Are Cities Preferred to Villages? Estimating Location Preference in A Developing Country

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Abstract

Rapid urbanization in developing countries has been attributed to higher expected income in cities and little importance has been given to the role city amenities play. Economists have measured quality of life (QOL) indices of cities in developed country context only. In this paper, I compute QOL measures of urban and rural locations in Senegal. Unlike in previous studies where estimates of location preferences are based on variations in real wages across locations, I estimate preferences directly from observed choices by developing a new empirical methodology based on discrete choice and spatial equilibrium models. I exploit unique location choice data of public school teachers whose nominal wages are fixed across locations. I obtain revealed preference rankings over locations. These rankings indicate teachers prefer cities despite its low real wages. I then build on standard methodology from previous literature to construct adjusted QOL measures: I find that cities have higher QOL than rural areas for all workers. These results have important implications for place-based policies, and for policies to bring high-quality public sector workers to rural areas.

Keywords: Amenities, Quality of Life, Spatial Equilibrium, Location Preference
JEL code: R10, R11, R23, O10

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1 Introduction

Developing countries are increasingly urbanized and understanding what drives this trend is important for urban-based policies. The traditional explanation has attributed urbanization to the higher expected income differential between urban and rural areas (Harris and Todaro (1970)). Amenities is however a key determinant of location choice and therefore might play an important role in explaining migration to cities. In effect, Glaeser, Kolko, and Saiz (2001) find that high amenity cities have grown faster than low amenity cities. In the US, to examine what determines location choice, economists provide QOL measures of cities (Roback (1988), Albouy (2012)). These measures are based on real wage variations across cities under a spatial equilibrium model. To obtain these measures, one requires the strong assumption that the marginal worker, who is indifferent across two locations, is similar to the average worker and the assumption that the job that same wages across locations are similar in quality.

In this paper, I measure QOL of locations by directly estimating location preference from individual observed choices, and I do so in a developing country context. I develop a new empirical methodology based on discrete choice estimation, models of spatial equilibrium and observed choices to measure the QOL of cities and villages in Senegal. I exploit unique data on public school teachers' location choices when nominal wages are fixed across locations to recover QOL indices and obtain revealed preference rankings over locations. The derived preference rankings indicate that teachers' demand for cities is high despite lower real wages. Standard QOL measures estimated with the standard methodology from previous literature give different preference rankings for teachers. Thus I use my estimates to show how previous QOL methodology needs to be adjusted in a developing country context. Using the adjusted methodology, I show that cities have higher QOL than rural areas not just for teachers but for all workers.

First, I estimate teachers' location preference directly from observed choice data. The data, which is from the Ministry of Education of Senegal and contains ranked ordered choices of preferred locations along with individual characteristics, provides an empirical setting in which teachers' nominal wages are fixed across locations; in other words conditional on experience, if a teacher decides to move from a village to a city, her wage will not be adjusted for cost of living. Using a discrete choice model under the spatial equilibrium framework, I estimate teachers' location preference and obtain QOL rankings of urban and rural locations.

The data on teachers comprise of individual lists of location choices, and the assignment of teachers to locations follows a serial dictatorship matching mechanism: this allows me to estimate preference from choices. Each teacher submits a list of four choices. All teachers are ordered by points, an ordering mainly based on teaching experience. The highest ranked teacher is assigned her first choice. The second highest ranked is assigned her second choice if still available; otherwise she assigned her second choice, and so on. So the nth ranked teacher is assigned her top ranked choice if available, or the remaining available choice on her list; otherwise she does not get an assignment and remains at her current location. The process ends when all slots are filled. The choice lists are truncated, which creates room for manipulation. However, ranking within the choice set is truthful. Therefore, I use rank ordered logit and maximum likelihood to estimate preferences.

The fixed nominal wage feature of the data provides a unique setting under the spatial equilibrium model. The spatial equilibrium model as developed by Rosen (1979) and Roback (1982) implies that variations in costs of living and wages are equalizing differences for amenities. And in equilibrium utility, which is a function of nominal wage, costs of living and amenities, is equalized across locations. Thus, fixed nominal wages reduce the dimension in utility maximization to only two variables: rent and amenities. So if demand for a city is high despite high costs of living, then the city must be offering high consumption amenities or QOL.

Second, I use my estimates to show how previous QOL methods need to be adjusted in a developing country context. Standard QOL measures estimated with the standard methodology from previous literature-based on variations in real wages across locations-give different and potentially incorrect preference rankings for teachers. QOL under the standard methodology are measures of how much real after-tax income exceeds the national average, or the percentage of total income households are willing to sacrifice (or get compensated) to live in a city rather than an average city depending on how high or low it is. These measures as given appear to be not suitable in the context of Senegal, and hence need to be adjusted. Thus I use my estimates to show how previous QOL methods need to be adjusted in a developing country context. Using the adjusted measures, I show that cities have higher QOL than rural areas not just for teachers but all workers.

I propose two methods of adjustment. In the first method, I make the following key adjustments to the current methodology based on the previous literature of urban economics, economic geography and urban-bias: location size and proximity to the capital city. The first adjustment arises from the fact that potential migrant takes into account destination population size as source of abatement for migration costs (which are likely higher in developing countries), gains from product variety (or agglomeration benefits): this is an adjustment based on the urban economics and the economic geography literature. The second adjustment arises from the fact that destination's proximity to the capital city plays a key role in developing countries: this is an adjustment based on the urban-bias literature. In the second method, I derive QOL measures structurally under a discrete choice model: I get adjusted QOL measures with location size as a key determinant without the assumption in the first method.

Regressing preference estimates obtained from teachers' choice data on those obtained from standard QOL methodology allows me to determine the direction and magnitude of the effects of population size and proximity to capital city in the two new methods. Therefore, I construct new adjusted QOL measures by amending standard QOL measures from previous literature with the key adjustments above. Using these adjusted measures, I compute QOL rankings of urban and rural areas in Senegal not just for teachers but for all workers, skilled or unskilled.

I show that QOL is higher in cities than in villages not just for teachers but for all workers. The most preferred locations are the biggest urban areas that are mostly clustered around Dakar, the capital of Senegal. Natural amenities of the preferred locations are proximity to the ocean, cool weather (less extreme heat). If urban-bias, the idea that urban classes in developing countries use political and social capital to enforce policies that are pro-urban, is present in Senegal, then access to public goods provisions, which may be higher both in quantity and quality in urban areas, constitute a consumption amenity.

Moreover, I find evidence for the existence of consumption or consumer cities for teachers, which is the idea that teachers are paying a premium to enjoy consumption amenities in cities. In effect, teachers prefer big cities to small towns or villages despite earning lower real wages in cities: nominal wages are fixed across locations and cities are more expensive. Thus, consumption amenities play a role usually overlooked in location-based decisions in a poor country context where cities are considered industrial (or job haven in general) where people move to in order to find employment despite high crime and congestion .

The implications of this paper are relevant for theory, methodology, and policy. The theoretical implication is this paper provides a complementary theory to rural-urban migration in developing countries, which has traditionally been attributed to the expected income differential between urban and rural areas (Harris and Todaro (1970)). The methodological implication is that standard QOL estimates need to be adjusted for destination location size and its proximity to the capital city. Finally, the first policy implication is that place-based policies need to take into account the consumption or QOL dimension aspect of location preference and not just the production aspect (jobs). The second policy implication is that to bring high-quality public sector workers to rural areas, the government should set a higher wage in rural areas or a lower wage in urban areas: good teachers need to be compensated to move to rural areas.

In fact, preference for big cities in Senegal might lead to unequal outcomes in education. Given the assignment mechanism of teachers currently employed in Senegal, which favors seniority, city bias leads to sorting of experienced teachers to big cities and inexperienced teachers to small locations. This phenomenon may potentially contribute to the observed inequality in student outcomes across regions: students in big urban areas perform better if teacher experience matters for student performance. [1]

This paper is organized as follows. Section 2 provides a brief analysis on previous studies related to urbanization and QOL. Section 3 presents the empirical strategy. Section 4 describes mainly the teachers data used to estimate preferences; it also describes price used to compute the alternative QOL estimates. Section 5 presents the results on teachers' preference estimation and the existence of consumption cities. Section 6 discusses standard (previous) QOL methods; shows their applications and results for Senegal; presents how standard QOL methods are adjusted

[1] See Figure A.18, A.19, A.20.

and its results; finally presents a discrete choice model of standard QOL methods and its results. Section 7 goes over some robustness checks, while Section 8 discusses policy implications before the conclusion in Section 9.

2 Background

Most of the world population currently resides in urban areas and developing countries are experiencing urbanization at the fastest pace. According to World Urbanization Prospects UN, 2014: 54 percent of the world's population resides in urban areas as of 2014; developed and Latin American countries are more urbanized with more than 70 percent living in cities but urbanization is increasing much faster in Asian and African countries. Living in densely populated areas is becoming a norm. Mumbai, the most densely populated city in the world, with 30,000 people per square kilometer [2], illustrates this pattern. This urbanization phenomenon has many implications for welfare across regions within a country, for urban-based policies such as decentralization policies for example.

The rapid urbanization of countries in the world, particularly in Africa has led to a phenomenon of over-urbanization where most people are migrating from rural areas to cities and creating big cities. Some view this phenomenon in a negative light as over-urbanization leads to many "dis-amenities" such overcrowding, pollution, crime, etc. Hence some economists believe cities pay a wage premium to compensate workers for these "disamenities" (Hoch (1972)). Nordhaus and Tobin (1972), in their attempt to measure welfare overtime, discount economic growth measures by urbanization or over-urbanization. The perceived lower QOL affects particularly the poor who often end up in slums (Marx, Stoker, and Suri (2013)).

Other economists, however, view urbanization as a positive force driving economic progress (Glaeser (2011)). The existence of agglomeration economies, the fact that productivity rises with density, illustrates the benefit of urbanization. Other forms of agglomeration economies arises from the gains that come from reduced transport costs (Krugman (1991)), labor pooling and flow of ideas in cities. The movement to cities and city growth in general has led to the phenomenon of

[2] World Bank (2009).

mega cities. Tokyo, a city of 35 million people where a quarter of the population of Japan inhabits, occupies 4 percent of its land and "Visitors to Tokyo can see people being crushed into trains by professional train-packers. Millions of people willingly subject themselves to the unpleasantness of such a crush" (World Bank (2009)). Whichever view one holds, there is an explicit or implicit assumption about the QOL of cities. Understanding why people move to big cities is important since it will help inform how they respond to location-based policies.

Harris and Todaro (1970) were the first economists to develop the traditional model explaining urbanization from the viewpoint of migration. Few decades ago, many developing countries were rapidly experiencing (they still are) rural-urban migration. In the Harris-Todaro framework migration arises in response to expected rural-urban expected earning differential. The urban location has a manufacturing/industrial sector that pay a higher wage than the rural location which has an agricultural sector that pays subsistence wages. Then a rural migrant, discounting the probability of unemployment in the city, will move to the urban location as long as her expected rural-urban earning differential is positive. However, industrialization has slowed and is relatively low in developing countries, yet rural-urban migration persists and urbanization has increased.

Gollin, Jedwab, and Vollrath (2013) explain why the expected relationship between urbanization and the level of industrialization is not observed in many developing economies. They propose two paths of urbanization. The first path is the traditional rural-urban movement that gives rise to production cities that make for domestic and international markets. The second path is the fact that large resource endowments lead to a strong income effect, which increases the demand for both tradable and non-tradable goods. Labor is drawn to the non-tradable sector to produce the non-tradable goods, resulting in urbanization without industrialization. This pattern gives rise to what the authors call "consumption cities": consumption of resource rents in the form of urban non-tradable goods and services. A related study by Jedwab (2013) finds a strong causal effect of the production of cocoa, a rural- based natural resource, on the growth of cities in Ivory Coast and Ghana.

In developed country context, Glaeser, Kolko, and Saiz (2001) find that high amenity cities have grown faster than low amenity cities. They argue demand for living in cities have risen for reasons beyond urban wages because urban rents have risen faster than urban wages, which suggests a consumer city phenomenon. The rise of reverse commuting exemplifies this phenomenon. They claim these results challenge the view that cities are great places for production that arise from agglomeration economies, and bad places for consumption that arise from disamenities such crime, pollution, etc. Even though these consumption or consumer city studies explain urbanization patterns, they do not estimate location preference.

Another explanation for urbanization patterns in developing countries comes from urban bias theory: urban-biased policies have led to over-urbanization in developing countries. Lipton (1977), one of the earliest proponent of urban bias theory, argues that urban classes in developing countries use political and social capital to enforce policies that are pro-urban: inequitable allocation of public resources which results in rural-urban inequality. Another political economy mechanism for urban bias arises from dictatorship regimes, where centralization is a rational tool to stabilize power (Ades and Glaeser (1994)). In both theories, urban location attract rural population which leads to over-urbanization. However, these studies do not distinguish the QOL and the production aspects of cities.

All plausible explanation of urbanization or over-urbanization from various papers mentioned above, are one of reason why the study of the QOL of cities have emerged, a study based on spatial equilibrium. The spatial equilibrium model as developed by Rosen (1979), and Roback (1982) has been successful in understanding location choice. As studied in Roback (1988), the spatial equilibrium model implies that variations in rents and wages are equalizing differences for amenities. In a decision to choose a city to live in, an individual considers the potential utility obtained in each location, a utility that depends on nominal wage, living costs and amenities. In equilibrium, the marginal individual is indifferent across locations and spatial equilibrium holds, at least in the long run (Glaeser and Gottlieb (2009)).

This provided the basis for estimating QOL indices where the main questions are: "Do people move for jobs or fun?"(Chen and Rosenthal (2008)), and "Are Big Cities Bad Places to Live?" (Albouy (2012)). At the frontier of these studies, Albouy (2012) provide the standard framework for estimating QOL measures. He finds that quality-of-life measures successfully predict how housing costs rise with wage levels, are positively correlated with popular "livability" rankings and stated preferences, and do not decrease with city size. He also finds that people like mild seasons, sunshine, hills, and coastal proximity, which accounts for most inter-metropolitan quality-of-life differences. But these studies have only been undertaken in U.S and not in a developing country.

This paper is the first to estimate QOL of locations in a developing country context. Prior QOL studies, which started with the original formulations of spatial equilibrium models by Rosen (1979) and Roback (1982), and later improved by Albouy (2008), Albouy (2012) have until now focused on developed countries, namely the U.S. Accurate measurement of the QOL of cities is particularly important for developing countries because they are key to examining the observed large rural-urban migration within countries and therefore they play a crucial role in the design and analysis of location-based policies. For instance, decentralization policies often consider only the production aspects of cities and ignore the consumption dimension. Migration from villages to cities may not only be based on employment opportunities as I will show.

I will now present the empirical strategy: I will discuss the assignment mechanism, the source for identification, and the discrete choice model used to estimate preferences.

3 Empirical Strategy

I first describe the matching mechanism in the teachers' choice data in order to set up my identification strategy. Then, under certain conditions, I exploit location rankings in the choice lists to estimate preferences via maximum likelihood using rank ordered logit.

