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# Long and short-distance internal migration motivations in post-apartheid Namibia: a gravity model approach

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2020

## ABSTRACT

The paper estimates a gravity model to analyse migration in contemporary Namibia, with the specific aim of understanding differences in long and short-distance migration. The sample is restricted to migrants moving in 2010 and 2011, who are between the ages of 20 and 49 years. Given Namibia's history of apartheid-era segregation, the sample is later restricted to African-language speaking migrants to determine whether the distances traveled to satisfy information and finance-constrained needs differ from that of the full population. A zero-inflated negative binomial model is applied to estimate the effects of constituency-level economic indicators, labour market conditions, agricultural activity, and built amenities on migration flows. Regression analysis shows that analyzing internal migration flows in Namibia without accounting for distance-related differences in migrant motivations may produce misleading results. Disaggregation of migration flows by distance reveals that for both the entire population and the restricted African-language speaking sample, constituency differences in amenity quality are significant predictors of intermediate-distance migration volumes. Per capita income differences in favour of the receiving constituency increase long-distance migration volumes. For all distances, previous migration in the sending constituency is a strong positive predictor of migration volumes.

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## 1. Introduction

Namibia's independence in 1990 solidified its borders with South Africa, which up until that point had been porous for citizens from both countries (Pendleton *et al.*, 2014: 193). These new cross-border controls, along with the elimination of internal migration controls (Frayne and Pendleton, 2002), were expected to set in motion two profound changes in Namibian population movement: labour migration to South Africa would likely decrease dramatically from its pre-independence levels, and *internal* migration and urbanisation in Namibia would possibly increase rapidly as labour markets could adjust more naturally.

The phenomenon of rapid urbanisation in Namibia since independence is evidenced by the population share growth of its most urbanised regions, Khomas and Erongo. By 2011 these two regions alone accounted for 23.3 percent of the population, up from 15.7 percent in 1991 (Namibian Statistics Agency, 2015: 2). While the role of migration in that urbanisation has been documented with descriptive statistics by the Namibian Statistics Agency's (2015) Migration Report, there has been no published research based on the 2011 Census delving into the regional *determinants* of migration flows.

Namibia's extremely low population density of 2.6 inhabitants per km<sup>2</sup> is the third lowest worldwide (World Bank, 2019). This, along with previous discriminatory legislation that contributed to much of its African-language speaking population still being concentrated on or near its northern borders, means that many Namibians have to migrate long distances to access urban labour markets in the economic centres of Windhoek, Walvis Bay and Swakopmund.

The combination of a vast landscape, and previous discriminatory controls on settlement that placed a large part of the population far from economic centres present two distance-related questions that may be of interest to migration researchers. The first is: Does distance act as deterrent in a country where traveling vast distances is inevitable? And secondly, do the distances that migrants travel differ because their motivations differ?

This paper therefore estimates a gravity model to analyse migration motivations in Namibia<sup>1</sup>, with the specific aim of understanding differences in long and short-distance migration flows. While gravity models have been popular for some time in analysing migration flows in and to developing countries, the paucity of bilateral data at small region level, particularly in panel data form, have

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<sup>1</sup> The gravity model approach is similar to the one used by Von Fintel and Moses (2018) in their study of South African migration.

made the application of similar models difficult in the African context. However, the recent Namibian Census 2011 has provided constituency-level information about migration choices, which make it a suitable candidate for gravity model estimation of internal migration flows.

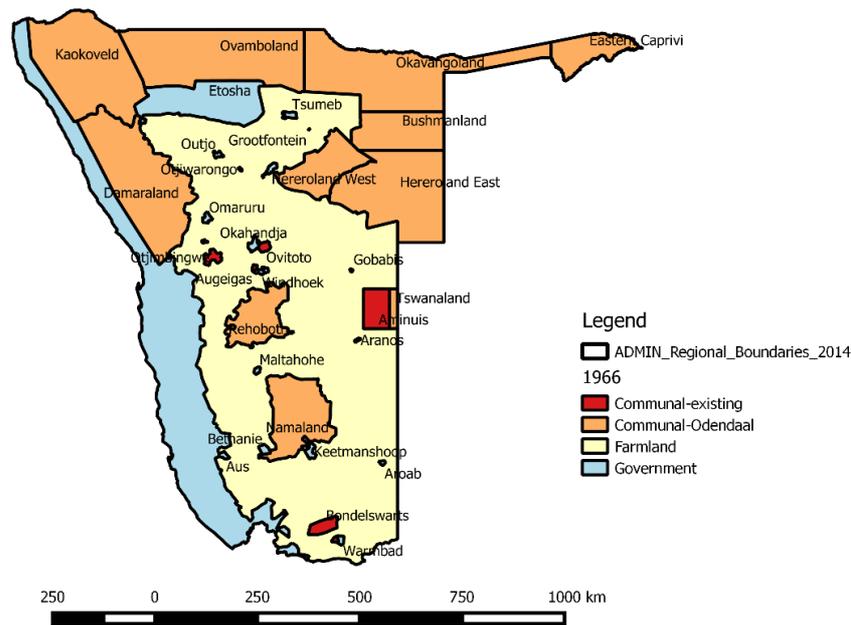
The paper is organised as follows: Section 2 contextualises the contemporary migration and urbanisation space in 20<sup>th</sup> century Namibia. Section 3 presents some of the international evidence on short and long-distance migration. Section 4 and 5 discuss the data and methodology, while Section 6 discusses the appropriate gravity model form. The results of the models are then presented in Section 7. The paper concludes in Section 8 with a brief discussion of the implications for future research on internal migration patterns in Namibia.

## **2. Migration and Urbanisation in 20<sup>th</sup> century Namibia**

Namibia's economic and population centres largely grew in colonial times (Tvedten, 2004: 400). Urban settlements in the South and the centre of the country grew under German rule from 1842 to 1914 as the country developed commercial centres in a bid to assert economic independence. Namibia's contemporary migration patterns have been shaped in large part by the South African occupation since the first World War. From 1915 to 1990, the South African government administered Namibia (then South West Africa) almost as a fifth province, extending its racially discriminatory policies to the region (Lawrie, 1964: 4; Frayne and Pendleton, 2001: 207). The migration of Black individuals to town and farming areas outside of communal land was therefore limited and controlled strictly, as was the case in apartheid-era South Africa.

Labour migration from Namibia's northern regions was officially governed by the South West African Labour Association (SWANLA) from World War II until the 1970s (Cooper, 1999: 122). Migrants were mostly contracted through SWANLA for physically demanding work in poor conditions on Namibia's diamond mines on its southern borders, farms, fishing factories in Walvis Bay and in small towns. Upon contract termination, workers were compelled to return to one of ten Bantustan regions of origin in the north (shown in orange in Figure 1). These Bantustans were created upon the recommendation of the Odendaal Commission of 1962, who recommended that Namibia's Black population only be allowed to own agricultural land and settle in these Bantustans (Frayne and Pendleton, 2002: 4).

**Figure 1.** *Bantustan borders, as determined by the Odendaal Commission in 1964*



NOTES: Shapefile uses 1966 boundaries as this is the first map that was produced by the Surveyor General of South West Africa after the Odendaal Commission's Proposals were implemented in 1964.

The development of commercial agricultural areas in Namibia's southern and central regions was made possible by cheap government-provided loans and relatively good market access (Pendleton *et al.*, 2014). Outside of commercial farms, Namibia's rural areas were characterised by poor growing conditions and low carrying capacity (Pendleton, 2014: 195). While the commercial farming sector, developed by White German and South African settlers, received much government assistance, the communal areas where Black residents had farming rights received almost no development assistance (Frayne *et al.*, 2001: 1059).

While Namibia's economic development continued to be biased towards the centre under South African rule, increased militarisation of the northern areas, and later incursions into Angola in the 1970s, fuelled the expansion of towns in the north. Initially established as administrative centres for the homelands proposed by the Odendaal Commission, these towns had basic government departments, schools, hospitals and police stations (Tvedten, 2004: 401). Towns in the north were typically segregated, with relatively well-serviced White suburbs, and informal settlements on the outskirts, where Black people could reside.

The war fought between SWAPO and the apartheid-era South African Defence Force from 1966 until the 1980s also heavily impacted the movement and settlement of Namibians in the north,

with many rural inhabitants being forced to move by the military (Frayne and Pendleton, 2001: 1060). South African separatist laws and policies applied to Namibia as well, forcing rural Black Namibians into communal areas outside of the White areas. These areas received very little from the government in the way of development assistance, further entrenching the deep inequality between deep rural and more urban areas (Kössler, 2000: 450). In addition, a veterinary fence<sup>2</sup> was created to separate communal areas in the north from commercial farming areas, and to prevent people and animals from crossing (Frayne and Pendleton, 2002: 4). Persistently low levels of agricultural activity in these regions have contributed to Namibia's rural areas being reserves for cheap labour, even after the country attained independence in 1990.

One of the more prominent towns to develop in the north under South African rule was Oshakati, established in 1966 and serving as a military stronghold for South African Defence Force incursions into Angola in the 1970s and 80s (Tvedten, 2004: 411). Its initial population of mostly military personnel grew as the needs of those military personnel grew. Military activity not only brought military employment opportunities for the local Ovambo people but also ushered in excellent road networks (Freund, 2006: 154), as well as a number of informal employment opportunities as a result of increasing settlement. This historical concentration of economic development in Oshakati makes it the most popular northern destination for rural-urban migrants<sup>3</sup>, despite employment prospects and living conditions being poor.

Apartheid controls on Black urbanisation were eventually relaxed in the 1980s, acting as a catalyst for rural-urban internal migration to Namibia's economic centres of Windhoek, Walvis Bay and Swakopmund. Windhoek, for example, the country's capital and one of its economic centres, had a population of 57 000 in 1968, with more than half of its inhabitants being White. By 1991, one year after independence, Windhoek's population had increased to 147 000 (Pendleton *et al.*, 2014: 193), with approximately two-thirds of its population now Black. While Namibia no longer classifies its population by race, examination of the Namibian Population and Housing Census 2011 reveals that 69% of Windhoek's 325 828 inhabitants speak an African language as a first language<sup>4</sup>.

