in all these attempts is using the follow-up process to examine a key dimension of digital capitalism: when and how data become an economic asset – a resource and a property which provide regular revenue streams (Birch et al. 2020).

Building upon these approaches, I choose a generic event, which is bounded geographically and temporally yet subject to many iterations: a bonded sale, wherein an ordinary buyer purchases a house with a mortgage. This type of transaction is the outcome of informational flows networking real-estate agents, banks and homebuyers, but is also the source of further data creation and circulation. Follow the data is therefore particularly suited to examining the digital assemblages that reshape real estate, an industry historically characterised by a strong appetite for data (Migozzi 2024b; Sawyer et al. 2014). It is also a timely

method for identifying the crossing points of extraction and circulation, through which data become subject to enclosure and assetisation (Birch 2023): real estate has indeed been the subject of multiple digital experiments that have platformed housing and land markets, reshaping their socio-technical construction and political economy (Cowan 2021; Fields 2024; Nethercote 2023).

This method of follow the data builds upon a decade of in-depth fieldwork on the real-estate industry in Cape Town to map and model the data streams triggered by a bonded sale. I conducted 116 interviews with stakeholders all along the market's value chain (buyers, real-estate agents, developers, mortgage originators, banks, data brokers, credit bureaus, attorneys), and shadowed agents in a real-estate agency located in Khayelitsha, Cape Town's largest black township, to better understand the paper-based and digital practices involved at every step of the transaction process. Buying a house might represent a trivial event, yet each step of the process (finding a property, obtaining a mortgage, signing an offer to purchase and a deed of sale, registering the title deed etc.) rests upon a flow of data, fed by manual entries and automated queries.

Observing and inventorying the data produced, circulated and interpreted by market actors, I propose a visual model of the data flows that govern the South African housing market (Figure 8.1). Like any model, it answers a need for simplification and abstraction (Chorley and Haggett 1967). Using the case of a bonded sale, I model the functioning of the housing market in two main data streams: one streams circulates information on people, the other on properties. I then follow data in two directions: upstream, looking at the data flows whose output regulates and conditions the transaction process; and downstream, looking at the data generated by the finalisation of the transaction. Converting land, housing and people into digital data, these informational flows recompose urban inequalities.

Data identifiers: South Africa's informational legacies

To follow data, one needs to look at the identifiers that support the creation, circulation and querying of data during the sale process. Identifiers play a crucial role in informational flows: as 'labels of physical and digital objects and services', identifiers are 'part of how we make sense of the world and communicate' (Open Data Institute 2020). In South Africa, two identifiers are necessary for any transaction such as a bonded sale: the ID number for the person, and the *erf* number for the property (Figure 8.1).