3.1 Assignment Mechanism and Identification

The mechanism of assigning public school teachers to locations in Senegal is unique. When a public school teacher is initially hired, he has no choice in the location of school. That is, she is randomly assignment to a vacant school, which in general tend to be located in a village or small town. But she can submit, yearly, a list of location preferences if she wants to move to a different location: she can rank up to 4 choices. She gets to stay in her current location if she does not get assigned one of her choices. The likelihood that a teacher's choice is granted depends her number of points. All teachers are ranked-ordered by points. The point system is mainly based on experience, teaching grade, number of children, etc. Wage is fixed across locations and hence one's wage will not be adjusted by the cost of living index of the new location one moves to.

The assignment mechanism follows a serial dictatorship scheme. All teachers are ranked-ordered by points. The highest ranked teacher is assigned her first choice. The second highest ranked is assigned her second choice if still available; otherwise she assigned her second choice, and so on. So the nth ranked teacher is assigned her top ranked choice if available, or the remaining available choice on her list; otherwise she does not get an assignment and remains at her current location. The process ends when all slots are filled. If teachers were allowed to rank all vacant locations then the submitted lists will reflect true preferences. But the choice lists are truncated as teachers are allowed to rank only four choices. This truncation creates room for manipulation because a teacher will choose preferred locations that are accessible (good probability of getting accepted). However she has no incentive to manipulate within the list: Ranking within the choice set is truthful. That is for any list $\{A, B, C, D, H\}$, the preference is $\{A \succ B \succ C \succ D \succ H\}$:

Proposition 1. *Ranking within list is truthful*

Proof. Without loss of generality, consider teacher i with a ranked choice list $\{A, B\}$. Now suppose she prefers B to A but as seen on her list she ranked A over B. A is at least as likely as B to get assigned to her because once it is her turn the mechanism assigns the first choice first. Therefore the list $\{B, A\}$ would be preferable to the list $\{A, B\}$. Thus the ranking $\{A, B\}$ must be truthful, and the same logic applies to the list $\{A, B, C, D, H\}$.

□

3.2 Empirical Model

The utility a teacher i obtains from location l depends on its observed and unobserved characteristics. Let the utility be given by:

$$U_{il} = \bar{V}_l + V_{il} + \eta_l + \varepsilon_{il} \tag{1}$$

where $\bar{V}_l$ is the component of utility that varies across locations but not teachers V_{il} is the component of utility that varies across locations and teachers, η_l is utility derived from unobserved characteristics, and ε_{il} is the idiosyncratic error.

Define the location fixed effects as

$$\alpha_l \equiv \bar{V}_l + \eta_l \tag{2}$$

Let $V_{il} = X_i\beta_l + Z_{il}\gamma$, where X_i is the vector of teacher personal characteristics such as age, marriage status, number of children, etc; where Z_{il} birthplace dummy with a value of one if location l is teacher i's birthplace

The utility of the teacher becomes

$$U_{il} = \alpha_l + X_i\beta_l + Z_{il}\gamma + \varepsilon_{il} \tag{3}$$

The assignment mechanism of teachers is a truncated serial dictatorship. So a teacher i in location H_i with choice list $\{A_i, B_i, C_i, D_i\}$ may manipulate her choice of the set out all other location given her preferences and likelihood of acceptance, however she has no incentive to manipulate within the list: Ranking within the choice set is truthful. That is:

$$Prob\,(Ranking = A_i, B_i, C_i, D_i, H_i) = Prob\,(U_{A_i} > U_{B_i} > U_{C_i} > U_{D_i} > U_{H_i}) \tag{4}$$

Assuming that ε_{il} follows a type I distribution, following Hausman and Ruud (1987), the likelihood function for teacher i is that of ranked ordered logit:

$$\mathcal{L}_i = \prod_{l=1}^{L_i} \left[\frac{\exp\left(\alpha_l + X_i\beta_l + Z_{il}\gamma\right)}{\sum_{k=1}^{L_i} \delta_{ilk} \exp\left(\alpha_k + X_i\beta_k + Z_{ik}\gamma\right)} \right] \tag{5}$$

where for example: $l \, \epsilon \, L_i \equiv \{A_i, B_i, C_i, D_i, H_i\}$

where

$$\begin{cases} \delta_{ilk} = 1 \quad Y_{il} > Y_{ik} \\ \\ \delta_{ilk} = 0 \quad otherwise \end{cases} \tag{6}$$

where Y_{il} is the rank given to location l. With a sample of N teachers, the log likelihood is

$$\mathcal{LOGL} = \sum_{i=1}^{N} \sum_{l=1}^{L_i} \left((\alpha_l + X_i\beta_l + Z_{il}\gamma) - \log \left[\sum_{k=1}^{L_i} \delta_{ilk} \exp\left(\alpha_k + X_i\beta_k + Z_{ik}\gamma\right) \right] \right) \tag{7}$$

This allows me to obtain the estimates of parameters $\hat{\alpha}_l$,$\hat{\beta}_l$, $\hat{\gamma}$. Using these estimates, I can now measure the average location fixed effect, $\hat{\theta}_l$:

$$\hat{\theta}_l = \hat{\alpha}_l + \bar{X}\hat{\beta}_l \tag{8}$$

I can also measure average fixed effects for different groups such as: old or young teachers, and married, or single teachers. These location fixed effects measure average preference for locations. Under this measure, I can rank all cities $\hat{\theta}_l$ as these are the implied measures of QOL by revealed preference approach.

4 Data

The main dataset used are: public school teachers location choice data from the ministry of education; rent and earnings data from a 2011 Senegalese Household Survey; data on student and teacher outcomes from a national aptitude survey in Senegal, and population data. The main dataset, which is from the Ministry of Education of Senegal, contains ranked choices for preferred locations along with individual characteristics such as gender, age, teaching experience, etc. The unique feature of this empirical setting is that teachers' wage are fixed across locations; on other words conditional on experience, if a teacher decides to move from a village to a city, her wage will not be adjusted for cost of living. The data allows us to directly estimate preferences for cities.

The choice data contains detailed information on teachers. The data is from the Ministry of

Education of Senegal, department of human resources, Division of Resources Planning, Recruitment and Mobility. The data comprises of filled out forms containing individual choices of teaching locations. The form contains a lot of information about the teacher. First it contains information on her professional rank, class echelon, last professional degree, major, and school year completed. Teachers fill out individual forms with the following information: the subject she teaches, first and last name, year and place of birth, marital status, sex, current post, location of current post, date since in current post (and as of). The teacher then indicates four choices of teaching location. The form allows administrators to design a point system, which assigns points to a teacher based on different characteristics: seniority in teaching, which is based on the number of years of teaching multiplied, average of teaching grade (out of 20) of the last two years, family size, etc. After all the above computation, the teacher gets a total number of points, which determines the likelihood of her choice(s) being accepted. I have a representative sample of 2058 individual forms of selected teachers from 2011 to 2013.

Earning and cost of living data is from a 2011 household survey of senegalese households in Senegal, L'Enquête de Suivi de la Pauvreté au Sénégal (ANSD (2011)). It is national survey on poverty and well being in all regions of Senegal covering urban and rural areas of the country. The initial sample includes 20250 households but the survey on earnings and housing costs covers 6750 households as more details are included. It covers spending on many different types of goods including housing. It describes different types of housing and covers wage and non-wage income with information on personal characteristics such as education, profession, etc. The main assumption here is price differences between locations within a country is fixed in the short run.

The education data comes from l'Enquête sur l'éducation et le bien-être des ménages au Sénégal (EMBS), from CREA, a 2003 Household Survey on Education and Welfare in Senegal, conducted in 33 rural and 30 urban communities and from CRES (2011). The education data cover primary school students only: second and fifth graders. Population data is also from ANSD (2011).

5 Results: Teachers' Preferences for Urban and Rural Locations

First I explain how coefficients, especially the location fixed effects, from the rank ordered logit estimations can be interpreted. Then I present preference of teachers for different type of locations in Senegal before presenting evidence for consumption cities.

5.1 Preference For Locations

First, it important to interpret the results before analyzing the preference estimates. The alternative specific constants, that is the location fixed effects without personal characteristics as shown in Table 1 are mostly significant and positive relative to the base location Tambacounda Rural. In a discrete choice framework, the relative odds of a teacher i choosing a location l relative to location k is:

$$ODD_{ilk} = \frac{P_{il}}{P_{ik}} = \frac{exp^{\alpha_l}}{exp^{\alpha_k}} = exp^{(\alpha_l - \alpha_k)} \tag{9}$$

So the likelihood of choosing the capital Dakar Urban (the capital of Senegal) relative to the base location Tambacounda Rural,, given a fixed effect value of 4.63, is

$$ODD_{lk} = exp^{(4.63-0)} = 99 \tag{10}$$

That is, on average a teacher is about 99 times more likely to choose Dakar Urban than Tambacounda Rural. Similarly, a teacher is about 26 times more likely to choose Dakar Urban than Kaffrine Urban and 1.12 times more than Dakar Suburb. Controlling for birthplace, on average a teacher is 1.6 times more likely to choose a location where she was born than all other locations all else fixed.

To compute the location fixed effects from the full model, I take into account personal characteristics such as age and marriage status, and birthplace dummy. As previously shown, the QOL measure is $\hat{\theta}_l = \hat{\alpha}_l + \bar{X}\hat{\beta}_l$, which can be used to compute location rankings.

Before presenting the results, I describe the geographic setting of Senegal (see map in Figure A.17). Senegal is geographically a small country of 76,000 square mile with a density of 177.7 per square mile. The closest location to Dakar Urban is Dakar Suburb, which is 30 minutes away by car (if one owns a private vehicle) with no traffic. However, the driving distance can take up to 2 hours in public transport with traffic. Thus it is not as close as one would expect given the short distance between the location. The farthest location from Dakar Urban is Tambacounda Rural, the base location. Tambacounda is about 450 miles away. Travel time between these cities can take up to 16 hours. All cities are far away enough from each other and from Dakar to not be commutable for work.

Overall, teachers prefer big urban areas to rural areas. As Table 1, Figure A.1, and Figure A.2 show, the most preferred areas are Dakar Urban and Suburb, Thies Urban, and Mbour Urban. Dakar is the capital of Senegal and the biggest city; Thies[3] and Mbour are second and seventh biggest cities and are the closest to Dakar. The pattern indicates that teachers prefer the biggest urban areas with a big cluster centered in Dakar. These results are consistent across different types of teachers. The only differences are both married and single teachers prefer Thies Urban as the top place while young teachers prefer Fatick Urban as the top place. Fatick is not a big city but it is close to Mbour, Kaolack, and Diourbel. However, some rural places such as Thies Rural are preferred to Kolda Urban because the latter is a very small town while the former is close to a big city such as Thies.

The consistency of preferences across different groups rules out the idea that teachers are choosing big urban locations for personal reasons such as family and not because they inherently like them. One may claim that married teachers may choose a location because of their spouse: they co-locate. But unlike in some developed countries such as the United States, most public school teachers in Senegal are male[4] and because the head of household is male[5], the location decision is male driven. From the preference estimation above, married teachers do not differ from the average teacher. The Young and Old have also similar preference to the average teacher. Thus, it is reasonable to conclude that teacher prefer big urban areas because of urban amenities given their revealed preference. The scope of these amenities are not determined in this paper, but they may include weather, public goods, cultural amenities, etc.

The above results are also consistent when I restrict my estimation to teachers who did not choose their birthplace. Table 2 shows a positive and significant coefficient of 0.477 for birthplace

[3] Technically, Touba is the second biggest city but it has a special religious status and has no public schools: so it is not available in the choice set of teachers

[4] According to DHR Ministry of Education of Senegal; see also Table of Summary Statistics

[5] ESAM II

effect. Thus, on average a teacher is 1.6 times more likely to choose a location where she was born than all other locations, all else fixed. Therefore, one may claim that because teachers are choosing big urban locations, their preferences indicate they just like their origin locations given more are likely to be from big urban areas. So, I rerun the estimation restricting the sample to those who did not choose their birth place. I find the results are still consistent with previous results: teachers prefer big urban locations. The slight deviation is for Single teachers who rank Dakar Urban sixth most preferred. Otherwise all other groups (Married, Old, Young) have similar preferences: see Figure 1, Figure A.3 and Figure A.2. Note also that when controlling for whether both destination and birthplace locations are cities, location rankings remain consistent, too (see Figure A.16)

5.2 Consumption Cities

There is evidence for existence of consumption or consumer cities for teachers, which is the idea that teachers are paying a premium to enjoy consumption amenities in cities. The spatial equilibrium model implies that variations in rents and wages are equalizing differences for amenities. In a decision to choose a city to live in, an individual considers the potential utility obtained in each location, a utility that depends on nominal wage, living costs and amenities. In equilibrium, the marginal individual is indifferent across locations. The correlation between location rankings by preference and location rankings by rent differentials (how expensive is a location relative the average location) is 0.58 (see Table 3, Figure A.5, Figure A.6). The top ranked locations are the most expensive. Under the spatial equilibrium framework: amenities must be higher in these top locations if nominal wage is fixed. Teacher wage are not adjusted for quality of living costs. Demand for cities is high despite lower real wage: hence the existence of consumption cities. This is the first evidence for consumption cities from location preference viewpoint in a developing country context, which differs from standard consumption cities studies.

Gollin, Jedwab, and Vollrath (2013) denote "consumption cities" as a phenomenon of consumption of resource rents in the form of urban non-tradable goods and services that explains why the expected relationship between urbanization and the level of industrialization is not observed in many developing economies. They propose two path of urbanization. The first path is the traditional rural-urban movement that gives rise to production cities that make goods for domestic and international markets. The second path is the fact that large resource endowments lead to a strong income effect, which increases the demand for both tradable and non-tradable goods. Labor is drawn to the non-tradable sector to produce the non-tradable goods, resulting in urbanization without industrialization. But the concept of consumption cities in my paper arises from QOL of cities and not directly from non-industrial jobs.

The concept of consumption cities in this paper is closer to the concept of consumer cities found in a developed country context. In effect, Glaeser, Kolko, and Saiz (2001) find that high amenity cities have grown faster than low amenity cities. They argue demand for living in cities have risen for reasons beyond urban wages because urban rents have risen faster than urban wages, which suggests a consumer city phenomenon. The rise of reverse commuting exemplifies this phenomenon. They claim these results challenge the view that cities are great places for production that arise from agglomeration economies, and bad places for consumption that arise from disamenities such crime, pollution, etc. They call this phenomenon consumer cities. Unlike their paper, however, I find evidence of this phenomenon directly from choice data.

Finally, this paper provides a new channel of urban bias. A standard explanation for urbanization patterns in developing countries comes from urban bias theory: urban-biased policies have led to over-urbanization in developing countries. Lipton (1977), one of the earliest proponent of urban bias theory, argues that urban classes in developing countries use political and social capital to enforce policies that are pro-urban: inequitable allocation of public resources which results in rural-urban inequality. Another political economy mechanism for urban bias arises from dictatorship regimes, where centralization is a rational tool to stabilize power (Ades and Glaeser (1994)). In both theories, urban location attract rural population which leads to over-urbanization. However, these theories imply the channel for urban bias is usually through employment. That is, employment opportunities are centralized and so are public goods provisions. However, in this paper, I have shown that some are willing to give up some income to live in a big city to enjoy a higher QOL.

6 QOL Measures for Different Groups

I estimate QOL measures for different groups of individuals (educated and non-educated) and for the general population. To do so, I apply the standard QOL measures from spatial equilibrium models previously employed in a developed country context, namely the U.S. More specifically, I employ Albouy's method (Albouy 2008, 2009), which is at the frontier of the QOL measures' literature. After applying this method to Senegalese data, I use preference estimates from the teachers data to empirically recover how standard QOL measures models need to be adjusted in a developing country context.