The high net outmigration rates from Namibia's northern regions have been shaped in large part by apartheid-era migration and settlement policies. Migration is therefore a central part of many

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<sup>2</sup> The fence, known as the Red Line, was ostensibly created to prevent the transmission of cattle disease.

<sup>3</sup> According to the Namibian Population and Housing Census, recent in-migration rates to Oshakati town are only eclipsed by in-migration rates in Khomas and Erongo constituencies.

<sup>4</sup> Author's own calculations based on the Namibian Population and Housing Census 2011.

Namibian's lives, with many Namibians exposed to or actively participating in migration relatively early. Rural-born children often migrate temporarily to attend distant schools, while children born to parents in urban areas are also often sent to rural areas to be looked after by grandparents (Greiner, 2011: 611). This fostering period in rural areas often ends when school-going age is reached, as schools are predominantly located in Namibia's urban areas.

Adult Namibians from more rural regions also migrate to take advantage of urban labour market opportunities (Indongo *et al.*, 2013; Pendleton *et al.*, 2014). Throughout the migration process, urban-based families maintain strong relationships with their rural bases, allowing for what Greiner (2011: 610) refers to as a translocal organisation of households. This translocality allows the rural household with links to urban areas the ability to benefit from urban labour market opportunities through monetary and in-kind remittances. It also benefits the urban migrant in that they may have access to cheaper meat or dairy products, childcare for children left behind, and a possible place to retire after leaving the urban labour market.

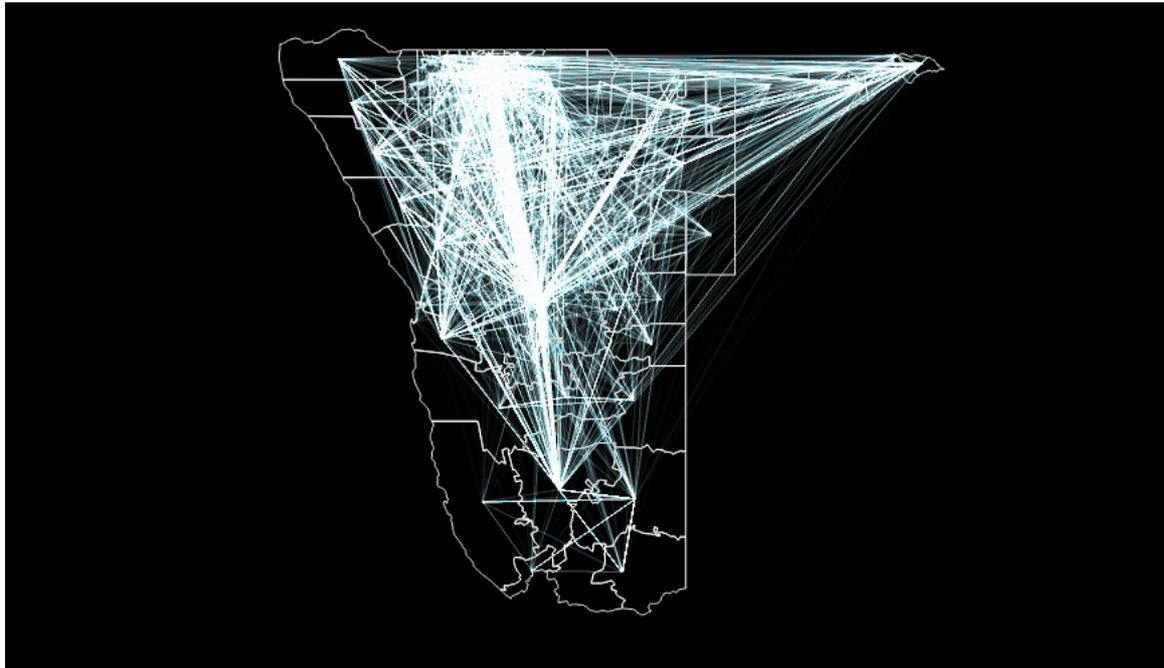
While the growth in Namibia's urban population from 28% in 1991 to 42% of its national population is in line with its blueprint for national development, Vision 2030<sup>5</sup> (Republic of Namibia, 2017), urban employment opportunities and formal housing have unfortunately not kept pace with urbanisation trends. Unemployment in 2011 in urban areas was estimated at 36.1%, while the rural area unemployment rate was 37.8% (Namibia Statistics Agency, 2013).

Despite high unemployment rates in urban areas, in-migration rates to the economic centres of Windhoek, Swakopmund and Walvis Bay are still amongst the highest in the country. Figure 2 shows internal migration flows for Namibians between the ages of 20 and 64 years old, within the twelve months preceding the Namibian Population Census 2011 interviews. The migration corridor from Namibia's northern region to the centre are clearly visible.

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<sup>5</sup> Vision 2030 highlights urbanisation as one of the key components to achieve a successful transition from its current mineral-based economy to an industrialised, knowledge-based economy.

**Figure 2.** *Internal migration paths in Namibia 2010 to 2011*



NOTES: Own calculations based on Namibian Population and Housing Census 2011.

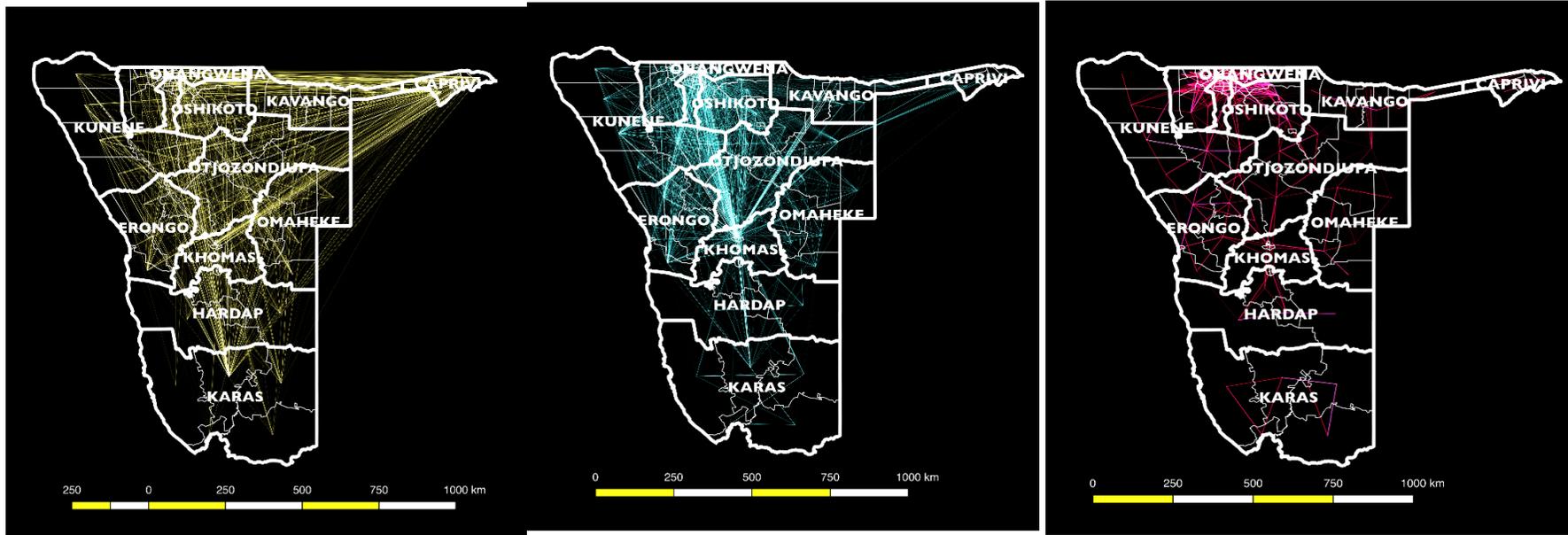
Disaggregation of the 2010/11 migration flows<sup>6</sup> by distance (shown in figure 3) reveals a few distinct flow patterns. Firstly, most long-distance migration (600 kilometres and further) originates from Namibia's far north-eastern regions. Secondly, intermediate-distance moves are dominated by migration between Namibia's former Ovamboland and Khomas. Lastly, short-distance migration flows are concentrated between constituencies along Namibia's northern border. More pointedly, 58.1% of Namibia's short-distance migration originates from regions within the former Ovamboland homeland borders (Oshana, Omusati, Oshikoto, Ohangwena).

These distinct migration corridors are only visible when disaggregating migration by distance travelled. However, the possible reasons why these migration corridors manifest themselves this way remain unanswered. It is for this reason that the next section of this paper delves into the international literature on short and long-distance migration, to understand the possible factors determining the distance travelled by internal migrants.

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<sup>6</sup> The migration distance intervals were constructed to roughly coincide with the bottom 25 percent, middle 50 percent and upper 25 percent of the actual migration distance distribution. Most rural-rural moves in Namibia are over relatively short distances, while rural-urban moves require moving longer distances on average.

Figure 3. Migration paths between constituencies in Namibia 2010 to 2011, by migration distance interval



3A. Long distances ( $d \geq 600$  km)

3B. Intermediate distances ( $200 \text{ km} \leq d < 600$  km)

3C. Short distance ( $100 \text{ km} \leq d < 200$  km)

NOTES: Namibian Population Census 2011 data used for the calculation of all migration flow volumes and distances between constituencies ( $d$ ). Sample includes only African language-speaking men and women between the ages of 20 and 64 years old.

### **3. Short and long-distance migration: differences in motivations**

Much of the research attention on migration in both the developing and developed worlds has focused on individual migrant motivations, but little work has been done to determine whether those motivations differ by the distance travelled. Distance has typically entered migration models as a deterrent to migration due to the economic and psychological sacrifices that migrants make. This framing of distance as a deterrent underpins the notion that migrants will move as short a distance as possible to achieve their (information-constrained) goals (Stouffer, 1960; Ritchey, 1976). As a result, internal migration in an information-constrained environment is likely to be dominated by moves that are as short as possible (and by implication least costly) to satisfy migrants' desires.