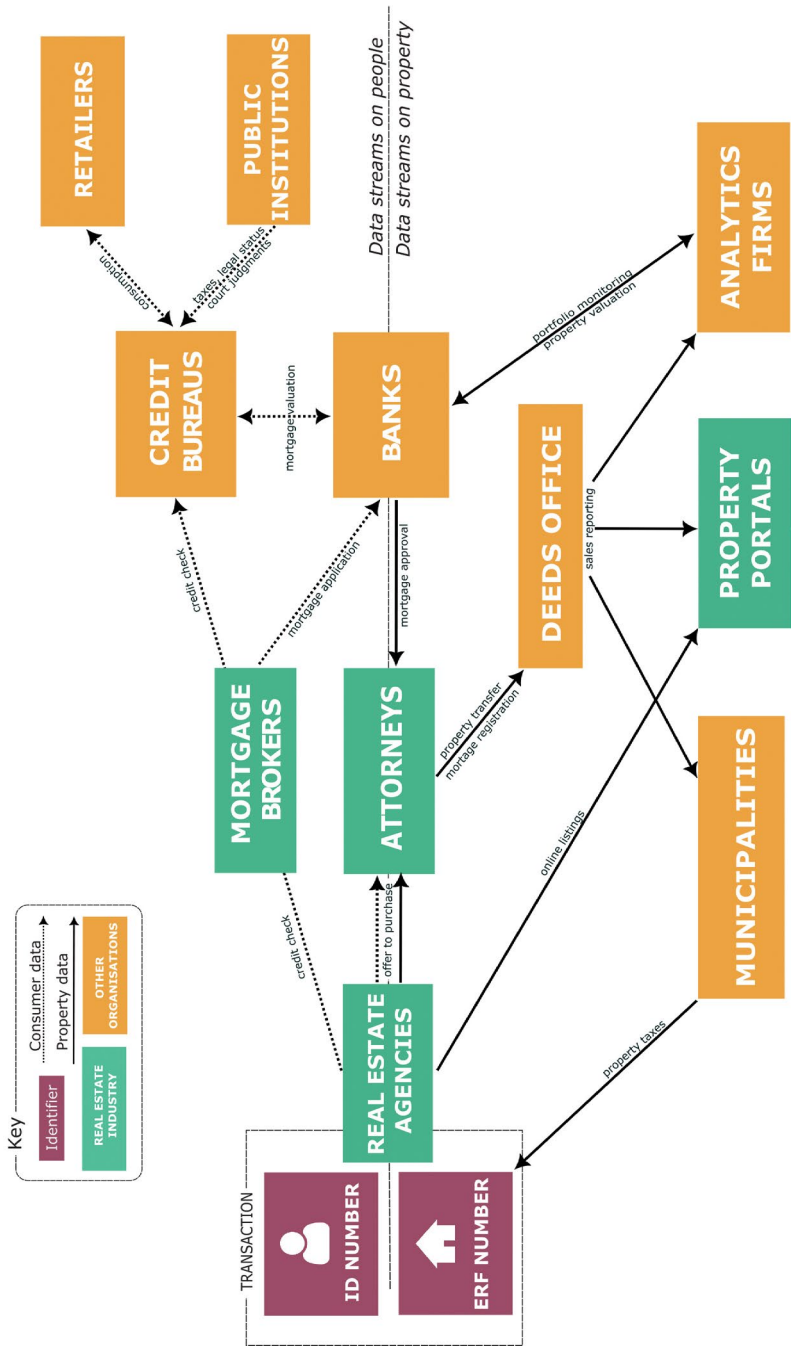

Figure 8.1 The housing market as a flow of data. Source: created by the author.

These identifiers structure informational flows, allowing stakeholders to circulate real-estate and consumer data at various steps in the transaction process: developers use *erf* numbers on printed estate layouts or online sales maps, increasingly popular in the industry; real-estate agents fill in these identifiers on templates such as offers to purchase; mortgage brokers feed them to their software to send mortgage applications to banks; banks use both identifiers to make lending decisions. Attorneys include these identifiers on the documents manually deposited at the Deeds Office, where a new title deed will be issued, marking the finalisation of the sale. A public institution, the Deeds Office manages the national property registry, including the registration of mortgages.

Unpacking the genealogy of these identifiers reveals the *longue durée* of the informational systems in South Africa. Both are rooted in the real-estate techniques of settler colonialism (Rogers 2016), where land was made through maps, cadastral data, deeds and land records (Sud 2020). In the South African 'racial regime of property' (Bhandar 2018), the classification of people into racial categories and bestowed with unequal rights is inseparable from the construction of land markets. The joint categorisation of people and land by property laws enforced the colonial racial order, promoting White economic hegemony through the restriction or denial of property rights for indigenous populations.

Let us examine the origin of the *erf* number: *erf* signifies 'plot of land' in Afrikaans – a clear legacy of Dutch colonisation. From the seventeenth century onwards, the use of cadastral maps and title deeds placed land into the hands of White settlers, allowing the emergence of the landed colonial elite (Dooling 2005). Land information systems were gradually harmonised during the colonial conquest, systematising dispossession in the process: from 1813, no transactions could be authorised without a prior inventory produced by the White-controlled Surveyor General. After the 1913 Native Land Act left only 7 per cent of the land to native populations, the 1927 Land Survey Act standardised the record system across the Union of South Africa, with a unique identifier attributed to each *erf* (Migozzi 2024a). As urbanisation progressed, more *erf* numbers got punched, shaping the informational landscape of housing markets.