6.1 Standard QOL Methods

Following Albouy (2012), I describe the spatial equilibrium model needed to estimate QOL measures. With a revealed preference approach, one can obtain QOL measures that are a function of price and wage differentials of locations.

6.1.1 Albouy's Method

I follow the model developed by Albouy (2012) based on Rosen (1979) and Roback (1982). Assume a closed economy with j cities where reside homogenous and fully mobile households who consume a traded good x with price one and a home good y with price p^j. Each city j has QOL $Q^j = \tilde{Q}\left(Z_j\right)$ where $\tilde{Q}$ is a function of amenities Z_j such as crime, weather, etc. But households work where they reside and earn wage w^j. Total household income is $m^j = I + w^j$ where I is non-wage income. Of this income, a household pays a tax rate $\tau\left(m\right)$. Households have utility $U\left(x, y; Q\right)$ that is quasi-concave and increasing in x,y, and Q. Given local price, local wage, tax rate and QOL (QOL), the after -tax expenditure necessary to obtain utility u is defined as

$$e\left(p^j, w^j, \tau, u; Q^j\right) \equiv min_{x,y}\left\{x + p^j y - w^j - I + \tau\left(w^j + I\right) : U\left(p^j, w^j; Q^j\right) \geq u\right\} \tag{11}$$

Full mobility guarantees that in equilibrium all cities are inhabited and no household needs additional compensation to live in her city of residence; thus

$$e\left(p^{j}, w^{j}, \tau, \bar{u}, Q^{j}\right) = 0 \tag{12}$$

where $\bar{u}$ is the national level of utility

To derive the relationship between QOL and local prices, total differentiate equation (19)

$$\frac{\partial e}{\partial p}dp^{j} + \frac{\partial e}{\partial w}dw^{j} + \frac{\partial e}{\partial Q}dQ^{j} = 0 \tag{13}$$

where the first-order approximation is taken around a city with average prices and QOL and the derivatives are evaluated at the national average prices and QOL: $\bar{p}$, $\bar{w}$, $\bar{Q}$. By Shepard's Lemma,

$$y.dp^{j} - \left(1 - \tau^{'}\right) dw^{j} = p_{Q} \cdot dQ^{j} \tag{14}$$

where $\tau^{'}$is the marginal tax rate on income, and $p_{Q} \equiv -\frac{\partial e}{\partial Q} = \frac{\frac{\partial U}{\partial Q}}{\frac{\partial U}{\partial x}}$ is the willingness-to-pay to increase QOL by one unit. After log-linearization so that $\hat{p}^{j} = \frac{dp^{j}}{\bar{p}}$, $\hat{w}^{j} = \frac{dw^{j}}{\bar{w}}$, and after normalization such that $\hat{Q}^{j} = p_{Q}\frac{dQ^{j}}{\bar{m}}$:

$$\hat{Q}^{j} = s_{y}\hat{p}^{j} - \left(1 - \tau^{'}\right) s_{w}\hat{w}^{j} \tag{15}$$

where $s_{y} \equiv \frac{py}{\bar{m}}$ [6]is the share of income spent on home goods and $s_{w} \equiv \frac{w}{\bar{m}}$ is the share of income received from labor. $s_{y}\hat{p}^{j}$, $\left(1 - \tau^{'}\right) s_{w}\hat{w}^{j}$ represents how high cost-of-living and after-tax nominal income are relative to the national average, respectively. Therefore QOL is a measure of how much real after-tax income exceeds the national average. That is, QOL represents the percent of total

[6] Non-tradable, non-housing goods prices are not available in Senegal. However, in Albouy (2012), it is shown that housing costs are highly predicted by non-housing costs. The adjustment he made, increase s_y to .36; if a similar method is applied here, the results hold.

income households are willing to sacrifice (or get compensated) to live in city j rather than an average city depending on how high or low it is.

But there two types of QOL measures: unadjusted QOL and adjusted QOL. Unadjusted QOL are measured from price differentials directly calculated from wage and rent data.

Adjusted QOL are measured from wage regression controlling for skills across cities. Following Albouy (2012), I run the following wage regression

$$\log w_i^j = X_i^{wj}\beta^w + \mu^j + \epsilon_i^{wj} \tag{16}$$

where $\log w_i^j$ is the logarithm of wage; X_i^{wj} is the set of controls such as education, experience, occupation, etc; μ^j are city-indicators. The coefficients μ^j are the measures of the wage differentials, and are interpreted as the causal effect of city$j$'s characteristics on workers wages. The main assumption is workers cannot sort across cities according to their unobserved skills.

One can calculate housing-cost differentials using a method similar to that used in the wage differentials case. I regress gross rents on controls (X_i^{pj}) such as size, rooms, type and age of building, etc; and on city-indicators

$$\log p_i^j = X_i^{pj}\beta^p + v^j + \epsilon_i^{pj} \tag{17}$$

The coefficients v^j are the measures of the housing-cost differentials. The main assumption here is average unobserved housing quality does not vary systematically across cities.

Note, however, there is heterogeneity in the QOL measures as different households have different preferences:

$$\hat{Q}_g^j = s_{yg}\hat{p}^j - \left(1 - \tau_g^{'}\right) s_{wg}\hat{w}_g{}^j \tag{18}$$

where g denotes a household type. The aggregate QOL measure is then:

$$\hat{Q}^j \equiv \sum_{\mu_g} \mu_g \hat{Q}_g^j \tag{19}$$

where μ_g is household type g income share

6.1.2 Standard QOL Methods: Results

The standard QOL estimates do not correlate with population distributions and perceived popular rankings as well as my estimates. According to standard QOL measures, Sedhiou Rural, Ziguinchor Rural, and Kaffrine Rural are ranked top 10 locations when these are some of the most remote and least inhabited places in Senegal (see Figure 7, Figure A.11, Figure A.12). The QOL measures under previous methods are correlated with the QOL measures using teachers choice data but the correlations are less than 60 percent. In effect, as Table 3 shows, correlation between QOL measures of teachers under teachers' choice data and QOL measures of the overall population studied under standard methods is 0.35. The correlation of QOL measures of teachers using teachers' choice data is highest with the non-educated group while it is lowest with the primary and non-educated group. This result is only somewhat puzzling as teachers are high school and university educated. However the more problematic finding is the QOL measures of teachers using teachers choice data and those using standard methods have a correlation of only 0.57(see Table 3).

My preferred measure is the one using teachers choice data because it is estimated directly from choice data in addition to the fact that nominal wages are fixed whereas the other measure is estimated from price and wage differentials. And in general, to the best of my knowledge, standard QOL studies have so far only been undertaken in developed country context, namely the U.S. This paper is the first to estimate QOL measures in developing country context. The goal then is to adjust the standard QOL models using my estimates and plausible assumptions based on previous studies to obtain measures that are more consistent.

6.2 New QOL Methods

6.2.1 First Adjusted Method

Location size is an important factor in migration models (Schultz (1982)). First, the bigger the location the more likely is a migrant to find a friend or relative, which helps abate migration costs (Kennan and Walker (2011)). Second, the bigger the location the more the gains from variety of consumption goods due to size (Schiff (2012)).

Distance to the capital city is also an important potential factor in migration decisions in developing countries. In urban-bias studies such as Lipton (1977), one of the earliest proponent of urban bias theory, urban classes in developing countries use political and social capital to enforce policies that are pro-urban: inequitable allocation of public resources. Thus moving closer to the capital provides an additional advantage because one is more likely to enjoy capital city amenities due to proximity.

Therefore it is plausible to adjust the standard QOL models with location size and distance to capital. In the adjusted model I assume that households have utility $U\left(x, y; Q^j, q_N^j, q_{dak}^j\right)$ in location j, where as before x is the traded good with price one and y is the home good with price p^j; $Q^j = \tilde{Q}\left(Z_j\right)$ is overall QOL in location j where $\tilde{Q}$ is a function of amenities Z_j such as crime, weather, etc; q_N^j is QOL derived from population size N^j in location j; q_{dak}^j is amenity derived from proximity to the capital city Dakar, D_{dak}^j. As before , given local price, local wage, tax rate and QOL (QOL), the after -tax expenditure necessary to obtain utility u is defined as

$$e\left(p^j, w^j, \tau, u; Q^j, q_N^j, q_{dak}^j\right) \equiv min_{x,y}\left\{x + p^j y - w^j - I + \tau\left(w^j + I\right) : U\left(p^j, w^j; Q^j, q_N^j, q_{dak}^j\right) \geq u\right\} \tag{20}$$

Full mobility guaranties that in equilibrium all cities are inhabited and no household needs additional compensation to live in her city of residence; thus

$$e\left(p^j, w^j, \tau, u; Q^j, q_N^j, q_{dak}^j\right) = 0 \tag{21}$$

where $\bar{u}$ is the national level of utility

To derive the relationship between QOL and local prices, total differentiate equation (19)

$$\frac{\partial e}{\partial p}dp^j + \frac{\partial e}{\partial w}dw^j + \frac{\partial e}{\partial q_N}dq_N^j + \frac{\partial e}{\partial q_{dak}}dq_{dak}^j + \frac{\partial e}{\partial Q}dQ^j = 0 \tag{22}$$

where the first-order approximation is taken around a city with average prices, population, distance to Dakar, and QOL and the derivatives are evaluated at the national average prices and QOL: $\bar{p}$, $\bar{w}$, $\bar{q_N}$, $\bar{q}_{dak}$, $\bar{Q}$. By Shepard's Lemma,

$$y.dp^j - \left(1 - \tau^{'}\right) dw^j + p_{q_N} dq_N^j + p_{q_{dak}} dq_{dak}^j = p_Q \centerdot dQ^j \tag{23}$$

where $\tau^{'}$is the marginal tax rate on income, $p_Q \equiv -\dfrac{\partial e}{\partial Q}$ is the marginal willingness-to-pay for QOL, p_{q_N} is the marginal willingness-to-pay for population, $p_{q_{dak}}$ is the marginal willingness-to-pay for distance to Dakar. After log-linearization so that $\hat{p}^j = \dfrac{dp^j}{\bar{p}}$, $\hat{w}^j = \dfrac{dw^j}{\bar{w}}$, $\hat{q}_N^j = \dfrac{dq_N^j}{\bar{q}_N}$, $\hat{q}_{dak}^j = \dfrac{dq_{dak}^j}{\bar{q}_{dak}}$ and after normalization such that $\hat{Q}^j = p_Q \dfrac{dQ^j}{\bar{m}}$:

$$\hat{Q}^j = s_y \hat{p}^j - \left(1 - \tau^{'}\right) s_w \hat{w}^j + c_1 \hat{q}_N^j + c_2 \hat{q}_{dak}^j \tag{24}$$

where $s_y = \dfrac{py}{\bar{m}}$, $s_w = \dfrac{\bar{w}}{\bar{m}}$: s_y is a vector of expenditure shares, out of gross income, and s_w is the share of gross income received from labor. c_1 and c_2 are constant such that $c_1 = \dfrac{\bar{q}_N}{\bar{m}} p_{q_N}$ and $c_2 = \dfrac{\bar{q}_{dak}}{\bar{m}} p_{q_{dak}}$. Assuming $q_N^j = f(N) = \lambda_1 N^j$ and $q_{dak}^j = f\left(D_{dak}^j\right) = \lambda_2 D_{dak}^j$. where λ_1 and λ_2 are constants, then equation 24 becomes:

$$\hat{Q}^j = s_y \hat{p}^j - \left(1 - \tau^{'}\right) s_w \hat{w}^j + \varphi \hat{N}^j + \psi \hat{D}_{dak}^j \tag{25}$$

where $\varphi = \lambda_1 c_1$ and $\psi = \lambda_2 c_2$. To determine φ and ψ, I first assume that the marginal willingness-to-pay for population and the marginal willingness-to-pay for distance to Dakar are the same different groups of households. Then the individual QOL for different groups and for the aggregate QOL are respectively:

$$\hat{Q}_g^j = s_{yg} \hat{p}^j - \left(1 - \tau_g^{'}\right) s_{wg} \hat{w_g}^j + \varphi \hat{N}^j + \psi \hat{D}_{dak}^j \tag{26}$$

$$\hat{Q}^j \equiv \sum_{\mu_g} \mu_g \hat{Q}_g^j \tag{27}$$

where g denotes a household type. Denote the QOL for the group of teachers $\hat{Q}_T^j$. Since nominal wage is fixed across locations for teachers, their QOL is:

$$\hat{Q}_T^j = s_{yT}\hat{p}^j + \varphi \hat{N}^j + \psi \hat{D}_{dak}^j \tag{28}$$

Let $\hat{T}^j$ be the QOL measure of teachers from teachers choice data. To adjust $\hat{Q}_T^j$, the QOL measure of teachers from the standard method, I regress $\hat{T}^j$ on $\hat{Q}_T^j$ to obtain $\hat{\varphi}$, $\hat{\psi}$. I therefore use these coefficients to adjust the QOL measures for different groups and for the aggregate:

$$\hat{Q}_g^j = s_{yg}\hat{p}^j - \left(1 - \tau_g^{'}\right) s_{wg}\hat{w_g}^j + \hat{\varphi}\hat{N}^j + \hat{\psi}\hat{D}_{dak}^j \tag{29}$$

6.2.2 First Adjusted Method: Results

The main finding is that, on average, big urban areas have higher QOL than rural areas for all groups: educated or non-educated. All else fixed, higher population and lower distance to the capital imply a higher QOL for a location. The coefficients obtained from equation 28 are $\varphi = 0.10$ and $\psi = -0.68$, with the right expected signs. The correlations between the QOL measure of teachers from teachers choice data and QOL measure of teachers from standard methods or QOL measures of other groups (non-educated, primary educated, middle school educated, high school educated, and university educated) are much higher than in the non-adjusted model. As Table 4 shows, the correlations vary from 0.84 to 0.85. So the the location rankings are similar: see Figure 8, Figure 10, Figure A.13, Figure A.14). These results confirms what was found for teachers, that most prefer cities to villages and this is true for all groups.