In the few migration studies that disaggregate migrant motivations by distance, crossing administrative borders has typically served as proxies for distance travelled (White and Meuser, 1988). Movements within regional or provincial borders would generally be defined as short-distance moves, while movements across those initially defined borders would be defined as long-distance moves. Such studies have produced results that are largely consistent with conventional understandings of migrant motivations: short-distance migration is motivated by housing quality or size changes, while long-distance moves are motivated by labour market considerations. Owen and Green (1992), for example, find that British home buyers with mortgages generally moved short distances (16 kilometres and nearer) in response to housing factors, such as home size increases, or life-stage factors such as a change in marital status. Long-distance migration, on the other hand, is often associated with a change in residence as a result of, or in anticipation of, a change in employment or employment-seeking strategies (Owen and Green, 1992; Clark and Huang, 2004; Stilwell and Thomas, 2016).

The same dominant motivations for short and long-distance migrations are found using longitudinal data between 1970 and 1992 in the United States (Clark and Davies-Withers, 2007), Census data in the United States (Schachter, 2001) and longitudinal data in Sweden (Niedomsyl, 2011; Niedomsyl and Fransson, 2014). While these studies use varying thresholds to define the difference between short and long-distance migration, the overarching view is consistent – short-distance moves are motivated by housing reasons, more often than not, while long-distance moves are mainly for employment reasons.

The disruptive nature of long-distance moves relative to short-distance moves is explained in Roseman's (1971) categorisation of migration types as either partial displacement or total displacement migration. Partial displacement involves a change of only one or some important places normally visited on a regular basis, such as a change in workplace or school. Total displacement would involve a change of all places normally visited, normally because the dominant place of residence is some distance from the previous place of residence. Given that the level of disruption increases with distance, potential migrants are disincentivised to move further than would satisfy their needs.

While the findings for developed countries are relatively consistent in the literature, applying the same distance yardsticks to developing countries, particularly in the African context, may prove difficult. The difficulties stem not only from the paucity of longitudinal data, but also the spatial configurations of economic activity in developing countries. Developed countries generally have a number of economic nodes that sustain employment spread across most of their respective landscapes. In contrast, developing countries generally have economic activity concentrated in and around capital cities, while large parts of their respective landscapes are dominated by rural or semi-urban regions with low levels of economic activity and employment. In addition, many African countries' rural regions are large in area, sparsely populated and have poor transport infrastructure.

There are some technical hindrances involved in the border-crossing approach to distance differentiation (Wong, 2009; Niedomsyl and Fransson, 2014: 359), the most obvious of these manifesting itself in the case where migration involves crossing two boundary levels. For simplicity's sake, assume that in a study short-distance migration is defined as crossing a municipal boundary, while long-distance migration is defined as crossing *both* municipal and provincial boundaries. Using this framework, migrating between municipalities that are adjacent to each other, with each municipality located in a different province, would be classified as long-distance migration. Similarly, moving from one municipality to another within a very large province could be classified as short-distance migration, when the determinants and outcomes of that migration decision are more consistent with that of long-distance migration. While this zonation effect can be dealt with by adding a further qualifier of contiguity or non-contiguity of areas (as in Jun and Chang, 1986), the distinction between short and long-distance migration is still likely to be inconsistent within and across studies, making analysis of the differences between the two phenomena difficult.

An alternative to measuring distance for use in migration models is calculating the centroid-to-centroid distance between areas (Stilwell and Thomas, 2016: 32). Distance can be measured from direct responses to survey questions or inferred from migration question responses that detail where the previous place of residence was, and the current residence. Coupling this information to shapefile coordinates, the Euclidean distance in kilometres between centroids can be calculated<sup>7</sup>. Naturally, as the areas of sending and destination regions increase, the accuracy of centroid-to-centroid distance declines. While it is not a perfect measure, in the absence of detailed address information or coordinates, the centroid-to-centroid method of computing distance is an improvement over simple binary distance measures (such as intra vs inter-provincial migration).

#### 4. Data

The primary source of data to describe and analyse internal migration in Namibia is the full Namibian Population and Housing Census 2011 collected and produced by the Namibian Statistics Agency (2011). The Census questions that allow for the analysis of internal migration patterns are:

1. “Where was (NAME)'s mother usually living when (NAME) was born?”
2. “Where does (NAME) usually live?”
3. “For how long has (NAME) been living at this place?”
4. “Where did (NAME) usually live since September 2010?”

(Namibian Statistics Agency, 2012)

These questions allow researchers to analyse migration propensities and correlates along two dimensions:

1. The birthplace, coupled with the usual place of residence, allows researchers to analyse lifetime migration patterns. Lifetime migrants are defined as those individuals whose current place of residence differs from their place of birth. If the place of birth and usual place of residence are specified at the same level of geographical aggregation within the same Census, net lifetime migration frequencies and rates can be estimated.
2. “Where did (NAME) usually live since September 2010?” allows researchers to consider short-term migration propensities and patterns in the year preceding Census 2011 (which was collected between 28 August and 15 September 2011). Again, this would provide

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<sup>7</sup> This paper makes use of the Stata package *geodist* (Picard, 2019) to calculate the Euclidean distance between centroids.

more current insights into which regions and constituencies are the largest and smallest net gainers and losers of population through migration.

Census 2011 data can also be combined with the Namibia Household Income and Expenditure Survey 2009/10 (hereinafter referred to as NHIES 09/10) data to determine whether constituency-level factors such as unemployment rates and poverty rates (or differences therein between regions) may contribute to lifetime and short-term migration probabilities. The NHIES 09/10 is temporally convenient to match with Census 2011 migration data as it describes labour markets and living conditions immediately prior to the migration decision (to stay or migrate) made in the September 2010 to September 2011 period.

Analysis of inter-constituency migration was previously not possible in Namibia, as older datasets did not have the required depth of geographical disaggregation. For example, while the 2001 Namibian Census also asks questions related to migration, the sending region for migrants is only specified at regional level. Since the 2011 Census is a full Census, the combination of coverage and geographical depth allows for a nuanced analysis of migration that is rare in the African context.

This study analyses internal migration flows of individuals aged 20 to 49 years between constituencies in the year preceding the collection of the 2011 Census (NSA, 2014). The lower age limit is chosen based on the assumption that individuals aged 20 and older are likely to have left school. The upper age limit is assumed to coincide with substantial decreases in migration probabilities. The study excludes immigration flows into Namibia as well as foreign-born nationals from the sample, as their birth places are not defined in as great detail as it is for locally born individuals.

In line with Long *et al.* (1988: 634), this study assumes that migration starts where regular commuting ends. In other words, when commuting becomes too inconvenient or expensive due to the distance between the home and the workplace, a change in residence to overcome the vagaries of long commutes is understood to be migration (Shyrock and Siegel, 1971: 617). The uppermost bound of commuting is therefore assumed to be 100 kilometres, which is consistent with Von Fintel and Moses (2018).

## 5. Methodology

A gravity model will be used to investigate migration flows between constituencies in Namibia. For the purpose of this paper, migration will be defined as the crossing of any one of Namibia's constituency borders for resettlement purposes.

Gravity models of migration are used to measure the degree of interaction between two locations and are rooted in Newton's law of universal gravitation, which was popularly applied to migration research in the 1960s (see for example Sjaastad, 1962). When applied to migration flows between two locations, the gravitational relationship between regions predicts that demographic interaction is directly proportional to the population sizes in both sending and receiving regions and inversely related to the distance between sending and receiving regions (Stewart, 1941: 89).

In its early forms, the gravity model was often specified as  $M_{ij} = \frac{P_i^{\beta_1} P_j^{\beta_2}}{D_{ij}^\alpha}$ , which in double-logarithmic form would yield elasticities of migration flows between regions  $i$  and  $j$  in response to regional factors.

A comprehensive migration flow equation includes variables which describe economic, political and demographic characteristics in both sending and receiving locations. Only inter-constituency flows are considered, so that 107 constituencies with 106 possible destinations produce a matrix of 11 342 migration dyads (sending-receiving constituency combinations). Following Karemera, Oguledo and Davis (2000: 1747 – 1748), the empirical specification of the gravity model between constituencies  $i$  and  $j$  will be:

$$m_{ij} = \beta_0 + \beta_1 d_{ij} + \beta_2 n_i + \beta_3 n_j + \beta_4 Y_i + \beta_5 Y_j + \beta_6 U_i + \beta_7 U_j + \beta_8 G_i + \beta_9 G_j + \beta_{10} A_i + \beta_{11} A_j + \beta_{12} K_j e_{ij}$$

where  $d_{ij}$  is the straight-line (or Euclidean) distance between the centroids of regions (which is a proxy for the costs of migration between regions),  $n_i$  and  $n_j$  the respective populations in the sending and destination regions before September 2010 and  $Y_i$  and  $Y_j$  are the incomes per capita in regions (from the NHIES 09/10 and which serve as a proxy for regional economic performance).  $U_i$  and  $U_j$  are the unemployment rates in regions  $i$  and  $j$ .  $G_i$  and  $G_j$  refer to government services in both regions while  $A_i$  is the proportion of the population in the sending area that is between 20 and 49 years old.  $K_j$  refers to a "migrant-friendliness" variable in the destination region, which is specified as the percentage of previous migrants in region  $j$  who were not born in region  $j$ , but did not move in the last 12 months. The independent variables are

specified separately by sending and receiving region, but can also be specified in ratio form ( $x_i/x_j$ ) when the need arises.

The relatedness of constituencies in close proximity to each other is a possible source of bias and inconsistency if not controlled for. To account for spatial autocorrelation between constituencies  $i$  and  $j$ , a spatial weighting matrix will be estimated. This matrix, where the off-diagonal elements contain the inverse of distance  $d_{ij}$  between constituencies, are included as an additional control in regressions to describe the strength of the relationship between constituencies (Von Fintel and Moses, 2018: 260). The eigenvectors of  $(I - \frac{1'1}{n})W(I - \frac{1'1}{n})$  are estimated, where the identity matrix is  $I$ , and  $1$  is a unit vector. The sum of eigenvalues within these eigenvectors represent the level of spatial autocorrelation. The gravity model includes all eigenvectors where the absolute value of  $\frac{\lambda_i}{\lambda_1} > 0.25$  ( $\lambda_1$  being the largest eigenvalue).

A brief justification for the inclusion of each of these variables is included in sections 5.1 to 5.5, categorised as gravity, economic and labour market, environmental and network variables. A summary table of variables and their descriptions follow.

### 5.1 Gravity variables: population size and distance

Gravity variables include distance between origin and destination regions, which is negatively related to migration flows, and population sizes in both regions, which is positively related to migration flows (the initial component of the gravity model explained earlier in this section). It may also include a destination area network component, which is expected to be positively related to migration flows.