ID numbers are similarly rooted in the country's colonial system of population classification, which largely predates apartheid (Christopher 2002): the use of racial categories for segregation purposes dates back to the nineteenth century (Bickford-Smith et al. 1998). Authorities conducted censuses that sorted South Africans into hierarchical, changing and contradictory racial categories, whose only consistency

was to erect whiteness at the top of the racialised social order. These techniques of classification paved the way for the apartheid state's mania for measurement (Posel 2000) and love of computers. The Population Registration Act of 1950 required every person to register and obtain an identity card. Deployed from 1955 and distributed to 6.5 million individuals by 1970, ID cards constituted both a 'totem' and an 'instrument' (Breckenridge 2014, 228) of apartheid – with one digit indicating the race of the card holder. To develop centralised databases of population registries, the state contracted with IBM and UK-based ICL.

The importing of computers and the storage of millions of paper-based fingerprints fuelled a managerial, racist ideology of perfect social control and complete segregation. Computers symbolised a modernist technopolitics of identity (Edwards and Hecht 2010): the Minister of Information declared in 1976 that computers made it 'possible for comprehensive data on each individual to be made available for a great many purposes' (quoted in Edwards and Hecht 2010, 627). A 1982 report entitled *Automating Apartheid* condemned the 'data systems [that] make up apartheid's automatic memory bank' (America Friends Service Committee 1982, 14). While incomplete, cumbersome and dysfunctional, these informational infrastructures survived the transition to democracy, and enabled the pioneering rise of the biometric state in South Africa. A 'smart ID programme' was rolled out, issuing new ID numbers with the purpose of not just identifying welfare recipients, but also enforcing surveillance and control (Breckenridge 2014).

The combination of *erf* and ID numbers shaped the production of urban hierarchies and spatial fragmentation. The Group Areas Act of 1951 divided cities into exclusive racial areas (Western 1981): all property transfers were governed by the ideology of racial homogeneity between the racial category of the buyer and the racial category of the property. This state-enforced, race-based fragmentation of the market resulted in extremely unequal market outcomes in terms of residential location, property rights and housing tenure, generating long-lasting inequalities of housing, wealth and life opportunities. Denied property rights in urban areas, Black South Africans were segregated into 'remote locations at the periphery of the city' (Maharaj 2020, 43), placed as tenants of the state housing stock in townships, or left with no option but to reside in informal housing. If democracy erased this racist control of the market, the infrastructural skeleton and identifiers of the apartheid era (Migozzi 2022) underpin contemporary informational flows through the circulation of real-estate and consumer data.

Data streams: assetising traces of debt and deeds

Going back to the visual model (Figure 8.1), I now examine the data streams linked to these two identifiers that condition a bonded sale. Real-estate agents, mortgage brokers and banks source large volumes of data, extracted from the credit reporting system via ID numbers, or resulting from the computerisation of title deeds. Follow the data reveals how the explosion of consumer credit and the rise of real-estate platforms precipitated the unprecedented datafication of people and properties (Migozzi 2024a), allowing credit bureaus and analytics firms to turn data into an economic asset.

When a person is interested in a property, the real-estate agent first needs to make sure the property can be legally sold to the aspiring buyer. This forms part of the 'Know Your Client' requirements under the Financial Intelligence Centre Act, which systematised queries sent to the databases of the Home Affairs National Identification System. Using *erf* and ID numbers, agents can verify the identity of customers and screen them against fraud databases, or check that the seller is also the rightful owner of the property. But identification is not the information that matters the most to them: in a landscape of structural indebtedness and low rates of mortgage approval, agents are mostly interested in accessing information on the customer's financial situation to assess the likelihood of their obtaining a mortgage. To that end, they perform, as early as possible, a 'credit check': before investing time and resource in preparing mortgage applications, real-estate agents, after obtaining consent from the buyer, use ID numbers to source automated credit reports and scores.