The adjusted model predicts also possible heterogeneity in preferences. An assumption in the adjusted model is that location size or distance to capital of potential destination enter similarly to all groups in the computation of QOL indices. However, if location size or distance to capital benefits the skilled more than the unskilled, then, by equation 26, more educated individuals will have higher QOL in bigger cities than less educated individuals and the difference in QOL between the high educated and the less educated will be higher in a bigger city than a smaller city, all else fixed. To see this, consider two cases where without loss of generality I assume heterogeneity in location but not in distance to capital:

$$\hat{Q}_g^j = s_{yg}\hat{p}^j - \left(1 - \tau_g^{'}\right) s_{wg}\hat{w}_g{}^j + \hat{\varphi}_g\hat{N}^j + \hat{\psi}\hat{D}_{dak}^j \tag{30}$$

or

$$\hat{Q}_g^j = s_{yg}\hat{p}^j - \left(1 - \tau_g^{'}\right) s_{wg}\hat{w}_g{}^j + \hat{\varphi}\hat{N}_g{}^j + \hat{\psi}\hat{D}_{dak}^j \tag{31}$$

where in the first case abatement in migration costs or gains from product variety are higher for the more educated than the non-educated, and in the second case these benefits are the same for all groups but the location size differential is higher for the educated than the non-educated (bigger cities have higher shares of educated individuals). In both cases, all else fixed, it is easy to show from equation 30 and equation 31 that: (1) more educated individuals will have higher QOL in bigger cities than less educated individuals:

$$\hat{Q}_{educated}^{BigCity} - \hat{Q}_{noneducated}^{BigCity} > 0 \tag{32}$$

and (2) difference in QOL between the high educated and the less educated will be higher in a bigger city than a smaller city:

$$\hat{Q}_{educated}^{BigCity} - \hat{Q}_{noneducated}^{BigCity} > \hat{Q}_{educated}^{SmallCity} - \hat{Q}_{noneducated}^{SmallCity} \tag{33}$$

6.2.3 Second Adjusted Method

The adjusted model above required two assumptions, which are both plausible, but is it possible to adjust standard QOL model without these assumptions. The answer is yes. To do so, I follow Albouy (2012) and model location size into the QOL of life measure. Define the utility of individual

i in city j as:

$$V_i^j = -\ln E\left(p^j, w^j, \tau, \underline{Q}^j\right) + \xi_i^j \tag{34}$$

where $E\left(p^j, w^j, \tau, \underline{Q}^j\right)$ is the expenditure function as defined previously, $\underline{Q}^j$ is the universal component of QOL in city j and ξ_i^j is a taste parameter and follows an extreme type I distribution with mean 0 and variance $\pi^2\varphi^2/6$.

Therefore, the choice probability of moving to city j is

$$P^j = \Pr\left(V_i^j > V_i^k \; \forall \; k \neq j\right) = \frac{\exp\left(-\ln E\left(p^j, w^j, \tau, \underline{Q}^j\right)/\varphi\right)}{\sum_{k\neq j} \exp\left(-\ln E\left(p^k, w^k, \tau, \underline{Q}^k\right)/\varphi\right)} \tag{35}$$

Assuming the denominator is constant (C), and denoting total population as $\bar{N}$, then the population share for each city is

$$N^j = \bar{N}P^j = \frac{1}{B}\exp\left(-\ln E\left(p^j, w^j, \tau, \underline{Q}^j\right)/\varphi\right) \tag{36}$$

Taking logs and rearranging:

$$\varphi \ln N^j + \varphi \ln C = -\ln E\left(p^j, w^j, \tau, \underline{Q}^j\right) \tag{37}$$

Log linearizing as in previous section:

$$\varphi \hat{N}^j = \hat{\underline{Q}}^j + \left(1 - \tau'\right) s_w \hat{w}^j - s_y \hat{p}^j \tag{38}$$

Or

$$\hat{\underline{Q}}^j = s_y \hat{p}^j - \left(1 - \tau'\right) s_w \hat{w}^j + \varphi \hat{N}^j \tag{39}$$

Locations with higher population have higher QOL than is implied by wages and costs.

As before, let $\hat{T}^j$ denote the QOL measure obtained using teachers' choice data, and $\hat{Q}_T^j$ the

QOL measure of teachers from the standard method, which is[7]:

$$\hat{Q}_T^j = s_{yT}\hat{p}^j + \varphi \hat{N}^j \tag{40}$$

Then regressing $\hat{T}^j$ on $\hat{Q}_T^j$ with parameter restrictions s_y, I obtain $\hat{\varphi} \simeq 0.39$. I therefore use this coefficient to adjust the QOL measures for different groups and for the aggregate, respectively:

$$\hat{Q}_g^j = s_{yg}\hat{p}^j - \left(1 - \tau_g^{'}\right) s_{wg}\hat{w}_g{}^j + \hat{\varphi}\hat{N}^j \tag{41}$$

$$\hat{Q}^j \equiv \sum_{\mu_g} \mu_g \hat{Q}_g^j \tag{42}$$

6.2.4 Second Adjusted Method: Results

In general, the correlation between QOL measures using teachers data and QOL measures using the discrete choice model are higher than the correlation with measures using the standard method: see Table 3, Tabe 5, Table 6, Table 7. But the correlation are only slightly improve for the aggregate QOL measure: from 0.35 to 0.39. However, this is only true when considering all locations, which include rural location with low populations: size effects are likely to be small. So when I consider urban location only, the correlation between QOL measures using teachers data and QOL measures using the discrete choice model are dramatically improved: from 0.46 to 0.69. Therefore, applying the discrete choice model, I obtain a "better" measure of QOL in Senegal. This model hence is likely to be appropriate in a developing country context where migration costs might be very high and might depend heavily on adjustment costs. The larger the destination size, the lower are the costs. The size can also come from gain from variety. Using these adjustments, one can obtain better measures.

[7] Assuming φ is the same for different groups

7 Robustness

It is reasonable to question wether nominal wages are fixed across locations for teachers, so I use differences in the types of teachers to deal with this potential problem. In Senegal, if teacher moves from a village to a city, his wage is not adjusted for cost-living. But it may be that teachers can earn extra income in the city by tutoring or teaching on the side at a private school. This phenomenon may be bigger in larger cities. Demand for tutoring is mainly in math and science subjects therefore teachers teaching this subject should be in much higher demand than non-science teachers. The prediction is then these teachers will have a stronger preference for cities all else fixed. Similarly, most private schools in Senegal start from middle school and high school[8]. The prediction again is teachers in high and middle schools will have stronger preference for cities than those teaching in primary school all else fixed. I reestimate preferences for each group.

I find preferences are similar to the average teacher. In either case, the results hold and there is no difference in preferences between types of teachers (see Table A.1, Table A.2. The rankings obtained are consistent with initial rankings (see Figure 4, Figure A.7, Figure A.8, Figure 5, Figure A.7, Figure A.8). In fact the top location in both cases is Thies Urban not Dakar Urban, suggesting that the outside option effect is absent and even in the opposite direction for the top places.

However, the outside option for teachers may be any potential jobs outside of education and hence big urban areas could still attract teachers for employment reasons and not for QOL reasons. Even though from the standard Harris-Todaro model unemployment may be much higher in the urban area, cities are places with great employment opportunities. But according to the Ministry of Education of Senegal Human Resources[9], only about 13% of teachers leave the teaching profession temporarily or permanently (many of which are temporary). Therefore, it is reasonable to rule out the outside option effect.

The third problem is interpreting preferences. Are teachers moving to cities because cities have better school and better students or are they moving for amenities. Moving because of better schools is not a problem because quality education is also amenities. In any case, it is reasonable

[8] Annuaire Statistique National 2000-2010, Direction de la Planification et de la Reforme de l'Education (Senegal)

[9] Mamdou Sonko, Direction des Resources Humaines, Ministere de l'Education Nationale du Senegal

to assume that when moving to a city the quality of schools is a second order decision compared to QOL of the city itself. However, one component of city amenities could be the quality of students because teachers may want to locate in places when their children can get better education. I have shown earlier (see results section) that married teachers have similar preferences that singles or other groups. Given data constraints, on one specification, I control for primary school score quality. Preferences for cities are still consistent with the baseline specification: see:Table A.3, Figure 6.

8 Policy Implications

These results of this paper have important implications for policies to bring high-quality public sector workers to rural areas, place-based policies.

8.1 The Sorting of Public School Teachers to Cities

Preference for big cities in Senegal may lead to unequal outcomes in education. Given the assignment mechanism of teachers currently employed in Senegal, city bias leads to sorting of experienced teachers to big cities and inexperienced teachers to small locations. which may potentially contribute to the observed inequality in student outcomes across regions: students in big urban areas perform better. Provided most prefers urban areas, it is likely teacher assignment which favors seniority in addition to the allocation of new teachers to rural areas creates this sorting of teachers by experience. This divergence may potentially contribute to the observed inequality in student outcomes across regions: students in big urban areas perform better if teacher experience matters for student performance. [10]

In effect, previous findings on teacher experience and student outcome, I suggest a plausible channel on how regional inequality in education arises. On the one hand, previous findings suggest the impact of experience is strongest during the first few years of teaching and new teachers are less effective than those with some experience: Clotfelter, Ladd, and Vigdor (2007); Harris and

[10] See Figure A.18, A.19, A.20

Sass (2011); Kane, Rockoff, and Staiger (2008); Ladd (2008); Sass (2007). The impact of early career experience appears to be stronger than the effect of most other observable teacher-related variables. On the other hand, I find that: the share highly experienced teachers (10 year +) to be much higher in big urban areas, the share of inexperience teachers (less than 5 years) is much higher in small towns or villages, and primary school students standardized test scores on mathematics and languages to be higher big urban areas. These results in addition to the fact that the assignment mechanism favors seniority suggest that the movement of teachers favor inequality in education outcomes between rural and urban areas in Senegal.

Another potential source of divergence in education outcome is teacher turnover. The mechanism and teacher preferences suggest a high teacher turnover in rural areas as most teachers desire to leave (and many do leave), and new teachers are usually assigned to small rural areas. Furthermore, origin locations in the choice lists comprises mostly of small towns and villages. Teacher turnover has a significant and negative effect on student achievement and is particularly harmful to students in schools with large populations of low-performing students (Ronfeldt, Loeb, and Wyckoff (2013)).

In effect, these types of divergence have been well documented in the health care sector in developed countries such as in the U.S. and Japan. In Health care, typical rural programs in the U.S. are less preferred to urban programs because rural programs tend to be associated with smaller hospitals and medical school affiliates with lower NIH funding according to Agarwal (2015), so he analyzes wage and supply policies aimed at increasing the number of residents training in rural areas while accounting for general equilibrium effects from the matching market. He finds that financial incentives increase the quality, but not the number of rural residents and that quantity regulations increase the number of rural trainees, but the impact on resident quality depends on the design of the intervention. Japan implements policies reducing capacities in urban residency programs to mitigate their rural resident shortage (Kamada and Kojima (2010)).

Therefore, taking into account the QOL dimension of cities is important for place-based policies, whether and how urbanization can be slowed, and for policies to bring high-quality public sector workers to rural areas. When governments want to to move certain industries to a location in order to decentralization certain location for example, they often ignore the consumption amenities dimension. Thus they might overestimate the population relocation effect of their policy because people place certain value on the QOL of the central location. The results of this paper have important implications for policies to bring high-quality public sector workers to rural areas. Some teachers are being over paid in cities; if paid less (the magnitude depends on price elasticity), teachers will still prefer urban locations. This is a big inefficiency in government wage-setting. But if it is not desirable to offer a lower pay in cities, then the government can still improve their pay policy by paying teachers more in rural areas to attract good teachers if spatial equality is a goal. Finally, because the QOL of cities is an additional pull factor (the other being productivity), it is harder to slow urbanization. And any policy to slow it, if that is a desirable policy, must take into account the QOL aspect of cities.

9 Conclusion

The phenomenon of urbanization developing countries is increasingly gaining attention with those who favor the rise of cities and those who do not. Cities in developing countries have productivity advantages over rural areas, but some view them as places with lower and deteriorating QOL due to congestion, pollution, and crime. However, the role cities' consumer amenities play in individuals' location preference has not been studied in a developing country context. This paper provides the first study of QOL of urban and rural locations in a developing country. Unlike in previous studies where location preferences are based on variations in real wages across locations, I estimate preferences directly from observed choices. I exploit unique data on public school teachers' location choices when nominal wages are fixed across locations to recover QOL indices and obtain revealed preference rankings over locations. Teachers prefer cities despite lower real wages. Standard methodology estimates from previous literature give misleading preference rankings for teachers. Thus I use my estimates to show how the standard methodology needs to be adjusted. Using the adjusted measures, I show that cities have higher QOL than rural areas for all workers.

First, this paper provides a complementary theory to rural-urban migration in developing countries, which has traditionally been attributed to the expected income differential between urban and rural areas. Second, standard QOL estimates need to be adjusted for destination location size and its proximity to the capital city. Third place-based policies need to take into account the consumption or QOL dimension of locations and not just the production aspect. Also that to bring high-quality public sector workers to rural areas, the government should set a higher wage in rural areas or a lower wage in urban areas: good teachers need to be compensated to move to rural areas. Pay in cities can be cut without teachers wanting to move to villages, which shows there exists inefficiency in the government's wage-setting policy of public workers.

The preference for cities has potential implications for the spatial distribution of public school teachers: sorting of experienced teachers to big urban areas and inexperienced teachers to rural areas given the assignment mechanism of teachers that favors seniority: this result is however only suggestive. Future research would to examine this aspect and the causal impact of this type of sorting on education outcomes. Finally, in future work I would like propose and evaluate an alternative assignment mechanism of teachers because the current mechanism is not strategy proof nor Pareto efficient due choice truncation and no room for trading spots. A better and more fitting mechanism is You request my house I get your turn (YRMH-IGYT) proposed by Abdulkadiroğlu and Sönmez (1999).

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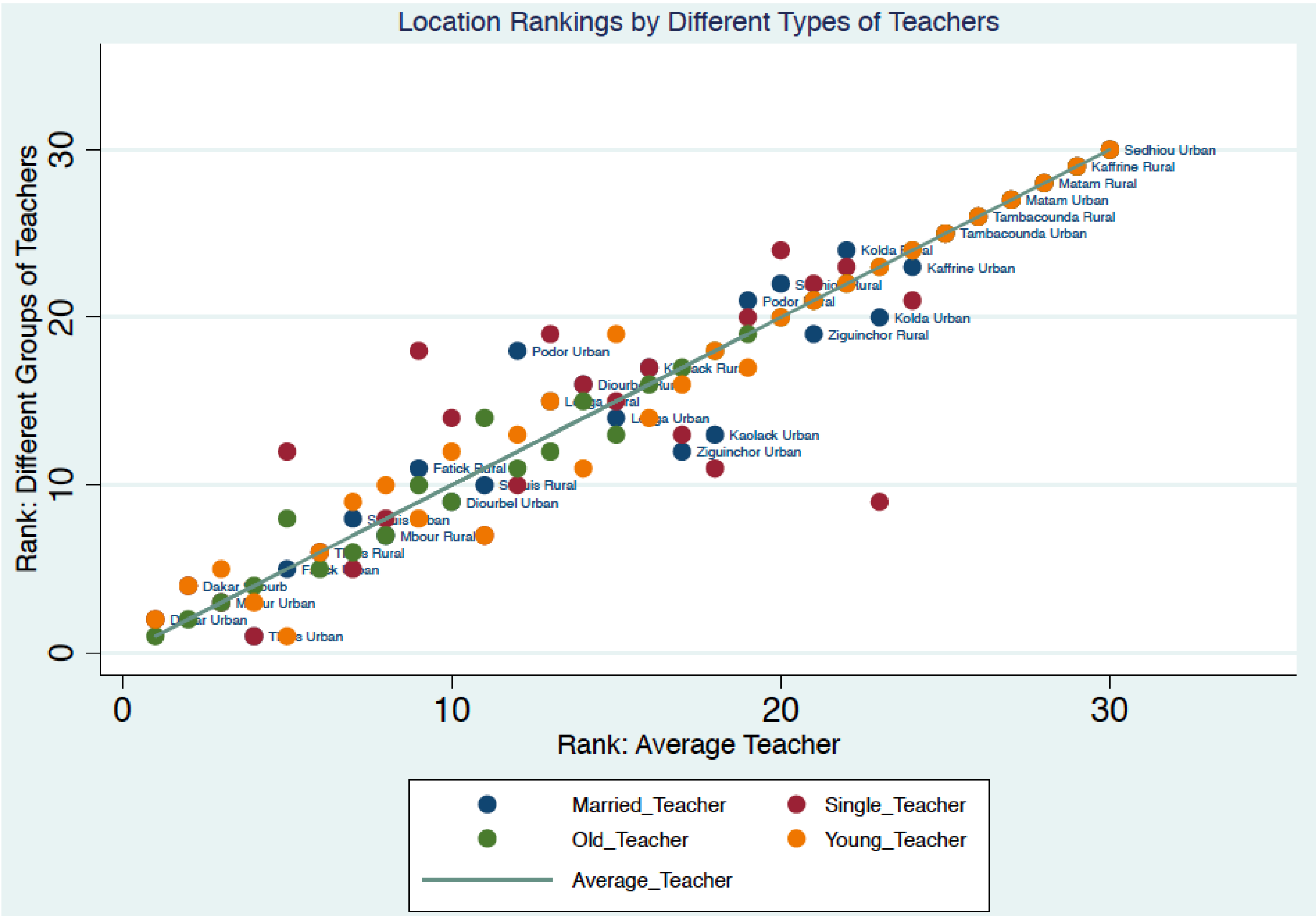
Figure 1: Location Rankings by Different Types of Teachers



Notes: Urban and rural location rankings given location fixed effects $\hat{\theta}_l = \hat{\alpha}_l + \bar{X}\hat{\beta}_l$ for different groups (average teacher, married teacher, old teacher, and young teacher) depending on the group personal characteristics. Old has average age of 40 where young has average age of 25. The line has a slope of 1.