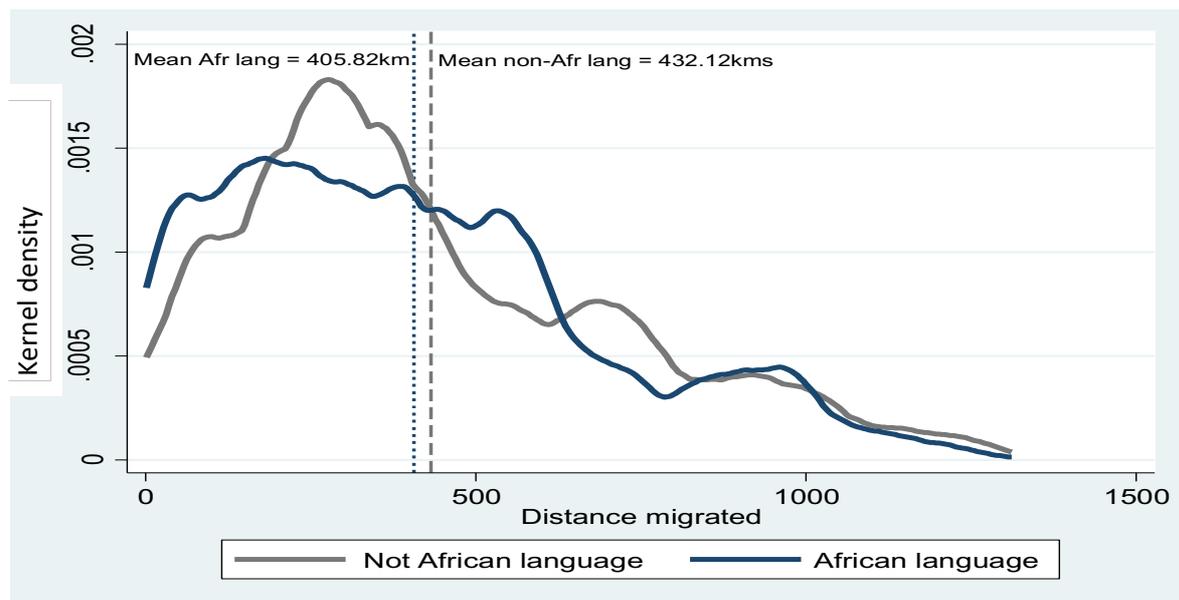
Tobler (1970: 236) developed the First Law of Geography as an extension of gravitational principles, stating that “everything is related to everything else, but near things are more related than distant things”. This formal statement of the principle of distance decay for migrant volumes has been explained theoretically in a number of ways. The inclusion of distance in gravity models was originally meant to serve as a proxy for the pecuniary costs of relocation, such as transport and accommodation costs, and the cost of obtaining information about the destination region, which enjoy a positive relationship with distance.

The intervening opportunities literature also posits that the longer the distance between origin and destination regions, the more job opportunities migrants would have to sacrifice between

origin and destination (Wadycki, 1974). Later literature also recognises the non-pecuniary costs of migration that presumably increase with distance (Bouare, 2002: 25). Some of the resistance to traveling long distances is rooted in the desire for proximity to the family base, where social capital and economies of scale benefits are likely to be strongest (Stillwell and Thomas, 2016: 31).

Kernel densities for distances travelled by adult migrants are shown in figure 4, disaggregated by the individual's first language. Migrants are split into these two language groups to examine the possibility that previous racially discriminatory barriers to migration and settlement in Namibia may still affect the distance travelled by migrants. The mean distance travelled by African-language speaking migrants is 405.82 kilometres, while the mean distance travelled by other-language speaking migrants is 431.12 kilometres. The difference between these two distributions is driven in large part by the fact that many migrants from Namibia's northern regions migrate within the northern regions (shown before in Figure 3).

**Figure 4.** Kernel density of distance covered, by language spoken



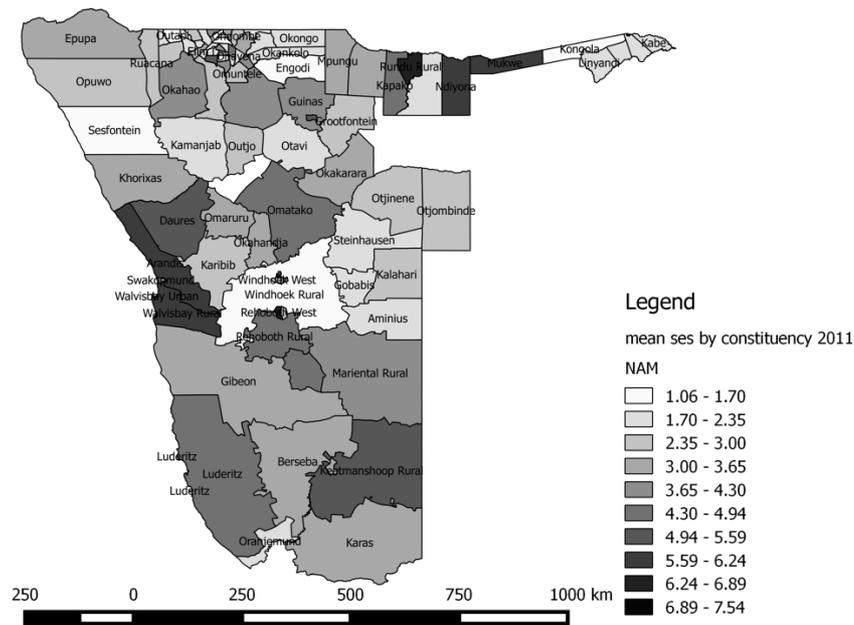
NOTES: Own calculations based on Namibian Population and Housing Census 2011.

This study therefore employs the Euclidean distance between constituency centroids as a proxy for economic and psychological costs of migration. The distance variable's secondary role will be to differentiate migration motivations.

## **5.2 Economic and labour market variables**

Differences in economic opportunity between regions have long been a central explanation for inter-regional migration. The central prediction of the disequilibrium model of migration, popularised by Hicks (1932), is that migration flows between regions arise because of initial inequalities in unemployment and wages. These regional disparities would continue to fuel migration until wages and unemployment rates were equalised over space. Figure 5 shows per capita incomes at the constituency level using data from the National Household Income and Expenditure Survey. Higher incomes are concentrated on Namibia's coast in the Erongo region, and within a few constituencies in Khomas.

**Figure 5.** *Log per capita incomes in Namibia 2009, by constituency*



NOTES: Own calculations based on Namibian Household Income and Expenditure Survey 2009 data. The income per capita is calculated at the household level, log-transformed, and then averaged at constituency level.

The income per capita of a region is expected to be a key determinant of the attractiveness of a region (see for example Shen, 1999; Biagi *et al.*, 2011: 116; Beine, Bertoli and Moraga, 2014: 13), not only as a signal of labour market returns to migration but also as a signal of other quality-of-life factors which are expected to increase with income, such as more choice of non-essential consumption items, entertainment and reduced crime rates. These quality-of-life factors are also assumed to be positively related to regions where there are high education levels on average. As the NHIES is not representative at the national level, the relationship between incomes per capita from NHIES and the proportions of adults who are highly educated within constituencies (considered to be a slow-moving variable) from Census 2011 is tested using a lowess regression. The results are shown in Figure A1 in the Appendix of this paper. The piecewise correlation coefficient between these two variables is 0.83. This indicates that incomes per capita are very closely tied to the proportions of the population that are highly educated in Namibia, and inspires some confidence that incomes per capita from NHIES are not unsuitable for use at constituency level.

Labour market conditions have been included in seminal discussions of internal migration decisions by luminaries such as Harris and Todaro (1970). Differences in unemployment rates between origins and destinations have been shown to stimulate migration flows in the southern African context (Kok *et al.*, 2006). Moses and Yu (2009: 95) show that broad unemployment rates

act as a push factor affecting migration from the Northern Cape (a South African province on Namibia's border).

The effect of differences in economic opportunity on migration flows are therefore tested using unemployment rate and household income differences between constituencies, from the National Household Income and Expenditure Survey 2009/10 (Namibia Statistics Agency, 2010). Constituency-level unemployment rates are calculated as individuals between the ages of 15 and 64 years, unemployed and actively looking for work, as a proportion of the active labour force.

### **5.3 Government service and environmental variables**

The importance of natural and non-natural amenities as being a driver of internal migration has been explored in some detail since the early 2000s. The relative weight of natural amenity differences in migration decisions have varied from significant to insignificant. Areas with more temperate climates has been found to be instrumental attractors of migrants in the United States, for example (Rappaport, 2007). Regional disparities in natural amenities such as national parks and climate have also been found to influence migration flows between regions in the United States (Partridge and Rickman, 2006). However, the evidence supporting migration as a function of natural amenity differences is weaker in Canada (Ferguson *et al.*, 2007) and Europe (see for example Biagi *et al.*, 2011). Nevertheless, as the agricultural sector provides jobs for 27.4% of Namibia's employed population (Namibia Statistics Agency, 2013: 9), a normalised differenced vegetation index (NDVI) aggregated at constituency level is included to represent the agricultural performance for each constituency.