The flow of consumer data that produce these reports is vast and always-on, and constitutes an economic asset for credit bureaus. As required by the National Credit Act of 2005, each credit application, each opening of a credit account, each late, missed or completed payment leaves a digital trace circulated through the Data Transmission Hub, which is co-owned by the South African Credit & Risk Reporting Association and the Credit Bureau Association. This reporting system connects a vast amount of data sites, mostly places of consumption (retail stores, supermarkets, car dealers, telecom providers etc.) and places of financial services (credit providers of all sorts, from retails banks to micro-finance companies).

Consumer data are ultimately harvested, and, crucially, enclosed and assetised by major credit bureaus such as TransUnion and Experian. When entering these firms, data are cleaned, enriched, stored and analysed through proprietary algorithms. Bureaus then secure regular

and ample income streams by selling scoring solutions or batches of raw data to their clients and business partners. The volume and depth of data they hold is truly enormous – and value is in the volume. In 2021, the National Credit Regulator counted 26.42 million active credit consumers owning more than 85 million credit accounts – twice the size of South Africa's adult population. This information dragnet (Fourcade and Healy 2017) is continuously fed: the third quarter of 2021 counted more than 9.94 million credit applications, while banks and financial institutions generated 271 million inquiries (National Credit Regulator 2021). Through ID numbers, credit bureaus also source biographical and financial data from other institutions: legal information from the court system, property and mortgage data from third-party brokers, and tax data from the South African Revenue Service. The number of people falling under the bureaus' data gaze is expanding through daily consumption: in 2021, 750,000 consumers opened their first credit product in 2021, most of them for a clothing account or a personal loan (TransUnion 2023, 14).

The other stream linked to a bonded sale circulates property data (Figure 8.1). Banks are not only interested in screening the mortgage applicant: the location and value of the property, along with the bank's existing exposure to the neighbourhood, are also critical information that guides lending decisions. Going beyond the scope of their own mortgage databases, banks source geolocated and longitudinal data on past sales and bond registrations, which are registered at the Deeds Office. The circulation of property data from the Deeds Office constitutes another key crossing point for value creation: depending on its directionality, property data either enters a cycle of assetisation, or is integrated into mechanisms of urban governance. In the former case, property data constitute a flourishing business: analytics firms, such as Lightstone, MSCI and Loom, either directly or through data brokers, purchase on a weekly basis the fresh batches of data from the Deeds Office. Data are then cleaned, merged and commercialised to real-estate agencies and financial firms through fee-based platforms. Querying databases with ID numbers or *erf* identifiers, real-estate agents purchase automated reports computed at various scales: the property, the neighbourhood, the suburb or the municipality. The information is rich: aerial imageries, history of transactions (with names and IDs of past and current homeowners), estimated tax rates, size of the plot, surface of the dwelling, number of rooms, distance to various amenities, social composition of the neighbourhood etc. In parallel, public institutions also collect data from the Deeds Office for the purposes of public governance. Municipalities

such as the City of Cape Town update their property records in order to calculate property taxes. On a national level, the statistical government office sources data purchased by the South African Reserve Bank from a third-party broker to calculate the Residential Property Price Index, used to inform monetary and macro-economic policies, such as the determination of interest rates.

These two data streams, and the economy they sustain, highlight how the housing market now operates as a stack (Bratton 2016) that performs multiple steps of computation and identification for real-estate actors. Two metrics in particular are required for any bonded transaction: property values and credit scores. These outputs, through which people and houses are converted into digital data, both reflect and re-upload urban inequalities. They exemplify how informational flows, as interpreted by actors, re-enact the differential valuation of human lives and urban contexts.

Data outputs: performing credit scores and property values

As people and properties are converted into digital data, they simultaneously become the subject of automated calculation: during the transaction process, the computational power of informational flows turns people into credit scores, and homes into property values. Following data streams and their outputs reveals here the performativity of informational flows: banks and real-estate agents see homeseekers and properties through the numbers and ordinal categories (high risk/low risk; high value/low value) produced by scoring algorithms. As used and interpreted by real-estate agents and banks to make lending decisions, the combination of credit scores and property values results in highly unequal market outcomes that affect access to and the cost of housing, thereby shaping urban inequalities.