Table 1: Location fixed effects: $\hat{\alpha}_l$

Dependent Variable: Rank	(1)	(2)
Dakar Suburb	4.543***	4.508***
Dakar Urban	4.722***	4.627***
Diourbel Rural	3.277***	3.205***
Diourbel Urban	3.998***	3.898***
Fatick Rural	3.726***	3.635***
Fatick Urban	4.259***	4.195***
Kaffrine Rural	0.701**	0.742***
Kaffrine Urban	1.382***	1.330***
Kaolack Rural	3.236***	3.185***
Kaolack Urban	4.012***	3.894***
Kolda Rural	1.186***	1.171***
Kolda Urban	2.548***	2.488***
Louga Rural	3.187***	3.122***
Louga Urban	3.557***	3.513***
Matam Rural	-0.136	-0.133
Matam Urban	1.138***	1.193***
Mbour Rural	4.196***	4.176***
Mbour Urban	4.574***	4.545***
Podor Rural	2.311***	2.292***
Podor Urban	3.448***	3.408***
Sedhiou Rural	1.658***	1.626***
Sedhiou Urban	2.976***	2.984***
Stlouis Rural	3.989***	3.965***
Stlouis Urban	4.256***	4.168***
tamba Urban	1.574***	1.521***
Thies Rural	4.307***	4.261***
Thies Urban	4.724***	4.674***
Ziguinchor Rural	2.698***	2.479***
Ziguinchor Urban	3.669***	3.663***
Birthplace		0.477***
Observations	9,946	9,946

*** p<0.01, ** p<0.05, * p<0.1

Notes: Base location is Tambacounda Rural (at 0). The coefficients represents the alternative specific constants or the location fixed effects without controlling for personal characteristics. These coefficients can be interpreted the following way: The coefficient on Dakar Urban (controlling for birthplace) is 4.63, so the likelihood of choosing Dakar Urban instead of Tambacounda Rural is $ODD_{lk} = e^{(.4.63-0)} = 99$.

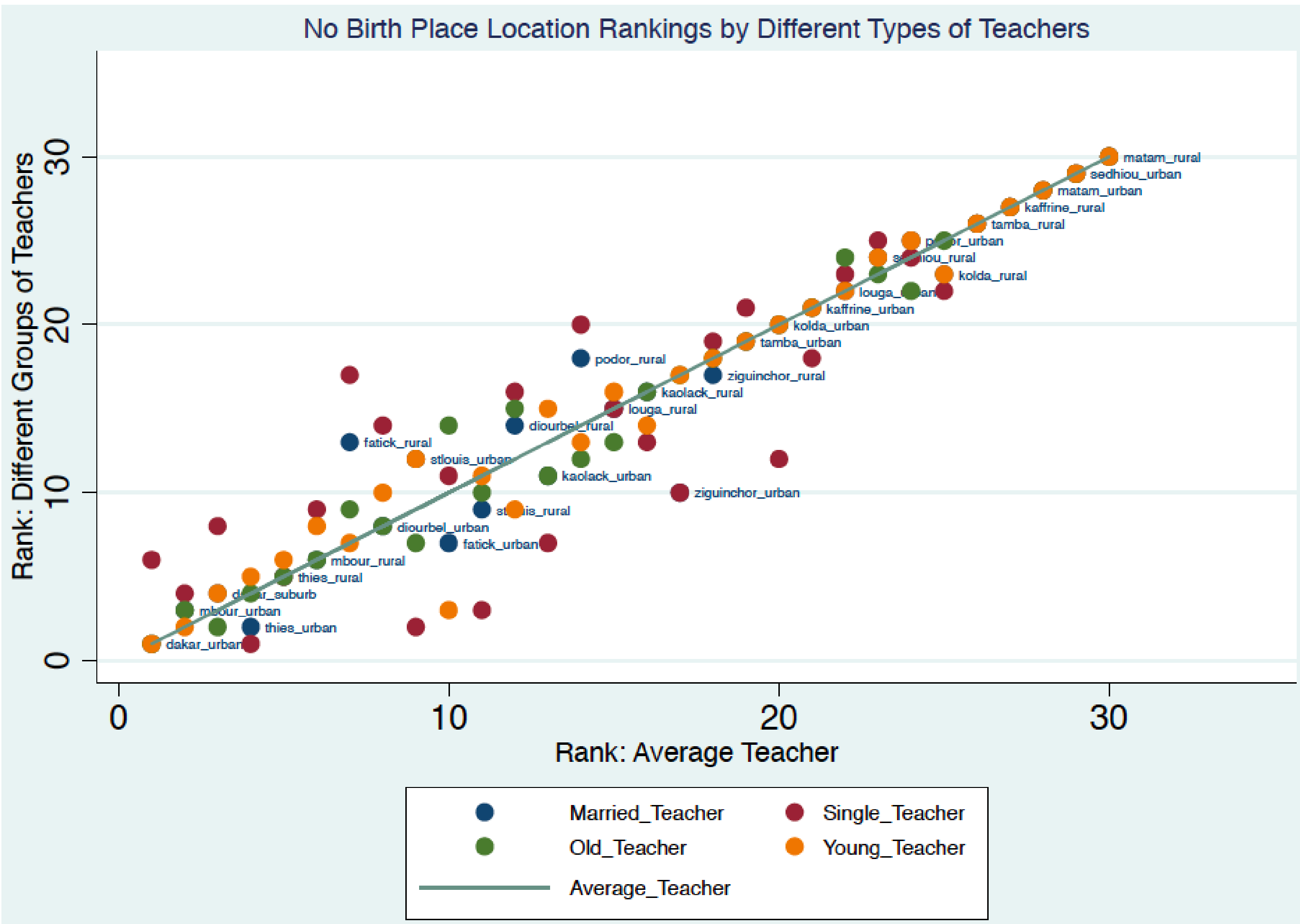
Table 2: Fixed Effects With Personal Characteristics and Average Location Primary school score

Dependent Variable: Rank	(1)
Dakar Suburb	4.198***
	(1.373)
Dakar Urban	3.845**
	(1.532)
Diourbel Rural	7.422***
	(1.519)
Diourbel Urban	3.875**
	(1.661)
Age*Dakar Suburb	0.00669
	(0.0370)
Age*Dakar Urban	0.0217
	(0.0406)
Age*Diourbel Rural	-0.113***
	(0.0423)
Age*Diourbel Urban	-0.00896
	(0.0450)
Married*Dakar Suburb	-0.580
	(0.492)
Married*Dakar Urban	-0.821
	(0.540)
Married*Diourbel Rural	-0.532
	(0.556)
Married*Diourbel Urban	0.207
	(0.555)
Child*Dakar Suburb	0.467
	(0.543)
Child*Dakar Urban	0.664
	(0.575)
Child*Diourbel Rural	0.351
	(0.600)
Child*Diourbel Urban	0.0673
	(0.604)
Birthplace	0.477***
	(0.0652)
PrimarySchoolScore	
Observations	9,594

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

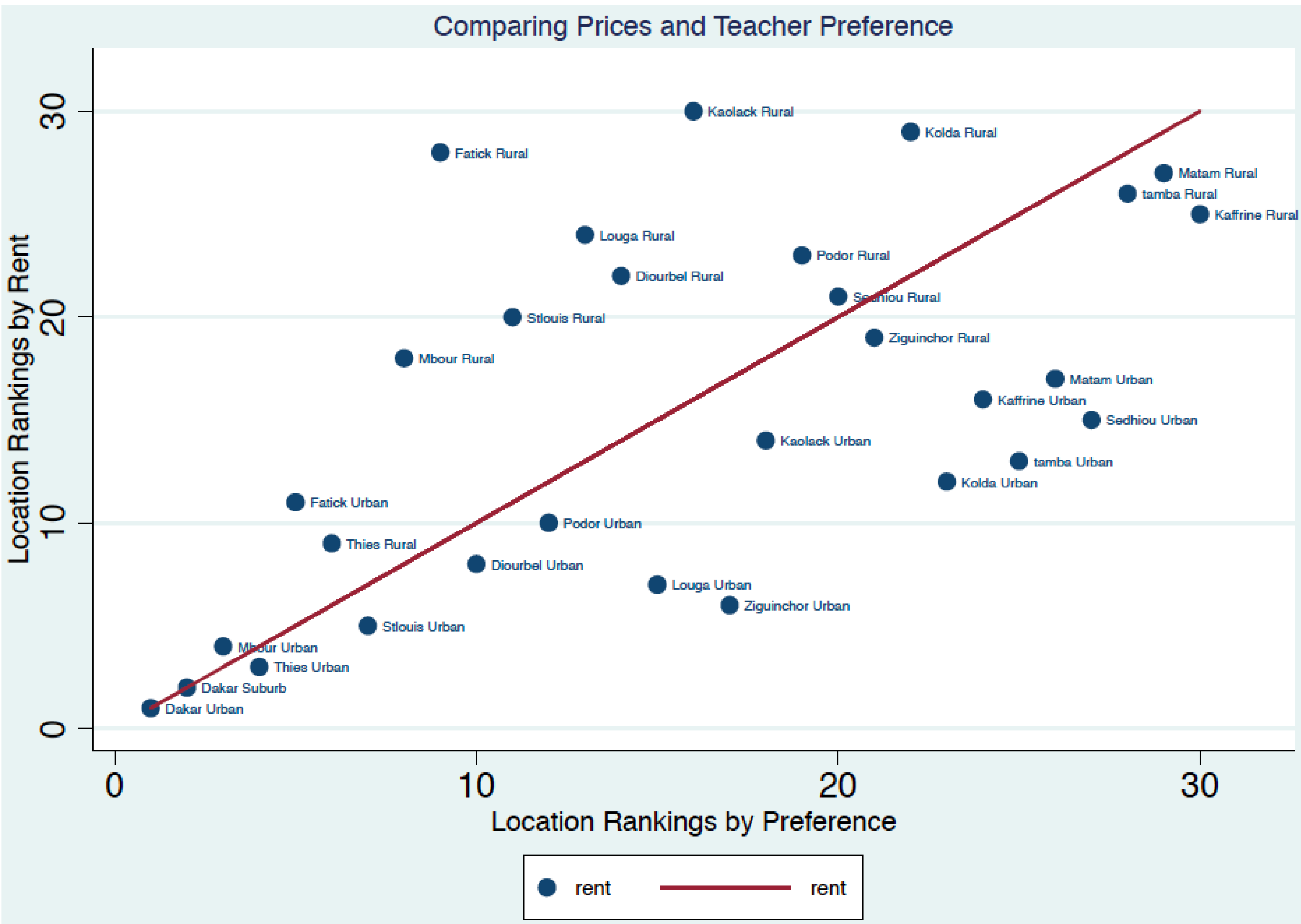
Notes: Base location is Tambacounda Rural (at 0). This table contains the partial output of the location fixed effects as the full table would not fit a page. The table is used as illustration. The coefficients here $(\hat{\alpha}_l, \hat{\beta}_l)$ are used in the estimation of the location fixed effect that take into account personal characteristics: $\hat{\theta}_l = \hat{\alpha}_l + \bar{X}\hat{\beta}_l$

Figure 2: No Birth Place Location Rankings by Different Types of Teachers



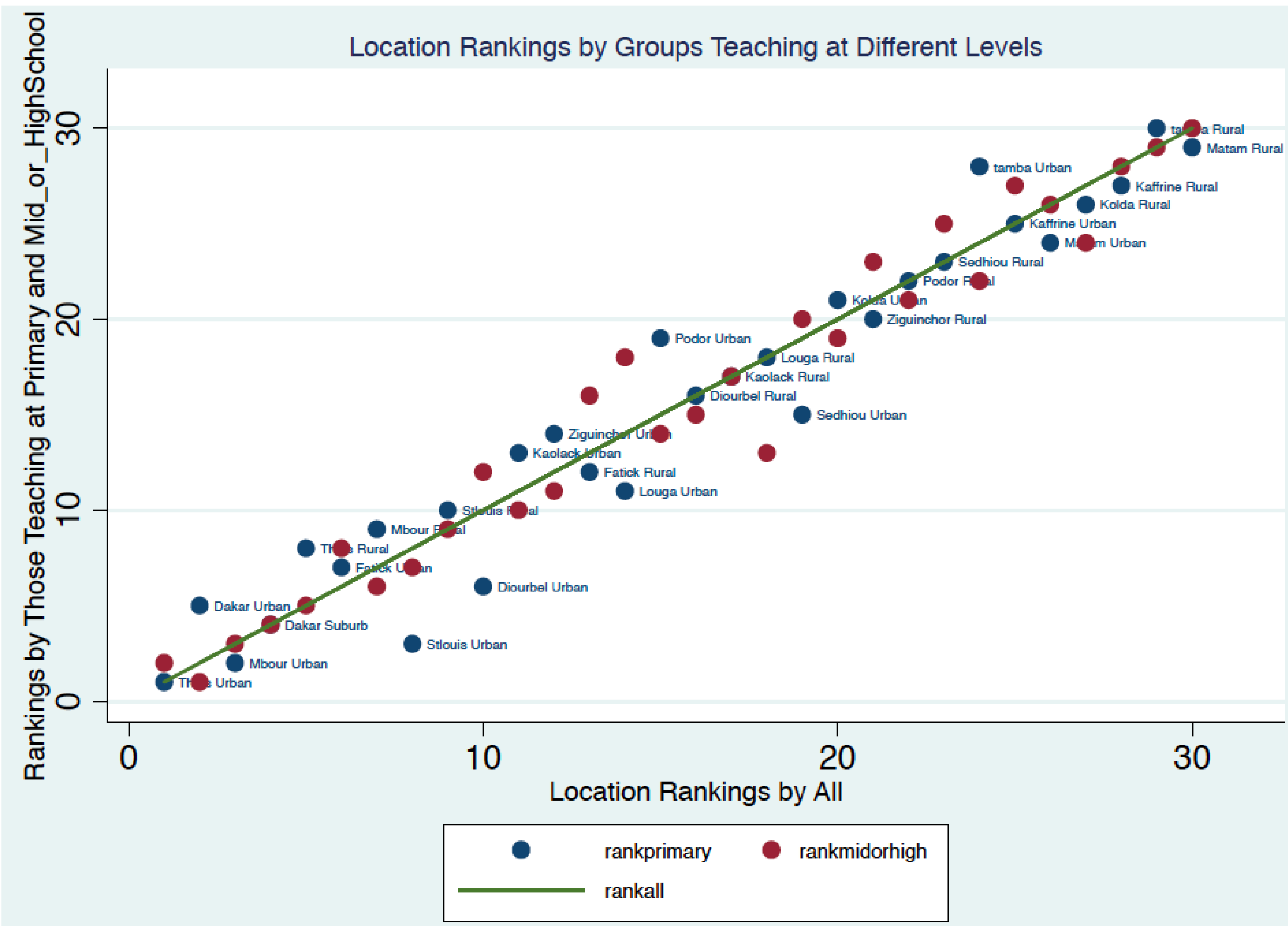
Notes: Limiting choices to only places where the teacher was **not** born. Urban and rural location Rankings given location fixed effects $\hat{\theta}_l = \hat{\alpha}_l + \bar{X}\hat{\beta}_l$ for different groups (average teacher, married teacher, old teacher, and young teacher) depending on the group personal characteristics. Old has average age of 40 where young has average age of 25. The line has a slope of 1.