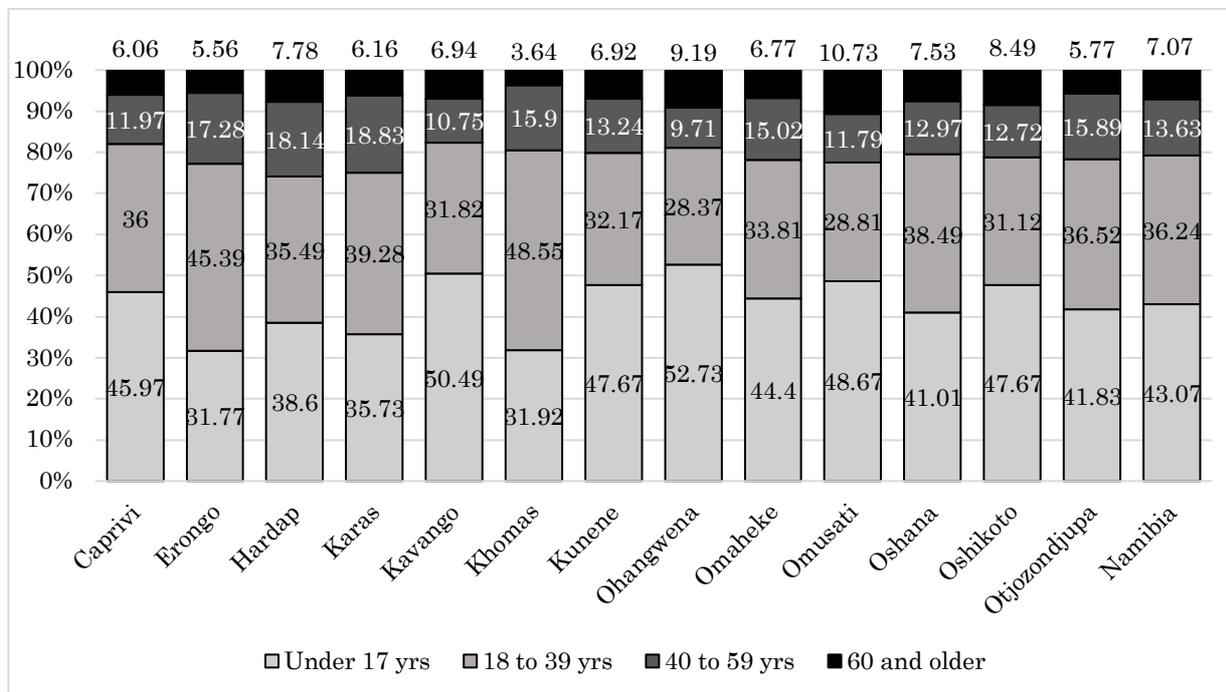
Environmental variables not only refer to those variables related to the physical environment such as climatic conditions and shocks but also factors related to the built environment such as the degree of urbanisation and access to leisure activities. Schools in Namibia are generally clustered in more urban areas, with rural areas having few schools. The Namibian National Household Income and Expenditure Survey 2009/10 contains data on the distance to school in kilometres. The data is converted from its original interval form to midpoints, after which the mean distances to school are determined for each constituency.

### **5.4 Demographic variables**

Contemporary approaches to internal migration have attempted to find rational explanations for the paradox of continued migration flows from rural areas in the face of poor labour market

prospects in urban destination areas. The New Economics of Migration school of thought depicts rural-urban migration as being an attempt by the rural household to diversify income sources (Stark, 1991). According to this theory, internal migration is a decision to maximise total household income by splitting the household into the rural base and satellite household. By diversifying income streams in this way, total household income is supplemented by cash income from young adults sent to urban areas. Young adults are more likely to migrate for a number of reasons that include lower psychological costs and higher education levels which position them more ideally for labour market success than would be the case if older household members migrate (Greiner, 2011: 611). Namibia's age structure by region is shown in Figure 6.

**Figure 6.** Broad age structures in Namibia in 2011, by region



NOTES: Own calculations from Namibian Census 2011. Age categories defined as child (younger than 17 years), younger adult (18 to 39 years), older adult (40 to 59 years), and retirement age adults (60 years and older).

Its most urbanised regions, Khomas and Erongo, have the highest proportions of young adults at 48.55% and 45.39%, respectively. In contrast, Namibia's more rural northern regions, such as Kavango, Ohangwena and Omusati, have very child-heavy populations, with approximately half of their citizens being younger than 18 years of age. Just as is the case in many sub-Saharan African countries, these age structure differentials between urban and more rural regions illustrate the impact of age-selective nature of migration (Tvedten, 2004: 404).

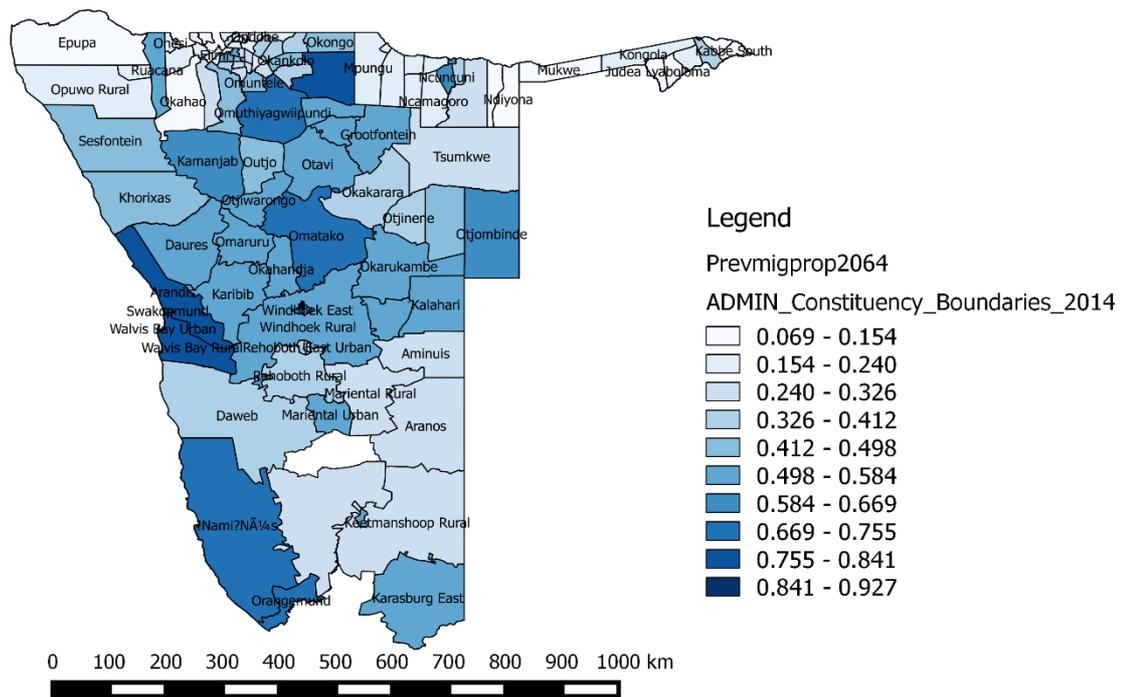
The inclusion of constituency-level age structures in migration modelling is based on findings from microeconomic analyses that migration is highly age-selective (Biagi *et al.*, 2014). Therefore, migration flows are expected to be larger between constituencies where young adults constitute a large proportion of the total sending population. Thus, in this paper, the proportion of adults between the ages of 20 and 49 years in sending and receiving regions are both expected to positively affect the gross migration flows of prime-aged adults between constituencies  $i$  and  $j$ .

### 5.5 Previous in-migration

Von Fintel and Moses (2018) show that in South Africa current migration paths are very similar to previous migration paths. The migrant destinations are typically urban areas where economic activity is concentrated. If this is true for Namibia as well, migrant destinations that were popular in the not-too-distant past are likely to be popular in the period under consideration, barring major shocks to the other variables that are expected to affect migration decisions profoundly.

Figure 7 shows the proportions of constituency populations who identify as having been born elsewhere than their current constituency but did not migrate in the last year (the proxy for previous in-migration rates). The constituencies with the highest proportions of previous migrants are Windhoek East, Arandis, Swakopmund and Walvis Bay, all of them concentrated in Namibia's most affluent regions of Khomas and Erongo.

**Figure 7.** Previous migrants as proportions of receiving constituency populations



NOTES: Own calculations based on Namibian Health, Income and Expenditure Survey 2009 data .

**Table 1.** Summary statistics and description of independent variables

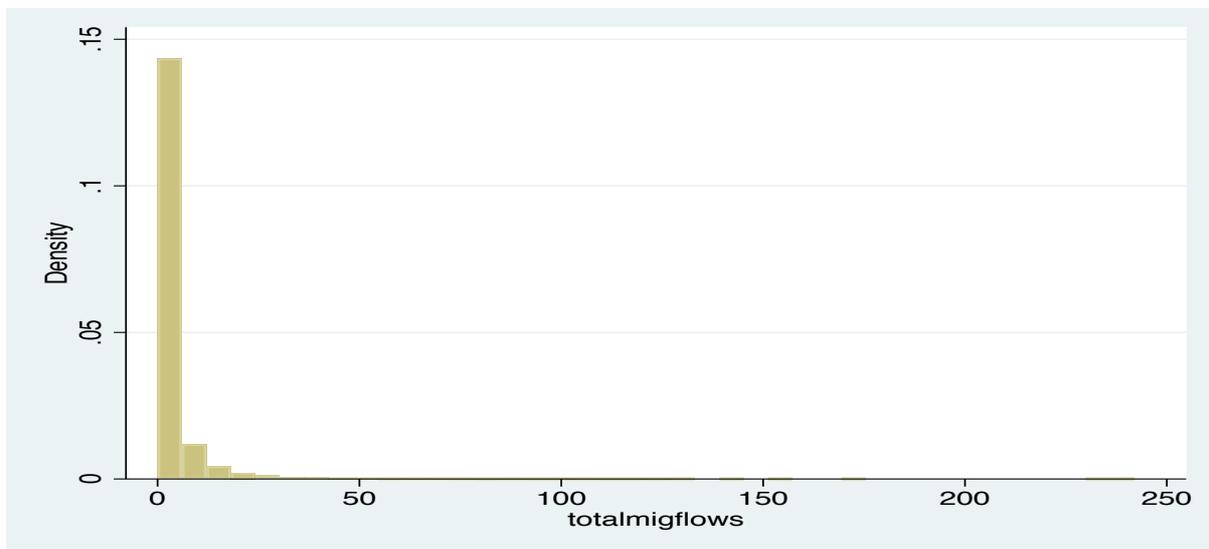
VARIABLES	Description		Mean/ Proportion	SD
Migration flows	Migration flows of prime-aged adults between $i$ and $j$ (including zero values)	<i>Source:</i> Census 2011	3.30	9.23
Distance	Euclidean distance in kms between constituency centroids		413.56	285.54
<i>Economic variables</i>				
Unemployment rate	Strict unemployment rate (at constituency level)	<i>Source:</i> NHIES 2009/10	31.26	8.62
Regional socioeconomic status	Mean annual per capita income (at constituency level)	<i>Source:</i> NHIES 2009/10	13924.07	15207.99
<i>Demographic variables (before current migration)</i>				
Population size	Population by constituency (before migration flows in 2010/11)	<i>Source:</i> Census 2011	18 221.92	10 509.64
Adult : population ratio before 2010 migration	Sum of adults 20 - 49 yrs old as proportion of total population	<i>Source:</i> Census 2011	0.41	0.49
Previous migrant population in receiving region	Adult population 20 to 64 years old whose birth constituency differed from their current constituency, but had not moved in 2010/11	<i>Source:</i> Census 2011	0.54	0.50
<i>Human capital</i>				
Highly educated	Percentage of population with grade 12 and higher	<i>Source:</i> Census 2011	0.26	0.44
<i>Amenities</i>				
Distance to secondary school	Distance to school in kilometres (using midpoints of distance brackets)	<i>Source:</i> NHIES 2009/10	4.16	1.68
Vegetation cover	Normalised differenced vegetation index in 2010 (at constituency level)	<i>Source:</i> NASA	0.44	0.14

NOTES: Own calculations based on Namibian Population and Housing Census 2011, Namibian Health, Income and Expenditure Survey 2009/10 data

## 6. Choosing an appropriate model for overly dispersed count data

As the dependent variable is the gross migrant population flows between constituencies  $i$  and  $j$ , a count model is most appropriate (Chun, 2008; Biagi et al., 2012). Count data are generally assumed to follow a Poisson distribution, where the mean is assumed to be equal to the variance. However, quite often, where data is left-censored or right-censored (as shown by the inter-constituency migration volumes in Figure 8), Poisson regression modelling is no longer appropriate.