Property values are central to the political economy of housing, and under digital capitalism these values are more visible than ever in South Africa: sales trends and prices are displayed on property portals, while property reports are relatively cheap to buy. But this visibility contrasts with the black-boxed, multi-sited, conflictual determination of property values, which reflects unequal relations of power and capital. The calculation of property values indeed mirrors and enforces the racialised social ordering of people and spaces (Zaimi 2020), as exemplified by the undervaluation of Black neighbourhoods in the USA (Taylor 2019) or by the redlining of South African townships (Kotze and Van Huyssteen 1991).

The calculation of property values profoundly frames any transaction process: property values differentiate buyers in terms of affordability and locational choices, determine profit margins in the industry, and influence municipal budgets. All stakeholders are involved in their determination: developers negotiate selling prices with banks prior to construction and sale in order to secure the participation of mortgages lenders. Banks keep a close eye on property values, contracting with analytics firms to evaluate their mortgage portfolio – a necessary task to meet legal requirements and inform future commercial targets. This evaluation blends in longitudinal and geolocated data: risk-averse banks tend to limit their portfolio exposure in low-income neighbourhoods and townships where repossession is historically difficult (Oldfield and Stokke 2006). Finally, property taxes, which account for 25 per cent of the municipal budget in Cape Town, are determined by property values. The Valuation Department calculates 'market-based' values for each of the 885,018 properties located in the metro area, a process automated through a Computer-Assisted Mass Appraisal system adopted in the late 1990s. Municipal valuations are subject to frequent contestation from dissatisfied homeowners seeking a tax rebate. At every release of the valuation roll, real-estate agents strategically offer services of 'free valuation', contrasting the municipality's 'inaccurate' method with their own expertise.

The other data streams yield credit scores, which are used on a daily basis by real-estate agents, mortgage brokers and banks to process mortgage applications. The consultation of credit scores is another key crossing point where informational flows generate stratifying effects. In South Africa, a stable job and a high income – criteria that only 20 per cent of the population meet – are not enough to get a mortgage: homebuyers must also evidence sufficient credit scores and appropriate financial metrics to mortgage lenders. All South African banks use credit scoring to screen applications and price their mortgage offers, feeding consumer data into their proprietary scorecards (Migozzi 2020). A negative digital trace, such as a missed payment or a court judgment, automatically lowers the score: low-scoring applicants are then flagged as high risk. Credit scoring, therefore, produces unequal market outcomes. A low score is likely to result in outright rejection or higher interest rates, effectively prohibiting homeownership altogether or making it prohibitively expensive. Conversely, a high credit score grants lower rates and more mortgage offers. Most importantly, banks' scorecards and pricing models combine credit scores with loan-to-value, restricting the range of mortgage options available to homebuyers: a low score means

that buyers will be asked to increase their deposit, which automatically eliminates a lot of cash-starved, asset-deprived households. The calculation of property values and credit scores therefore discriminates against buyers not just in terms of access to and the cost of housing, but also in terms of the way they are treated during the transaction process. Real-estate agents interpret credit scores on the grounds of moral values, choosing to prioritise or turn away homeseekers. Bad debt, as 'picked up' by agents in credit reports, is associated with unhealthy, immature or irresponsible behaviours.

The hegemonic use of an automated, black-boxed, fee-based technology such as credit scoring meets all legal requirements in South Africa, notably the interdiction of racial discrimination. But if credit scoring is presumably colour-blind, debt is 'startlingly racialised' (James 2018, 818): credit scores – and the data streams that produce them – bear the watermark of previous racial regimes of property and mass indebtedness. Bad debt is prevalent in South Africa: 38 per cent of consumers have impaired records (National Credit Regulator 2022), and 67 per cent of over-indebted consumers are Black African (National Credit Regulator 2017). With stagnating salaries, inflation, mass unemployment (28 per cent) and high poverty rates (48 per cent), the use of credit scores effectively maintains racialised lending patterns, enacting data-driven, acute social sorting on proprietary grounds: scoring algorithms are protected by industrial secrecy. This data output might convey an impression of rationality through the use of statistical modelling (Fourcade and Healy 2024), but it leaves, problematically, unquestioned inaccurate data entries, misattributions of information and calculation errors, and these are common across credit reporting systems (Friedline et al. 2023). As seen by algorithms and their standardised outputs, urban marginality translates into low credit scores, placing the low-ranked population into the algorithmic periphery.