Figure 3: Comparing Prices and Teacher Preference



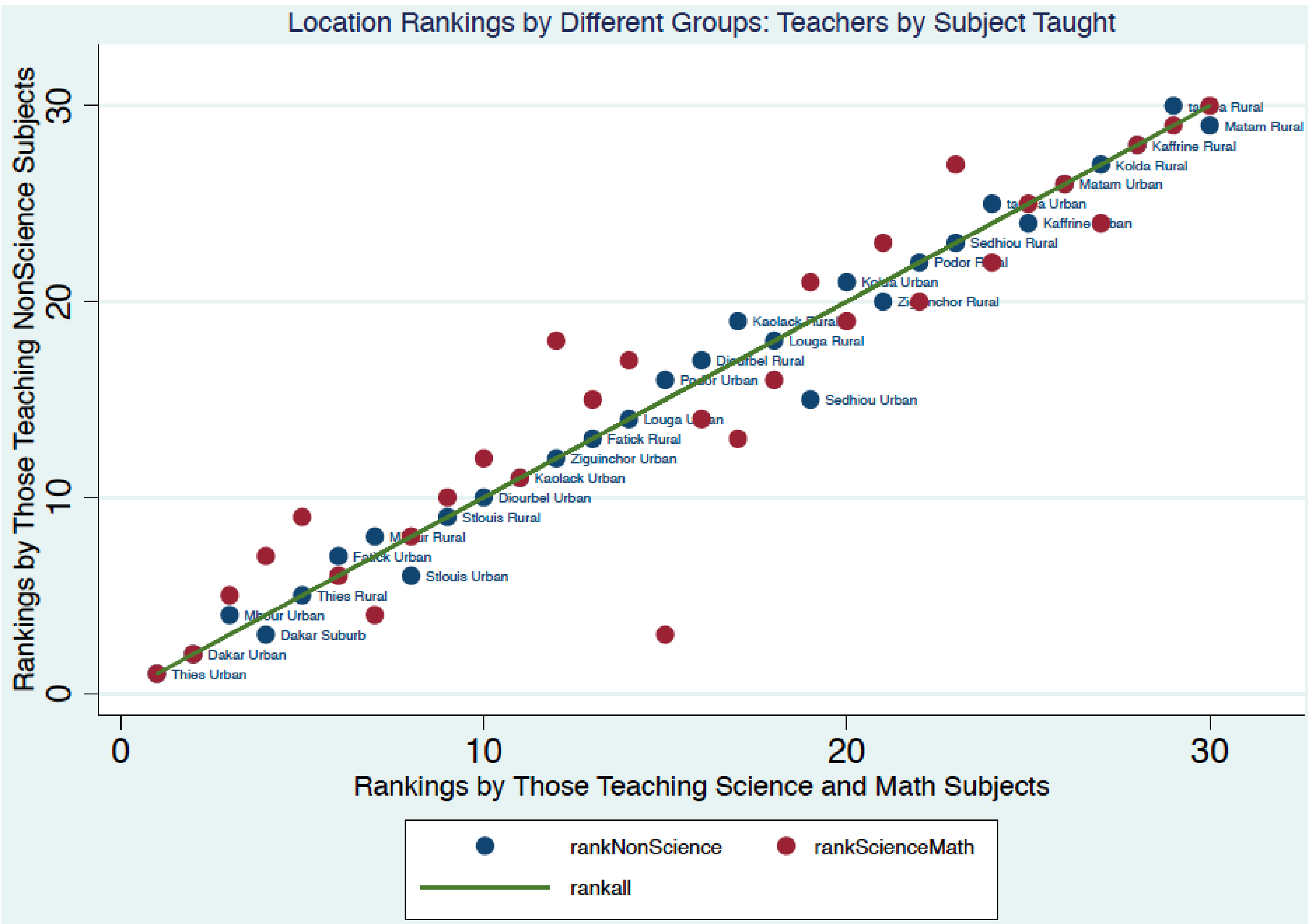
Notes: This table shows location rankings given location fixed effects $\hat{\theta}_l = \hat{\alpha}_l + \bar{X}\hat{\beta}_l$ for different groups (average teacher, married teacher, old teacher, and young teacher) depending on the group personal characteristics and location rankings by rent differentials (how expensive is a location relative to the average location. Top ranked placed are the most expensive. The line has a slope of 1.

Figure 4: Location Rankings by Groups Teaching at Different Levels



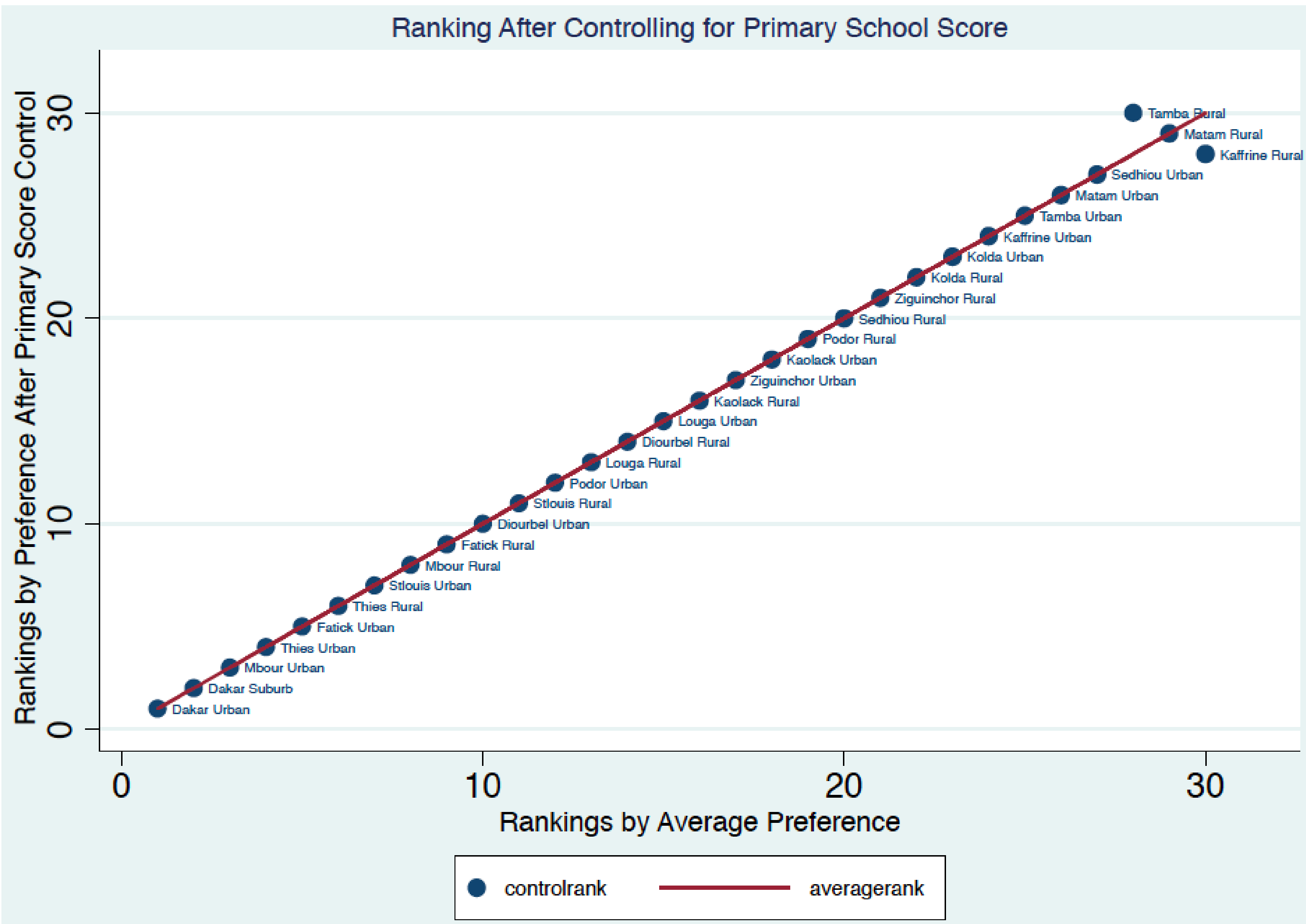
Notes: This table shows location rankings for all teachers, those teaching primary school only, and those teaching middle or high school only, respectively. The line has a slope of 1.

Figure 5: Location Rankings by Different Groups: Teachers by Subject Taught



Notes: This table shows location rankings for all teachers, those teaching non-science subjects only, and those teaching science or math only, respectively. The line has a slope of 1.

Figure 6: Ranking After Controlling for Primary School Score



Notes: This figure compares location rankings by teachers after primary school test scores are controlled to average rankings. The line has a slope of 1.

Table 3: Correlations Between QOL measures of Different Groups Under the Standard Method

	$\hat{T}$	$\hat{Q}_{noneduc}$	$\hat{Q}_{primary}$	$\hat{Q}_{middle}$	$\hat{Q}_{high}$	$\hat{Q}_{univ}$	$\hat{Q}_{teacher}$	$\hat{Q}_{all}$
$\hat{T}$	1							
$\hat{Q}_{noneduc}$	0.571***	1						
$\hat{Q}_{primary}$	0.173	0.175	1					
$\hat{Q}_{middle}$	0.227	0.235	0.826***	1				
$\hat{Q}_{high}$	0.496***	0.681***	0.394**	0.587***	1			
$\hat{Q}_{univ}$	0.479***	0.437**	0.484***	0.570***	0.693***	1		
$\hat{Q}_{teacher}$	0.572***	0.981***	0.154	0.220	0.694***	0.493***	1	
$\hat{Q}_{all}$	0.345*	0.343*	0.873***	0.906***	0.711***	0.771***	0.349*	1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table shows Spearman's rank correlation coefficients.$\hat{Q}_{noneduc}$, $\hat{Q}_{primary}$, $\hat{Q}_{middle}$, $\hat{Q}_{high}$, $\hat{Q}_{univ}$, $\hat{Q}_{teacher}$, $\hat{Q}_{all}$ are the QOL measures of teachers, the non-educated, the primary school educated, the middle school educated, the high school educated, the university educated, and all groups, respectively. And $\hat{T}$ is the QOL measure using teachers choice data.

Table 4: Correlations Between QOL measures of Different Groups Under the New Method

	$\hat{T}$	$\hat{Q}^{New}_{noneduc}$	$\hat{Q}^{New}_{primary}$	$\hat{Q}^{New}_{middle}$	$\hat{Q}^{New}_{high}$	$\hat{Q}^{New}_{univ}$	$\hat{Q}^{New}_{teacher}$	$\hat{Q}^{New}_{all}$
$\hat{T}$	1							
$\hat{Q}^{New}_{noneduc}$	0.846***	1						
$\hat{Q}^{New}_{primary}$	0.842***	0.994***	1					
$\hat{Q}^{New}_{middle}$	0.841***	0.996***	0.996***	1				
$\hat{Q}^{New}_{high}$	0.840***	0.995***	0.996***	0.999***	1			
$\hat{Q}^{New}_{univ}$	0.846***	0.995***	0.995***	0.996***	0.996***	1		
$\hat{Q}^{New}_{teacher}$	0.851***	0.999***	0.995***	0.996***	0.996***	0.997***	1	
$\hat{Q}^{New}_{all}$	0.845***	0.996***	0.998***	0.998***	0.998***	0.997***	0.996***	1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table shows Spearman's rank correlation coefficients.$Q^{New}_{noneduc}$, $Q^{New}_{primary}$, Q^{New}_{middle}, Q^{New}_{high}, Q^{New}_{univ}, $Q^{New}_{teacher}$, Q^{New}_{all} are the QOL measures, under the adjusted model, of teachers, the non-educated, the primary school educated, the middle school educated, the high school educated, the university educated, and all groups, respectively. And $\hat{T}$ is the QOL measure using teachers choice data.

Table 5: Correlations Between QOL measures of Different Groups Under the Standard Method for Only **Urban** Locations

	$\hat{T}$	$\hat{Q}_{noneduc}$	$\hat{Q}_{primary}$	$\hat{Q}_{middle}$	$\hat{Q}_{high}$	$\hat{Q}_{univ}$	$\hat{Q}_{teacher}$	$\hat{Q}_{all}$
$\hat{T}$	1							
$\hat{Q}_{noneduc}$	0.891***	1						
$\hat{Q}_{primary}$	0.376	0.439*	1					
$\hat{Q}_{middle}$	0.451*	0.532**	0.882***	1				
$\hat{Q}_{high}$	0.555**	0.659***	0.752***	0.845***	1			
$\hat{Q}_{univ}$	0.369	0.440*	0.953***	0.894***	0.666***	1		
$\hat{Q}_{teacher}$	0.869***	0.948***	0.465*	0.513**	0.677***	0.429*	1	
$\hat{Q}_{all}$	0.462*	0.505**	0.967***	0.946***	0.846***	0.940***	0.513**	1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table shows Spearman's rank correlation coefficients.$\hat{Q}_{noneduc}$, $\hat{Q}_{primary}$, $\hat{Q}_{middle}$, $\hat{Q}_{high}$, $\hat{Q}_{univ}$, $\hat{Q}_{teacher}$, $\hat{Q}_{all}$ are the QOL measures of teachers, the non-educated, the primary school educated, the middle school educated, the high school educated, the university educated, and all groups, respectively. And $\hat{T}$ is the QOL measure using teachers choice data. The correlation are only for **urban** locations.