**Figure 8.** *Distribution of total recent migrant flows in Namibia 2010/11*



NOTES: Own calculations based on Namibian Population and Housing Census 2011.

Columns 1 to 3 in Table 2 show the dyadic distribution of total migrant flow aggregates in percentiles. Many of the dyads have no population flows between constituencies, resulting in a migrant flow distribution that contains an excessive number of zero values. In situations where excess zeroes exist, Poisson regression is inappropriate as the mean and variance are no longer equal. Table 2 reveals that the mean for inter-constituency migration flow (including zero flows) is 3.3, while the variance is 85.21. The migration flow distribution therefore suffers from overdispersion, which renders the Poisson distributional assumption invalid.

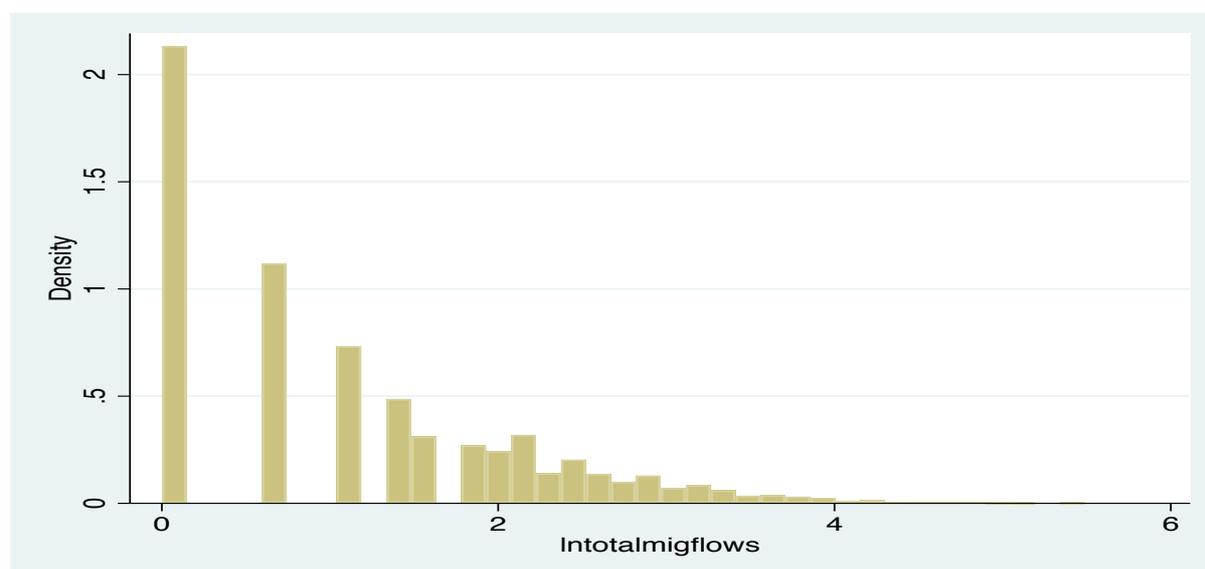
**Table 2.** *Distribution of total migrant flow aggregates between constituency i and j*

Percentiles	Smallest			
1%	0	0		
5%	0	0	<i>Obs</i>	11 342
10%	0	0	<i>Sum of Wgt.</i>	11 342
25%	0	0		
			<i>Mean</i>	3.30
50%	1		<i>Std. Dev.</i>	9.23
		<i>Largest</i>		
75%	3	172	<i>Variance</i>	85.21
90%	8	231	<i>Skewness</i>	9.92
95%	15	237	<i>Kurtosis</i>	169.38
99%	39	242		

NOTES: Own calculations based on Namibian Population and Housing Census 2011.

One option to remedy the skewed distributions is log transformation of the dependent variable, as in Figure 9. Unfortunately, where there are excess zeroes, log transformation of the zeroes produces undefined values that therefore are seen as missing values.

**Figure 9.** *Logged distribution of total recent migrant flows in Namibia 2010/11*



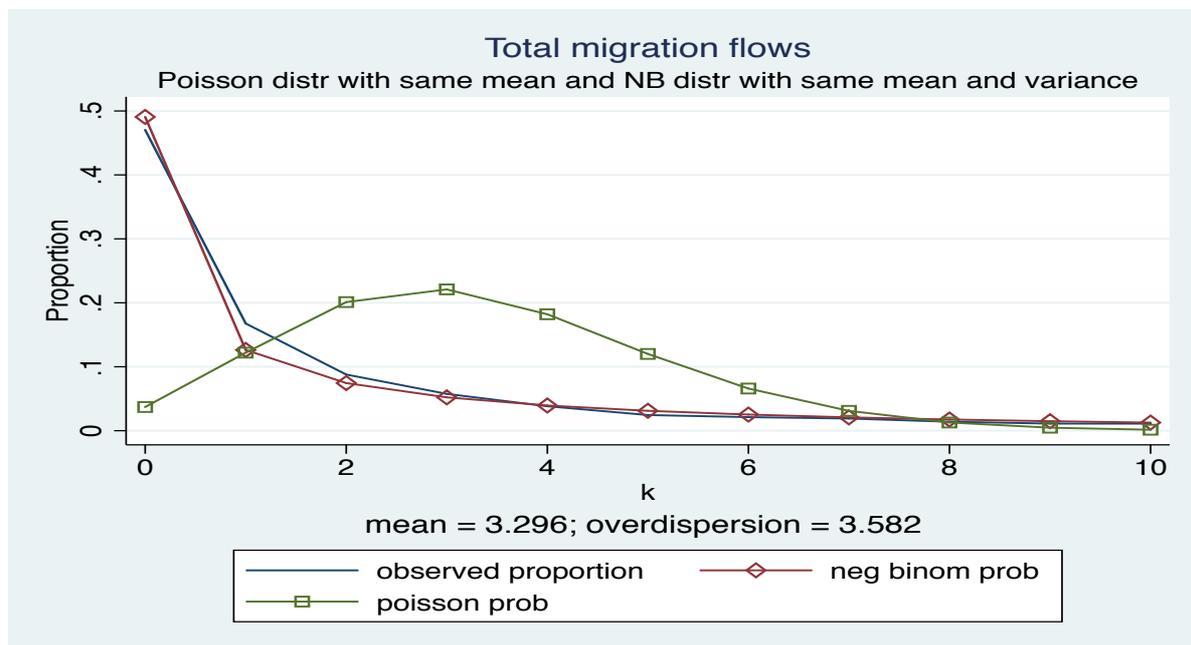
NOTES: Own calculations based on Namibian Population and Housing Census 2011.

Zero values can be dealt with in a number of ways, the most common of which are excluding them entirely, or adding a small positive constant to ensure that the logarithm is defined. Exclusion of zeroes, however, ignores the possibility that they are true zero values, and by design then also ignores the information contained in those zero values (Ramos, 2016: 5). In the gravity modelling context, for example, zero flows between regions could exist because region  $j$  and  $k$

are wholly unattractive destinations to migrants in each of these regions, or because  $j$  actually has no power to send migrants to destination  $k$ .

Figure 10 compares the observed distribution of dyadic migration flow data with distributions under Poisson assumptions (green curve) and negative binomial distribution assumptions (red curve).

**Figure 10.** Comparison of Poisson distribution and negative binomial distribution, with same means and variances



NOTES: Own calculations based on Namibian Population and Housing Census 2011.

The observed data (blue curve) suffers from overdispersion ( $\text{variance}(X) > \text{mean}(X)$ ), resulting in a poor fit between observed data and the hypothetical Poisson distribution<sup>8</sup> (green curve). While the shortcomings of the Poisson distribution assumption of equi-dispersion are immediately obvious, the negative binomial distribution fits the observed value distribution rather closely.

A possible solution for dealing with overdispersion is the two-stage zero-inflated negative binomial regression (ZINB) model (Hur *et al.*, 2002: 6), which relaxes the Poisson distribution assumption of the mean being equal to the variance *and* corrects for the presence of excess zeros in the data. The first stage of the ZINB model is a logit-style function, which models the

<sup>8</sup> The dispersion parameter is 3.58, indicating that the data are overly dispersed. Poisson modelling would have been appropriate if the parameter was equal to 0.

probability that there are no migrants flowing between constituencies  $i$  and  $j$ . This stage corrects estimates in the second stage of the ZINB.

## 7. Results

### 7.1 Full sample estimation

Table 3 shows the gravity model estimates of migration flows of *all* prime-aged adults between Namibian constituencies in 2010/11. All models account for possible spatial autocorrelation by including spatial filters. Preliminary diagnostic tests at the bottom of Table 3 reveal that the ZINB model is the most appropriate model for the data. The alpha dispersion parameter is not equal to 0, therefore Poisson distributional assumptions are inappropriate. The Vuong test statistic is significantly positive, suggesting that the ZINB model is preferable to the conventional negative binomial model.