Incalculable, invisible and disqualified: the algorithmic periphery

Under the market's algorithmic gaze, people living at the margin of the digitised economy, working in informal jobs or facing precarious financial situations, are ranked at the bottom of data-driven categories, cast in the algorithmic periphery as invisible, incalculable or disqualified. Similarly, properties located in low-income neighbourhoods such as townships or informal settlements, or associated with other modes of land ownership

foreign to the Western definition of property rights, fall into informational gaps and territorial stigma. In that regard, the platformisation of housing markets, through voluminous and granular data streams, uploads 'twentieth century real estate ideologies into twenty-first century information technologies' (Fields and Rogers 2021).

In South Africa, informational flows cover about 6.8 million residential properties, with an estimated total value of 6.7 trillion rand in 2023 (Lightstone 2023). But as wide as this data stream can get, it remains by design remarkably incomplete, failing to take into account the reality of housing situations. Informal settlements, which house 20 per cent of households across the main metropolitan areas (South African Cities Network 2022), remain excluded from the market's digital view: this means that one urban dweller out of five lives in an 'incalculable' house, invisibilised by market reports and data analytics, hidden by property portals, relocated in the informational periphery. The 437 informal settlements and their six hundred thousand Capetonians (Cinnamon and Noth 2023) are therefore treated as digital outcasts. In parallel, digital enrolment and visibility are not synonymous with equal algorithmic treatment: if properties located in Black and Coloured townships are now fully integrated into the market's stack, in stark contrast with the apartheid era, properties in these neighbourhoods remain under-valued compared to formerly White-only areas (Migozzi 2020). The industrial practices, ideologies, norms and datasets that preside over the calculation of property values therefore reproduce the differential valuation of human life enforced by settler colonialism (Dorries et al. 2022).

In contrast, data streams linked to credit scoring bridge the gap between formal and informal housing markets, to encompass virtually the entire population. Whether or not people are aware of credit scoring or willing to be measured, credit scores can be computed and low scores attributed, even in the absence of data: low scores are a necessary output of the statistical modelling. Yet low scores are not only an output of having too much debt, missing payments or being blacklisted: people situated outside the data landscape of credit bureaus are also very likely to be assigned a low score. These people are, in the industrial jargon, 'invisible' customers. Unbanked individuals who pay in cash and avoid registered credit providers are cast into an informational gap hollowed out by the absence of digital history, or by a lower engagement with digitised public institutions. Yet from a statistical viewpoint, data paucity does not stop the calculative possibility: scoring algorithms simply attribute a negative weight to the absence of data, hence associating poor visibility with higher financial risk – and penalising homeseekers for being seen

as such. For that reason, agents and mortgage brokers encourage people to 'build up' their credit scores by opening a credit card and using credit parsimoniously, paying back in time. Expanded by new credit users, the data landscape is further extended by credit bureaus and data brokers that seek to harvest alternative data and develop new scoring methods. TransUnion recently launched a new product aptly entitled CreditVision Link, which pretends to 'see millions of previously "credit invisible" and "thin file" South Africans' (TransUnion 2021). Like Experian, the bureau partnered with Chenosis, a 'cross-industry API marketplace', to leverage telecommunications records with the aim of scoring the 'unscoreable' individual (Ranjan 2023).