Table 6: Correlations Between QOL measures of Different Groups Under the Discrete Choice Model

	$\hat{T}$	$\hat{Q}^{Discrete}_{noneduc}$	$\hat{Q}^{Discrete}_{primary}$	$\hat{Q}^{Discrete}_{middle}$	$\hat{Q}^{Discrete}_{high}$	$\hat{Q}^{Discrete}_{univ}$	$\hat{Q}^{Discrete}_{teacher}$	$\hat{Q}^{Discrete}_{all}$
$\hat{T}$	1							
$\hat{Q}^{Discrete}_{noneduc}$	0.426**	1						
$\hat{Q}^{Discrete}_{prim}$	0.321*	0.880***	1					
$\hat{Q}^{Discrete}_{middle}$	0.329*	0.886***	0.966***	1				
$\hat{Q}^{Discrete}_{high}$	0.434**	0.908***	0.879***	0.932***	1			
$\hat{Q}^{Discrete}_{univ}$	0.524***	0.891***	0.866***	0.900***	0.936***	1		
$\hat{Q}^{Discrete}_{teacher}$	0.461**	0.991***	0.867***	0.882***	0.936***	0.923***	1	
$\hat{Q}^{Discrete}_{all}$	0.389**	0.900***	0.968***	0.984***	0.950***	0.942***	0.909***	1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table shows Spearman's rank correlation coefficients. $\hat{Q}^{Discrete}_{noneduc}$, $\hat{Q}^{Discrete}_{prim}$, $\hat{Q}^{Discrete}_{middle}$, $\hat{Q}^{Discrete}_{high}$, $\hat{Q}^{Discrete}_{univ}$, $\hat{Q}^{Discrete}_{teacher}$, $\hat{Q}^{Discrete}_{all}$ are the QOL measures, under the discrete choice model, of teachers, the non-educated, the primary school educated, the middle school educated, the high school educated, the university educated, and all groups, respectively. And $\hat{T}$ is the QOL measure using teachers choice data.

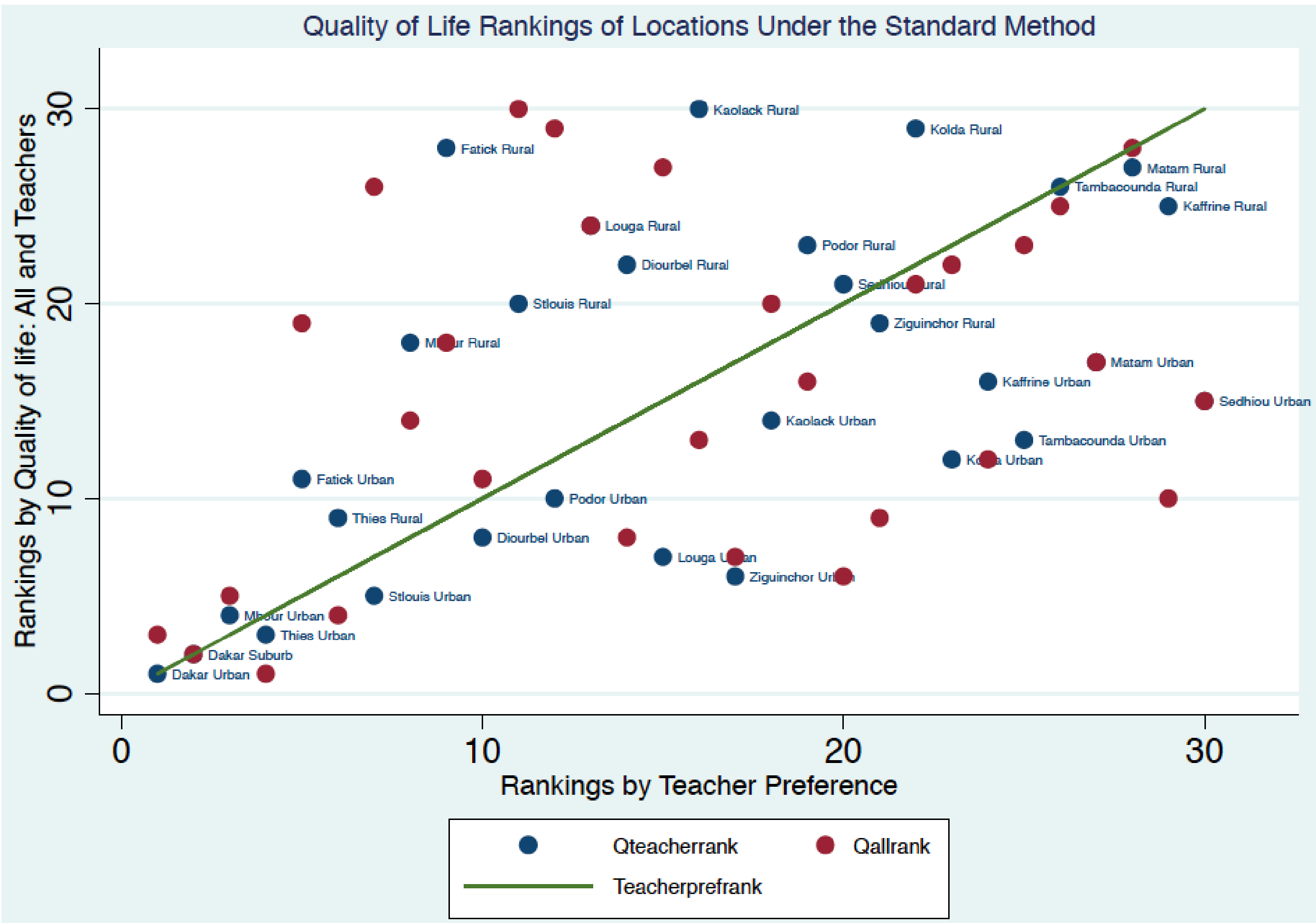
Table 7: Correlations Between QOL measures of Different Groups Under the Discrete Choice Model for Only **Urban** Locations

	$\hat{T}$	$\hat{Q}^{Discrete}_{noneduc}$	$\hat{Q}^{Discrete}_{primary}$	$\hat{Q}^{Discrete}_{middle}$	$\hat{Q}^{Discrete}_{high}$	$\hat{Q}^{Discrete}_{univ}$	$\hat{Q}^{Discrete}_{teacher}$	$\hat{Q}^{Discrete}_{all}$
$\hat{T}$	1							
$\hat{Q}^{Discrete}_{noneduc}$	0.683***	1						
$\hat{Q}^{Discrete}_{prim}$	0.517**	0.937***	1					
$\hat{Q}^{Discrete}_{middle}$	0.451*	0.899***	0.983***	1				
$\hat{Q}^{Discrete}_{high}$	0.503**	0.929***	0.993***	0.994***	1			
$\hat{Q}^{Discrete}_{univ}$	0.633***	0.980***	0.975***	0.937***	0.961***	1		
$\hat{Q}^{Discrete}_{teacher}$	0.685***	0.994***	0.947***	0.899***	0.929***	0.987***	1	
$\hat{Q}^{Discrete}_{all}$	0.685*	0.918***	0.998***	0.989***	0.995***	0.962***	0.927***	1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

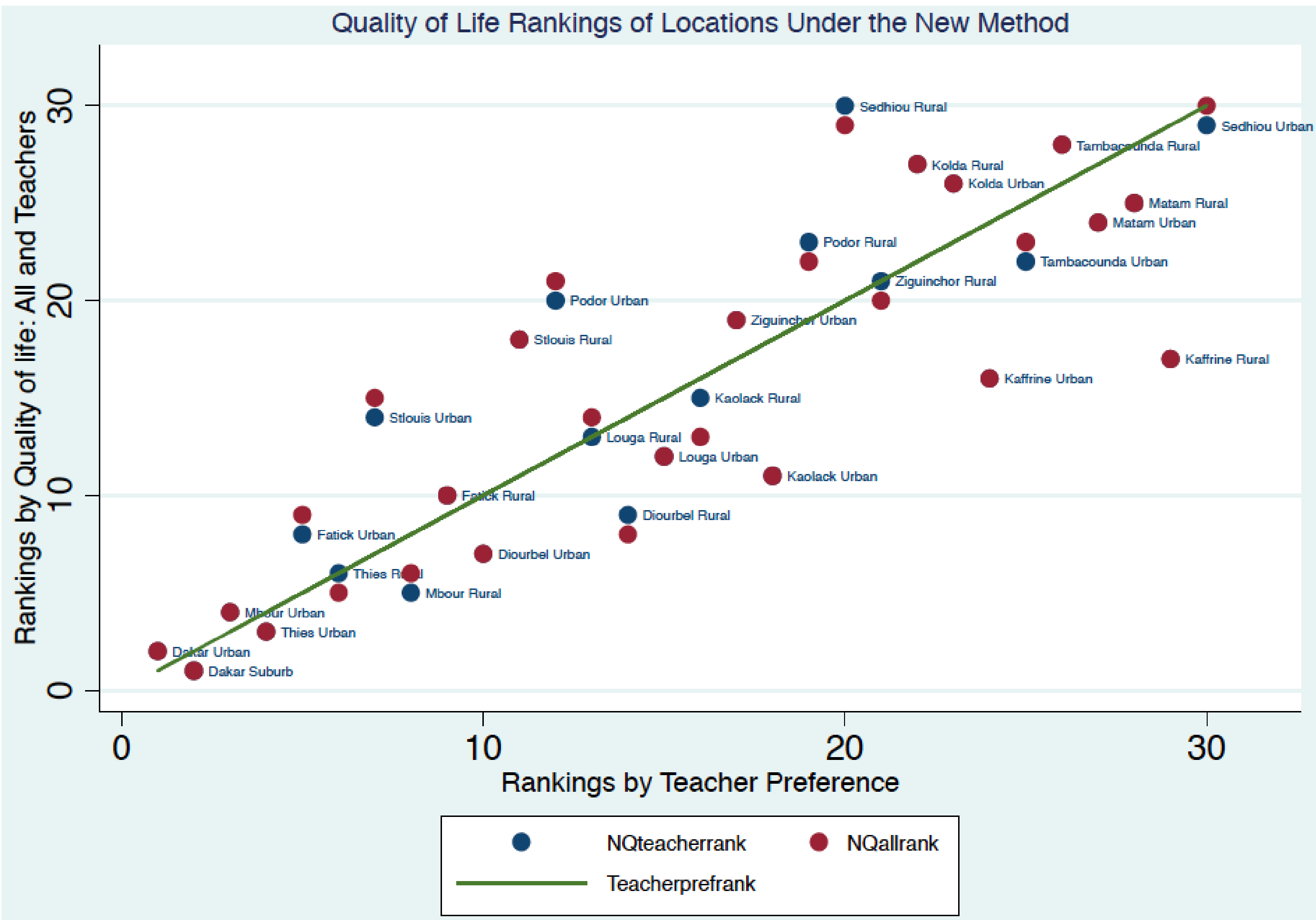
Notes: The table shows Spearman's rank correlation coefficients. $\hat{Q}^{Discrete}_{noneduc}$, $\hat{Q}^{Discrete}_{prim}$, $\hat{Q}^{Discrete}_{middle}$, $\hat{Q}^{Discrete}_{high}$, $\hat{Q}^{Discrete}_{univ}$, $\hat{Q}^{Discrete}_{teacher}$, $\hat{Q}^{Discrete}_{all}$ are the QOL measures, under the discrete choice model, of teachers, the non-educated, the primary school educated, the middle school educated, the high school educated, the university educated, and all groups, respectively. And $\hat{T}$ is the QOL measure using teachers choice data. The correlation are only for **urban** locations.

Figure 7: QOL Rankings of Locations Under the Standard Method



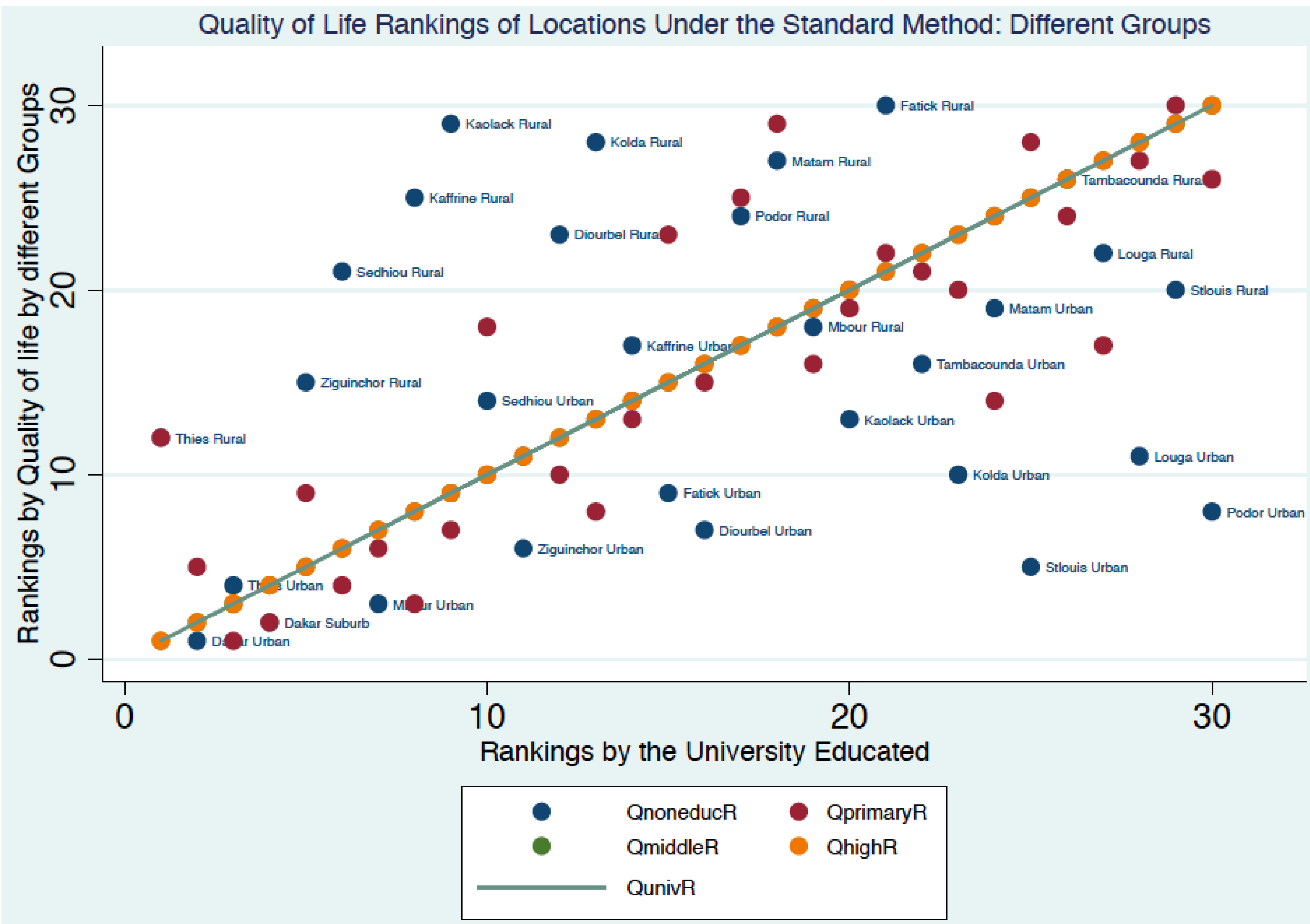
Notes: The figure shows location rankings given by the standard QOL measures of all groups and teachers (Qallrank, Qteacherrank) , and by teachers's preference using teachers choice data (Teacherprefrank), respectively. The line has a slope of 1.