The inflation function, used as a first stage to correct for the presence of excess zeroes in migration flows, contains the basic gravity variables included in gravity models. i.e. distance and respective population sizes in sending and receiving region combinations. These variables are assumed to also affect the probability of there being no flows between constituencies  $i$  and  $j$ . The inflation function coefficients perform as expected: distance between constituencies  $i$  and  $j$  increases the probability of there being zero population flows between  $i$  and  $j$  (although the significance of distance decreases somewhat as more variables are added to the gravity model from models 1 to 5).

**Table 3.** Gravity model of all adult migration flows in Namibia in 2010

<b>Dependent variable: Gross migration flows between <i>i</i> and <i>j</i></b>	Model 1	Model 2	Model 3	Model 4	Model 5
Distance	-0.0006*** (0.0001)	-0.0006*** (0.0001)	-0.0007*** (0.0001)	-0.0007*** (0.0001)	-0.0008*** (0.0001)
Population 2010 in sending region	0.0000*** (0)	0.0000* (0)	0.0000* (0)	0 (0)	0 (0)
Population 2010 in receiving region	0.0000*** (0)	-0.0000*** (0)	-0.0000*** (0)	-0.0000*** (0)	0 (0)
Adults as proportion of total pop 2010 rec		0.0002*** (0)	0.0001*** (0)	0.0001*** (0)	0.0001*** (0)
Adults as proportion of total pop 2010 send		0.0001*** (0)	0.0001*** (0)	0.0000*** (0)	0.0001*** (0)
Per capita income ratio 2010 (rec: send)			0.0510*** (0.0084)	0.0480*** (0.0084)	0.0384*** (0.0081)
Unemployment ratio 2010 (rec: send)			0.1738*** (0.0358)	0.1856*** (0.036)	0.2039*** (0.0363)
Distance to school ratio 2010 (rec: send)				-0.0490* (0.0203)	-0.0517* (0.0202)
NDVI 2010 ratio (rec: send)				0.0332* (0.0133)	0.0309* (0.0132)
Previous migrant adults as prop of 2010 adult pop (rec)					1.2833*** (0.1194)
_cons	-0.3776*** (0.0646)	0.1443* (0.067)	-0.0915 (0.0779)	-0.0644 (0.0855)	-0.7072*** (0.104)
<b><u>inflate</u></b>					
Distance	0.0005* (0.0002)	0.0005* (0.0002)	0.0004 (0.0002)	0.0004 (0.0002)	0.0004 (0.0002)
Population 2010 in sending region	-0.0002*** (0)	-0.0002*** (0)	-0.0002*** (0)	-0.0002*** (0)	-0.0002*** (0)
Population 2010 in receiving region	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***

	(0)	(0)	(0)	(0)	(0)
_cons	1.8524***	2.3127***	2.3235***	2.3292***	2.3229***
	(0.2171)	(0.2118)	(0.2108)	(0.2098)	(0.2108)
SPATIAL FILTERS	Y	Y	Y	Y	Y
N	10 402	10 402	10 402	10 402	10 402
alpha	1.995***	1.809***	1.789***	1.782***	1.749***
Vuong test (ZINB vs NB)	7.67	8.66	8.57	8.55	8.61

NOTES: Standard errors in parentheses. Significance levels: \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

The baseline ZINB in Model 1 in Table 3 contains the basic gravity variables included in gravity models. i.e. distance and respective population sizes in sending and receiving region combinations. Distance between constituencies reduces migration volumes between constituencies from models 1 to 6. Larger populations in both sending and receiving regions increase migration volumes in model 1.

Model 2 adds another variable of a demographic nature: prime-aged adults as proportions of their respective sending and receiving regions. Migration volumes are positively associated with both sending and receiving population prime-aged adult proportions. This relationship is statistically significant and consistent across models 1 to 6.

Model 3 adds economic and labour market incentives for migration. Migration volumes respond positively when the per capita income of receiving regions is higher than those of sending regions. This relationship holds throughout table 3 and is consistent with expectations that better earning potentials elsewhere is likely to increase the probability of migration.

Migration to urban areas despite high unemployment rates is also possible if natural and man-made amenities in the receiving constituency are superior to those in the sending constituency. Model 4 adds the amenity variables: distance to school for school-going children is a proxy for urban amenities and population density, while the normalised vegetation index is a proxy for natural amenities. Migration volumes are higher where the distance to school in the receiving region is lower than the distance to school in the sending region. Proximity to schools (and by proxy, government services) is therefore an important predictor of migrant volumes. Migration volumes also respond positively to potential destinations where the NDVI is higher than it is in their sending constituency. Thus, constituencies with greener land appear to attract migrants.

Model 6 includes the proportion of the receiving constituency population who are previous migrants. The presence of previous migrants in receiving constituencies positively affects migration flows to those receiving constituencies. This finding is consistent with the situation in South Africa, where migrants typically follow previous migration paths (Von Fintel and Moses, 2017). The result here can possibly be explained by inertia in migration flows to economic centres, or because select migrant destination constituencies are favoured because non-economic factors such as ease of settlement or assimilation positively affect migration volumes.

## 7.2 Full sample estimation by distance travelled

Table 4 disaggregates all inter-constituency movements by distance, separating migration flows into move distances between 100 and 200 kilometres, between 200 and 600 kilometres and moves of 600 kilometres and further. Moves shorter than 100 kilometres are discarded in the distance disaggregation to focus on moves that may more closely resemble very disruptive moves. Column 1 in table 4 shows the full model estimated at the end of Table 3.

Most of the variables in the regression retain the significance and signs they had in the final regression in Table 3, but there are some noteworthy exceptions. Long-distance moves are generally in the direction of higher average incomes, while short-distance migration appears to flow in the direction of destination constituencies that are poorer than sending constituencies. While the unemployment ratio displays the expected negative sign for short-distance moves, the relationship is statistically insignificant. As before, migrant volumes still respond positively to unemployment rates that are higher in the receiving constituency than in the sending constituency.

The distance-to-school ratio coefficient is negative and weakly significant for intermediate-distance moves as expected but insignificant for short and long-distance moves. The NDVI ratio coefficient is also positive and significant only for intermediate distance moves, implying that natural and man-made amenity differences are stronger motivators for these types of moves.

**Table 4.** Gravity model: inter-constituency migration flows of all migrants, by distance covered

<b>Dependent variable: Gross migration flows between <i>i</i> and <i>j</i></b>	Full sample (incl <100kms)	>=100 & <200kms	>=200 & <600kms	>=600kms
Distance	-0.0008*** (0.0001)	-0.002 (0.002)	-0.0011*** (0.0002)	0.0001 (0.0002)
Population 2010 in sending region	0 (0)	0 (0)	0.0000** (0)	0 (0)
Population 2010 in receiving region	0 (0)	0 (0)	0 (0)	0 (0)
Adults as proportion of total pop 2010 rec	0.0001*** (0)	0.0001* (0)	0.0001*** (0)	0.0001* (0)
Adults as proportion of total pop 2010 send	0.0001*** (0)	0.0001** (0)	0.0001*** (0)	0.0001*** (0)
Per capita income ratio 2010 (rec: send)	0.0384*** (0.0081)	-0.1404** (0.0473)	-0.0121 (0.0101)	0.1425*** (0.0204)
Unemployment ratio 2010 (rec: send)	0.2039*** (0.0363)	-0.249 (0.1353)	0.1311** (0.0407)	0.5393*** (0.0848)
Distance to school ratio 2010 (rec: send)	-0.0517* (0.0202)	-0.0643 (0.0767)	-0.0589* (0.0242)	0.0538 (0.0408)
NDVI 2010 ratio (rec: send)	0.0309* (0.0132)	0.0206 (0.0389)	0.0367* (0.0181)	-0.0074 (0.0222)
Previous migrant adults as prop of 2010 adult pop (rec)	1.2833*** -0.1194	1.6813*** (0.4349)	1.4201*** (0.1498)	1.4765*** (0.2519)
_cons	-0.7072*** (0.104)	0.6767 (0.4296)	-0.8249*** (0.156)	-2.2991*** (0.2737)
<b><u>inflate</u></b>				
Distance	0.0004 (0.0002)	-0.0073 (0.0066)	-0.0003 (0.0008)	0.001 (0.0008)

Population 2010 in sending region	-0.0002*** (0)	-0.0001*** (0)	-0.0002*** (0)	-0.0002*** (0)
Population 2010 in receiving region	-0.0001*** (0)	-0.0001*** (0)	-0.0001*** (0)	-0.0001*** (0)
_cons	2.3229*** (0.2108)	-1.428 (1.9553)	2.6784*** (0.48)	0.0647 (0.9309)
SPATIAL FILTERS	Y	Y	Y	Y
N	10 402	981	5 290	3 100
alpha	1.782***	1.478***	1.491***	1.736***
Vuong test (ZINB vs NB)	8.55	5.24	5.60	4.63

NOTES: Standard errors in parentheses. Significance levels: \* p<0.1, \*\* p<0.05, \*\*\* p<0.01.

### 7.3 Gravity model estimation for the African-language speaking sample only

Table 5 restricts the sample to the African-language speaking population only. This group was particularly negatively affected by apartheid-era restrictions on movement and settlement. It is therefore of some interest to study the relationship between migrant motivations and distance travelled for this group only. Column 1 shows the full model for the African-language speaking population only for comparison purposes. Columns 2 to 4 again show factors affecting migration flows of varying distances, where short-distance migration is characterised as migration that covers distances between 100 and 200kms. Intermediate-distance migration are those moves that are between 200 and 600kms long, while long-distance moves are moves that are further than 600 kilometres.

In the full African sample, the gravity model variable coefficients behave mostly as expected. Distance reduces migration volumes, while population size in the sending constituency increases migration volumes. Migration flows respond positively to income premia in the receiving constituency but flows also increase when the unemployment rate is higher in the receiving constituency. Migration volumes increase when the distance-to-school ratio is negative. In addition, migrant volumes increase as the NDVI difference increases in favour of the receiving constituency. The distance-to-school and NDVI ratio variables imply that amenities (or agricultural productivity) are significant predictors of migration volumes for the African-language speaking population.