People with low scores are grouped into two overlapping yet different categories: customers with 'bad debt'; and 'thin-file' or 'invisible' customers. Under the market's algorithmic gaze, being categorised as 'bad debt' or 'invisible' by informational flows leads to 'disqualification' from the transaction process. Depending on their credit scores and income, as well as their personal capacity to negotiate (for instance through private banking), homebuyers are either 'qualified' – that is, rendered eligible for mortgages – or 'disqualified' – categorised as uncreditworthy and rejected by mortgage lenders. As I observed while shadowing agents during fieldwork, banks, which have closed many local branches and reduced in-person interactions, communicate their decisions via email. A minimalist PDF letter states that the application is 'declined on score', 'does not meet the minimum requirements of our credit scorecard', is 'unsuccessful' because of the 'current credit profile', or is declined in view of a 'mitigated risk area'. No further explanation is usually provided. An output of automated calculation, the disqualification of homebuyers interrupts the transaction process. This has wider repercussions in terms of organisational practices: in the context of large-scale indebtedness, the real-estate industry (especially mortgage brokers) encourages homebuyers to obtain 'pre-qualification' certificates to present to the real-estate agent or a developer during initial interactions. This procedure can be completed online with ID numbers. While such a document is worthless from a bank's perspective, the procedure has gained ground in recent years, with the effect of further expanding the information dragnet. When submitting their personal and financial details to obtain a certificate of pre-qualification, aspiring buyers leave other digital traces and enrol themselves in the broker's databases.

To be 'qualified' or 'pre-qualified' under digital ID capitalism (Hicks 2020), homebuyers in need of housing finance are required to be identified as active consumers and to display appropriate, standardised

metrics of creditworthiness. Who gets to regulate this performative technology? Few people are even aware of their credit scores in South Africa, despite marketing campaigns to 'be smart about your credit' (Bendall 2023) and recent industrial attempts to penetrate subjectivities by gamifying scores and making them more familiar through smartphone apps. For instance, through a partnership with Experian, Standard Bank's app offers an add-on that provides monthly updates and tips on improving scores. Operating from behind computational walls, away from the buyer's eyes, concentrating data and power, credit bureaus and mortgage lenders score at a distance, exerting their classificatory power under poor public oversight. Neighbourhoods and populations subject to territorial stigmatisation and economic marginality have never been better seen than through an avalanche of data – but informational flows, in terms of metrics and social performativity, recast them in the algorithmic periphery, while turning data into an economic asset.

Widening the scope beyond logistics and exclusion

Seen from the digitised housing sphere, the making of informational peripheries needs to be captured from a double logic of *integration* (incorporating people and places into networked databases) and *ordering* (computing and interpreting unequal categories to read and act upon the social world). In that regard, the method of 'follow the data' reveals the inherent incompleteness and fragmented nature of data, and the performative function of identification systems. Yet the process of social ordering by identification, and the unequal networked geographies it sustains and creates, are not sufficiently acknowledged as a productive force in the current conceptualisation of informational flows and peripheries. One way to solve this tension would be to increase the empirical focus beyond logistics, and interpret the 'infrastructural and technological redlining' provoked by informational flows (Datta 2024) not in terms of 'bypassing' and 'exclusion', but rather as a process of unequal inclusion.

If logistics is key to the unequal incorporation of territories into global production networks, the new regime of governance that defines informational peripheries extends beyond the realm of logistics, as evidenced by the global spread of credit scoring and identification systems within and beyond emerging economies (Curran and Smart 2021; Hicks 2020; Opalo 2022; Wong 2003). Informational peripheries surge through the mediums of warehouses and labour markets, and also through the

ideology of identification and measurement – most of the time promoted by the alliance between the digitised state and IT companies, under the banner of promoting financial inclusion and fighting fraud and terrorism. E-commerce and social scoring are of course deeply related: as labour, trade, financial services and consumption become digitally mediated, more digital traces are generated, advancing the enrolment of people and territories into data regimes. Informational flows enact two logics: ordering by differentiation, given the uneven meshes of the information dragnet and the ordinal categories they produce; and integration by identification, given the organisational imperative to increase the volume and granularity of data.

These logics, weaving 'social measurement, differentiation, and hierarchy' (Fourcade 2021) through data-driven identification systems, therefore question what is currently designated as 'technological and infrastructural redlining' in the current concept of the informational periphery. At present, redlining designates how informational flows generate processes of bypassing and exclusion as productive mechanisms of the informational periphery (Datta 2024). Yet redlining is not only a practice of place-based exclusion, but also a form of discriminatory inclusion – seeking profit by charging people in poor areas higher rates for loans, mortgages or insurance (Aalbers, 2005). As an increasingly 'data-driven' practice (Koopman 2022), redlining should, then, rather be understood as unequal inclusion, computing preferential treatment or predatory lending practices (Taylor 2019; Wyly et al. 2009). Informational flows, especially at the scale of individuals, enact a shift towards individual-based treatment, charting unequal paths to financial services or housing. Current patterns of technological and infrastructural plumbing, as driven by state authorities, mean that more and more people are actually included in, rather than excluded from, informational flows – even if such inclusion takes place on asymmetrical, algorithmically obscure grounds (Burrell and Fourcade 2021). People might be 'fungible' for logistics labour (Datta 2024) in the informational periphery, but also, crucially, they are fungible for the purposes of market making and political governance, identifiable and calculable in a myriad of ways for political and commercial goals. It seems necessary to investigate the full spectrum of inclusion under technological redlining (Noble 2018) to fully grasp the making of informational peripheries.

Follow the data, find the digital outcasts

In this chapter I adopted 'follow the data' as a methodology, emphasising the need to define a sectoral scope, a starting point and a directionality to investigate data flows across infrastructures and organisations, to detect key crossing points of enclosure and assetisation, and to reveal when algorithms and data outputs become performative over urban lives and spaces. Informed by in-depth fieldwork within the real-estate industry in South Africa, I applied this method to map and model data flows across the housing market, choosing the generic scenario of a bonded transaction, and following data upstream and downstream from this event.

Harvesting traces of debt and streams of deeds, the real-estate industry feeds and plugs into always-on informational flows, through which people and properties are enrolled into data regimes and converted into digital data. The credit reporting system and the digitisation of title deeds feed two streams of data, both subject to enclosure and assetisation: as consumer and property data enter the proprietary grounds of credit bureaus and analytics firms, they become an economic asset – a resource and a property that generates revenue streams (Birch and Ward 2024). The calculative output of these streams – property values and credit scores – is commercialised to real-estate professionals, who interpret them to sort customers and allow or deny access to housing finance.

This chapter underlined how informational flows introduce a new regime of algorithmic visibility, in which people and properties 'must be visible, and available for measurement' (Fourcade and Healy 2017, 19). People and houses falling into informational gaps, failing to meet appropriate thresholds due to the structure of the economy, are ranked in the algorithmic periphery – categorised as low scoring, invisible or incalculable. Houses located in stigmatised neighbourhoods are subjects to under-valuation, while precarious and indebted homebuyers, wherever they live, can be disqualified from the transaction process. In that regard, the algorithmic periphery of post-apartheid South Africa attests that digital technologies have indeed broken down the 'conventional conflation of urban edge with the urban periphery' (Datta 2024). Yet it also highlights how social ordering in the digital world remains deeply connected to effects in the material world, as racialised inequalities of debt and income are uploaded into informational flows and affect their output.

Following the data, this chapter underlined the *longue durée* of infrastructures and identifiers, such as ID and *erf* numbers, through which 'human identities' and properties are converted into digital data

(Masiero 2023). Created to exclude, townships were not thrown into informational oblivion, but placed under the authoritarian gaze of the central state, municipal authorities and police forces. A dominated periphery, townships were imperfectly surveyed but violently surveilled. Property regimes obeyed a for-profit, racialised politics of identity, with identification systems paving the way for the datafication of people and property in the digital era. Pushing towards on-demand, granular information, real-estate stakeholders stack up financial and biographical data on properties and people: this networking of the digital and material worlds perpetuates the differential valuation of urban lives, casting the precarious and the informal into the informational periphery. These patterns of digitisation threaten to produce a poisonous equation between the algorithmically unseen, the economically informal and the politically illegitimate.

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