Disaggregation of migrant volumes by distance reveal that per capita income premia in the receiving constituency are extremely strong motivators for migrants to travel long distances. This is not the case for short and intermediate-distance moves, where the income premia coefficients are insignificant. For long-distance moves, migrant volumes increase when unemployment rate differences increase in favour of the receiving constituency. Migrants are willing to migrate long distances, even when employment probabilities are lower in the destination constituency. This may be because the migrant expects to earn a wage in the destination constituency that is substantial enough to offset the labour market opportunity cost of migration.

Only intermediate-distance migration flows seem to be responsive to differences in amenity quality between constituencies, with both the distance-to-school and NDVI ratio variables displaying the expected signs. As before, the previous migration variable is positive and significant for all distances travelled. Migrants simply travel where other migrants have gone before, possibly

because of momentum in migration flows from previous years that is yet to dissipate, or because unobservable receiving constituency conditions facilitate easy in-migration.

**Table 5.** Gravity model: inter-constituency migration flows of African-language speaking migrants, by distance covered

<b>Dependent variable: Gross migration flows between <i>i</i> and <i>j</i></b>	African sample only (all distances)	>=100 & <200kms	>=200 & <600kms	>=600kms
Distance	-0.0008*** (0.0001)	-0.0007 (0.0021)	-0.0012*** (0.0002)	0.0001 (0.0002)
Population 2010 in sending region	0.0000* (0)	0 (0)	0.0000*** (0)	0 (0)
Population 2010 in receiving region	0 (0)	-0.0000** (0)	0.0000* (0)	0.0000** (0)
Adults as proportion of total pop 2010 rec	0.0001*** (0)	0.0001*** (0)	0.0001*** (0)	0 (0)
Adults as proportion of total pop 2010 send	0.0001*** (0)	0.0001** (0)	0.0001*** (0)	0.0001** (0)
Per capita income ratio 2010 (rec: send)	0.0237* (0.0098)	-0.034 (0.0556)	-0.0186 (0.0119)	0.1167*** (0.023)
Unemployment ratio 2010 (rec: send)	0.2638*** (0.0388)	-0.1145 (0.1517)	0.1755*** (0.0458)	0.5874*** (0.0879)
Distance to school ratio 2010 (rec: send)	-0.0483* (0.0203)	0.0282 (0.0738)	-0.0568* (0.0249)	0.0596 (0.0412)
NDVI 2010 ratio (rec: send)	0.0329* (0.0136)	0.0288 (0.0405)	0.0389* (0.0186)	-0.011 (0.0233)
Previous migrant adults as prop of 2010 adult pop (rec)	1.2750*** (0.0909)	1.4266*** (0.3033)	1.3610*** (0.1182)	1.3175*** (0.1951)
_cons	-0.8831*** (0.0906)	0.045 (0.3789)	-0.9886*** (0.1454)	-2.3078*** (0.2715)
<b><u>inflate</u></b>				
Distance	0.0006** (0.0002)	-0.0056 (0.0063)	0 (0.0008)	0.0005 (0.0007)
Population 2010 in sending region	-0.0001*** (0)	-0.0001*** (0)	-0.0001*** (0)	-0.0002*** (0)
Population 2010 in receiving region	-0.0001***	-0.0001***	-0.0001***	-0.0001***

	(0)	(0)	(0)	(0)
_cons	2.2129*** (0.1937)	0.6639 (1.4378)	2.3875*** (0.4406)	1.1272 (0.8431)
SPATIAL FILTERS	Y	Y	Y	Y
N	10 402	981	5 290	3 100
alpha	1.741	1.478	1.468	1.810
Vuong test (ZINB vs NB)	8.86	4.96	5.61	4.87

NOTES: Standard errors in parentheses. Significance levels: \* p<0.1, \*\* p<0.05, \*\*\* p<0.01.

## 8. Conclusion

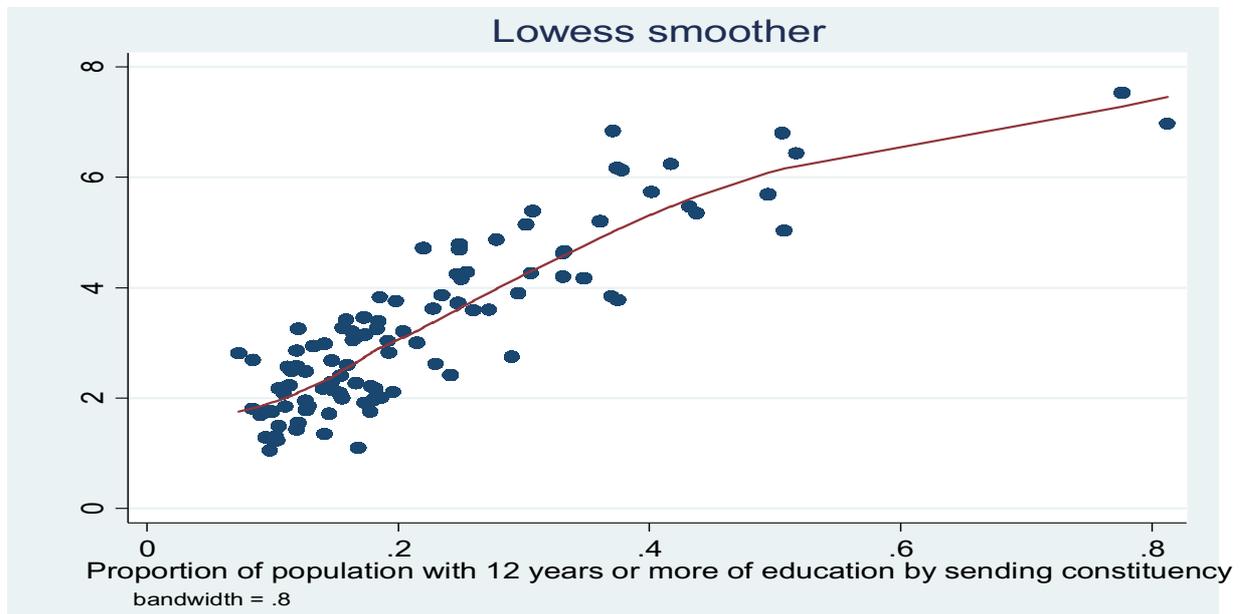
Although a number of papers have estimated gravity models in the developing country context, few, if any, have analysed which region-level factors drive the migrant's decision to engage in short-distance or long-distance migration. Namibia's history of apartheid-era restrictions on movement and settlement of its African-language speaking citizens, combined with its vast, sparsely populated landscape with few economic centres, provides researchers with an interesting opportunity to study sub-Saharan African country internal migration patterns.

The disaggregation of Namibian migration flows by distance reveals that for both the entire population and the restricted African-language speaking sample, constituency differences in amenity quality are significant predictors of intermediate-distance migration volumes. Per capita income differences in favour of the receiving constituency increase long-distance migration volumes. For all distances, previous migration in the sending constituency is a strong positive predictor of migration volumes.

The finding that migration volumes respond differently to the same economic and non-economic incentives depending on the distance traveled suggests that aggregation of migration volumes at the country level are likely to produce results that oversimplify the migration process. While migration flows have been decomposed by distance in developed countries before, this study is the first of its kind in southern Africa. It would therefore be instructive to replicate such a study with more detailed data on larger populations in sub-Saharan Africa to determine whether similar patterns exist elsewhere.

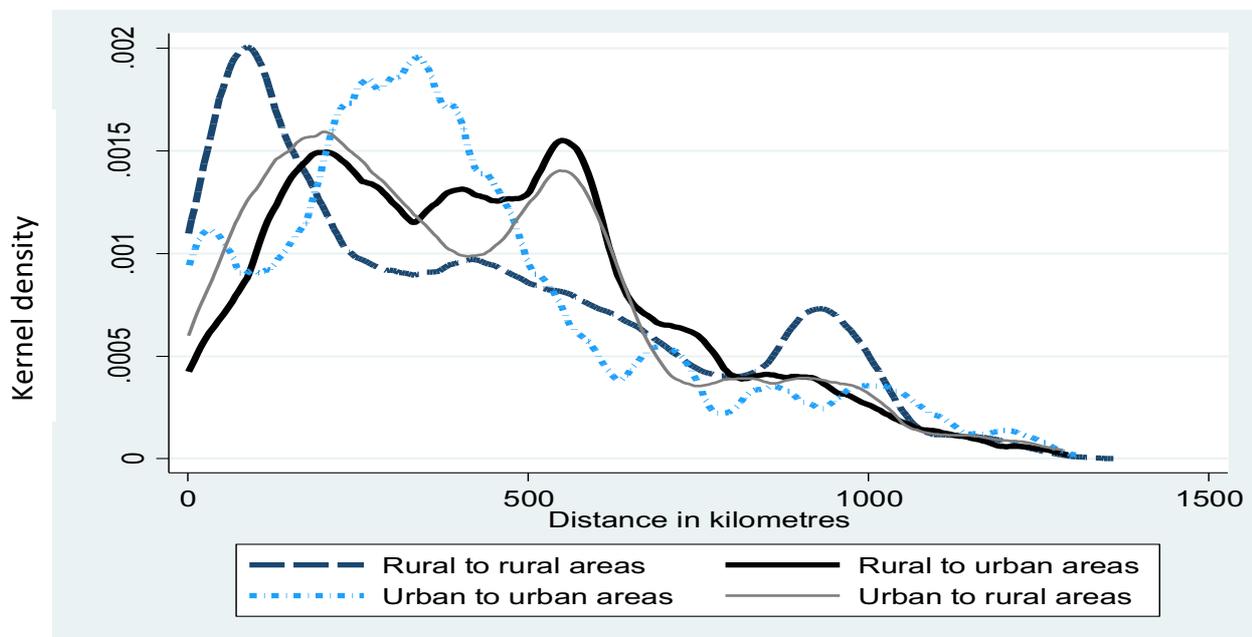
## Appendix

**Figure A1.** *Lowess regression: Income per capita in 2009 vs Highly educated adult population in 2010*



NOTES: Own calculations based on Namibian Population and Housing Census 2011 and National Household Income and Expenditure Survey 2009 – 2010.

**Figure A2.** *Kernel densities showing distance traveled, by migration type*



NOTES: Own calculations based on Namibian Population and Housing Census 2011.

## References

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