Figure 8: QOL Rankings of Locations Under the New Method



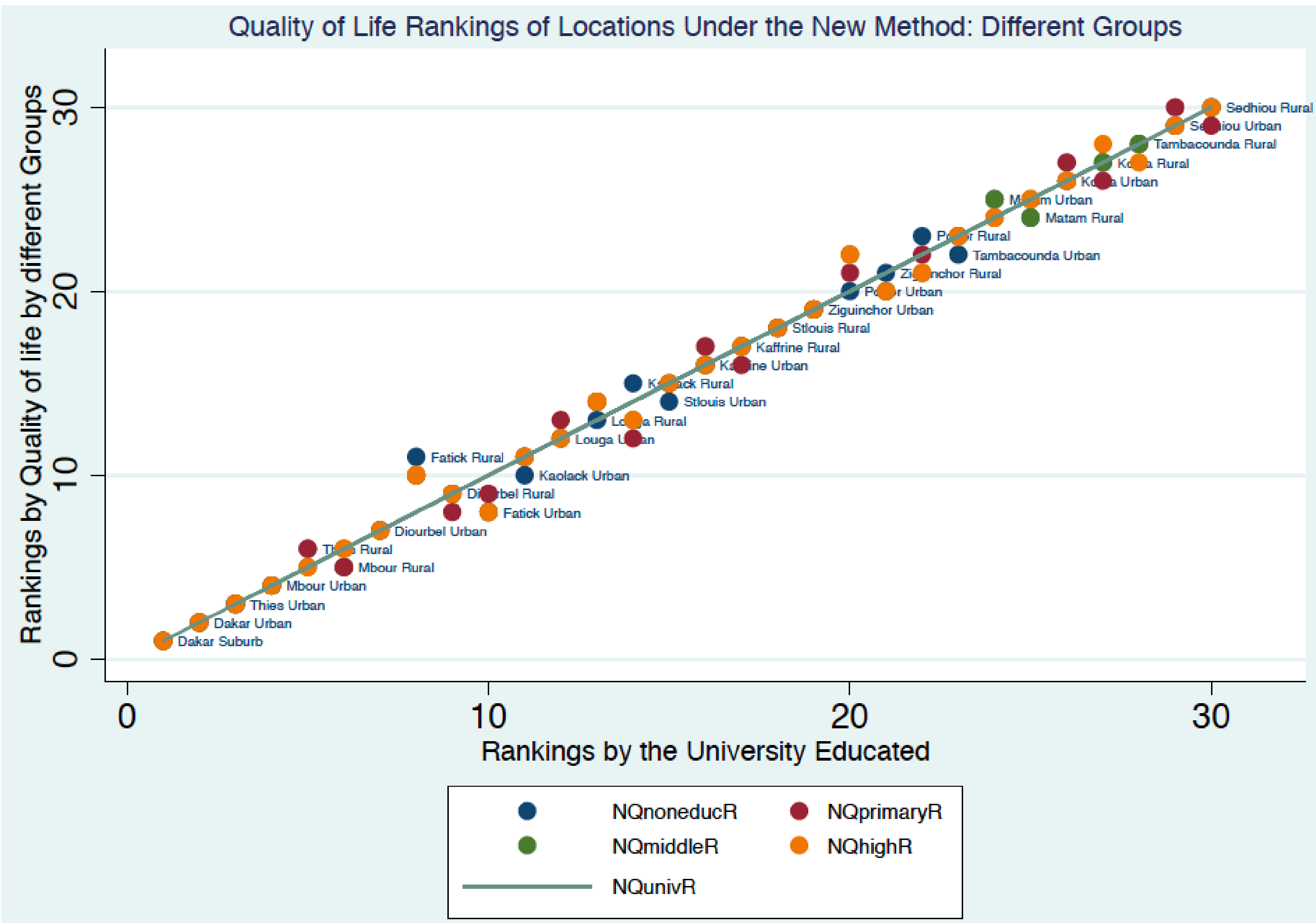
Notes: The figure shows location rankings given by the new QOL measures of all groups and teachers (NQallrank, NQteacherrank) , and by teachers's preference using teachers choice data (Teacherprefrank), respectively. The line has a slope of 1.

Figure 9: QOL Rankings of Locations Under the Standard Method: Different Groups



Notes: The table shows location rankings given by Qnoneducr, Qprimaryr, Qmiddler, Qhighr, Qunivr, which are rankings from standard QOL measures of the non-educated, the primary school educated, the middle school educated, the high school educated, the university educated respectively. The line has a slope of 1.

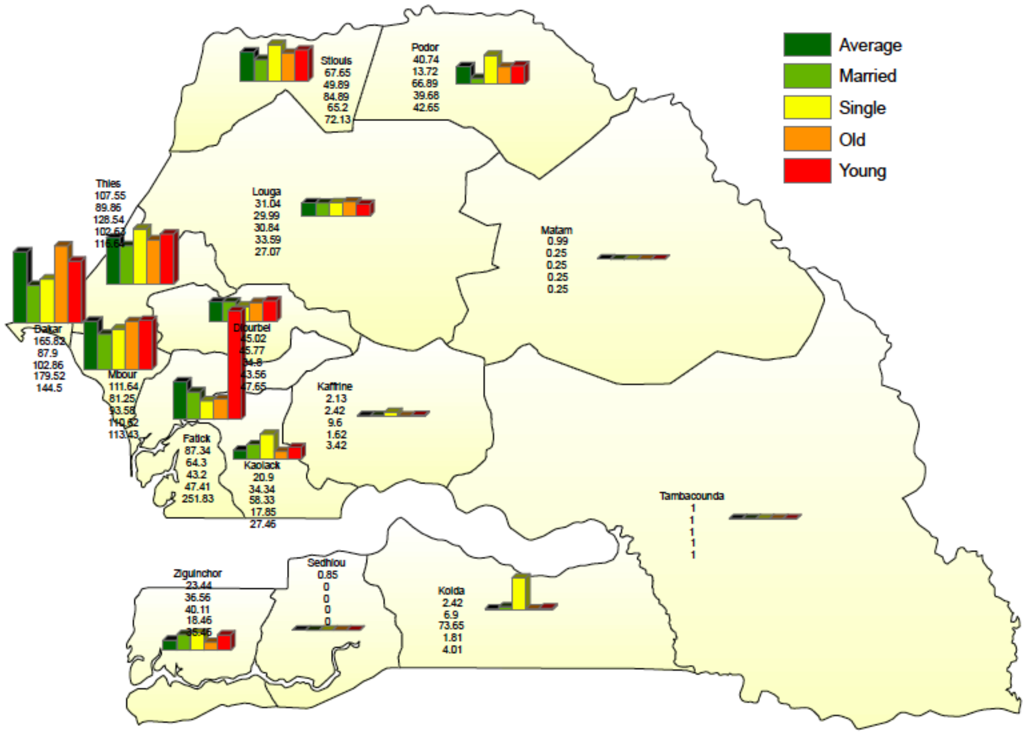
Figure 10: QOL Rankings of Locations Under the New Method: Different Groups



Notes: The table shows location rankings given by NQnoneducr, NQprimaryr, NQmiddler, NQhighr, NQunivr, which are rankings from new QOL measures of the non-educated, the primary school educated, the middle school educated, the high school educated, the university educated respectively. The line has a slope of 1.

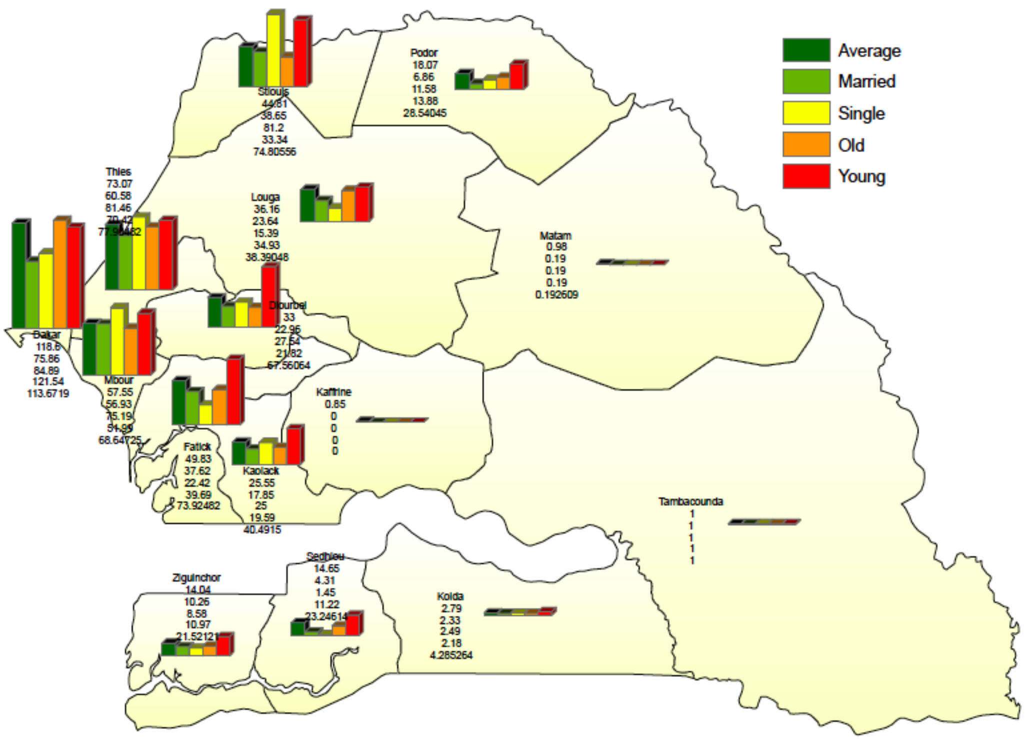
A Tables and Figures Appendix

Figure A.1: Urban Location Rankings by Different Types of Teachers



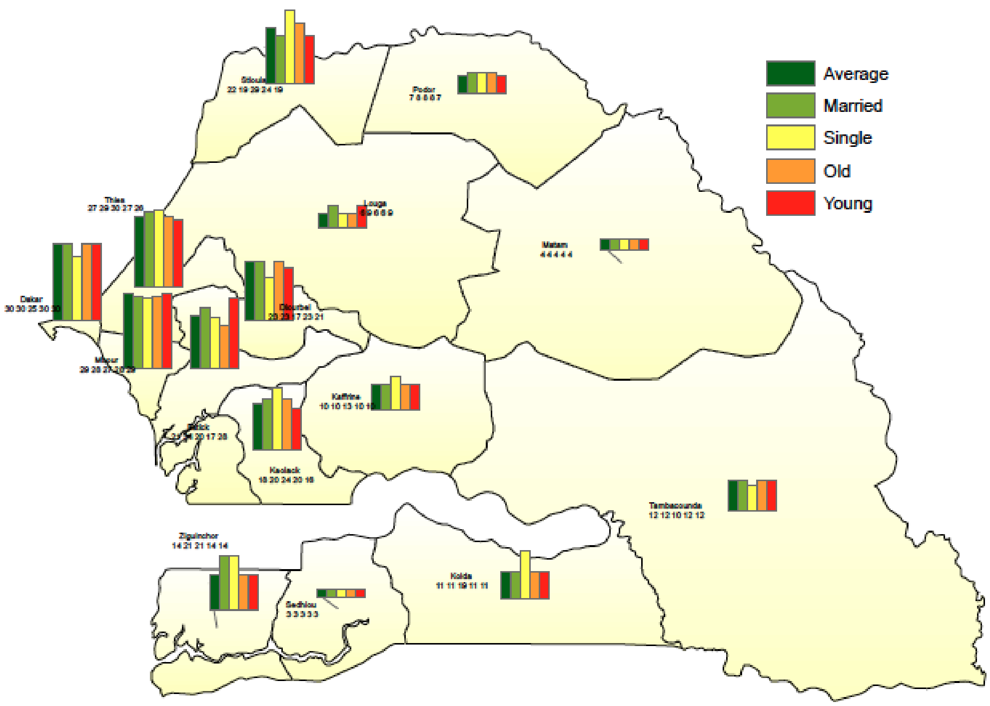
Notes: The figure shows the likelihood of choosing an urban location relative to the base location Tambacounda Rural, given location fixed effects $\hat{\theta}_l = \hat{\alpha}_l + \bar{X}\hat{\beta}_l$, for different groups: average teacher, married teacher, old teacher, and young teacher) depending on the group personal characteristics. Old has average age of 40 where young has average age of 25. Number 30 means ranked first while number 1 means ranked last.

Figure A.2: Rural Location Rankings by Different Types of Teachers



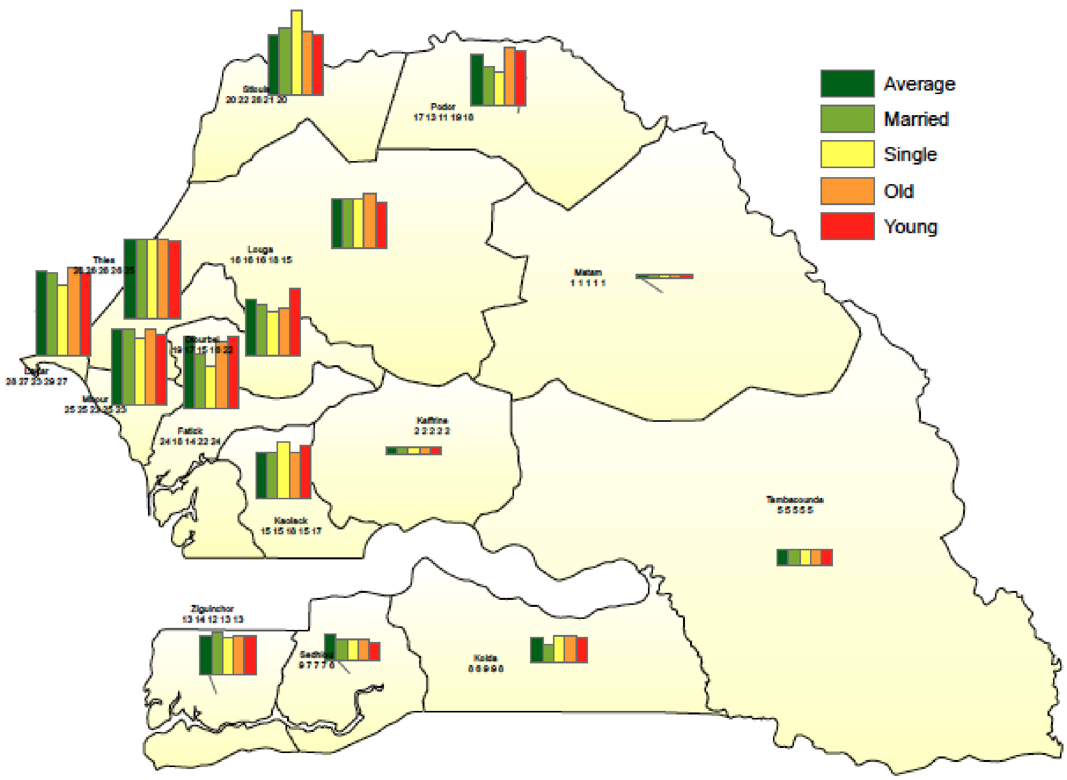
Notes: The figure shows the likelihood of choosing a rural location relative to the base location Tambacounda Rural, given location fixed effects $\hat{\theta}_l = \hat{\alpha}_l + \bar{X}\hat{\beta}_l$, for different groups: average teacher, married teacher, old teacher, and young teacher) depending on the group personal characteristics. Old has average age of 40 where young has average age of 25. Number 30 means ranked first while number 1 means ranked last.

Figure A.3: No Birth Place Location Rankings by Different Types of Teachers: Urban



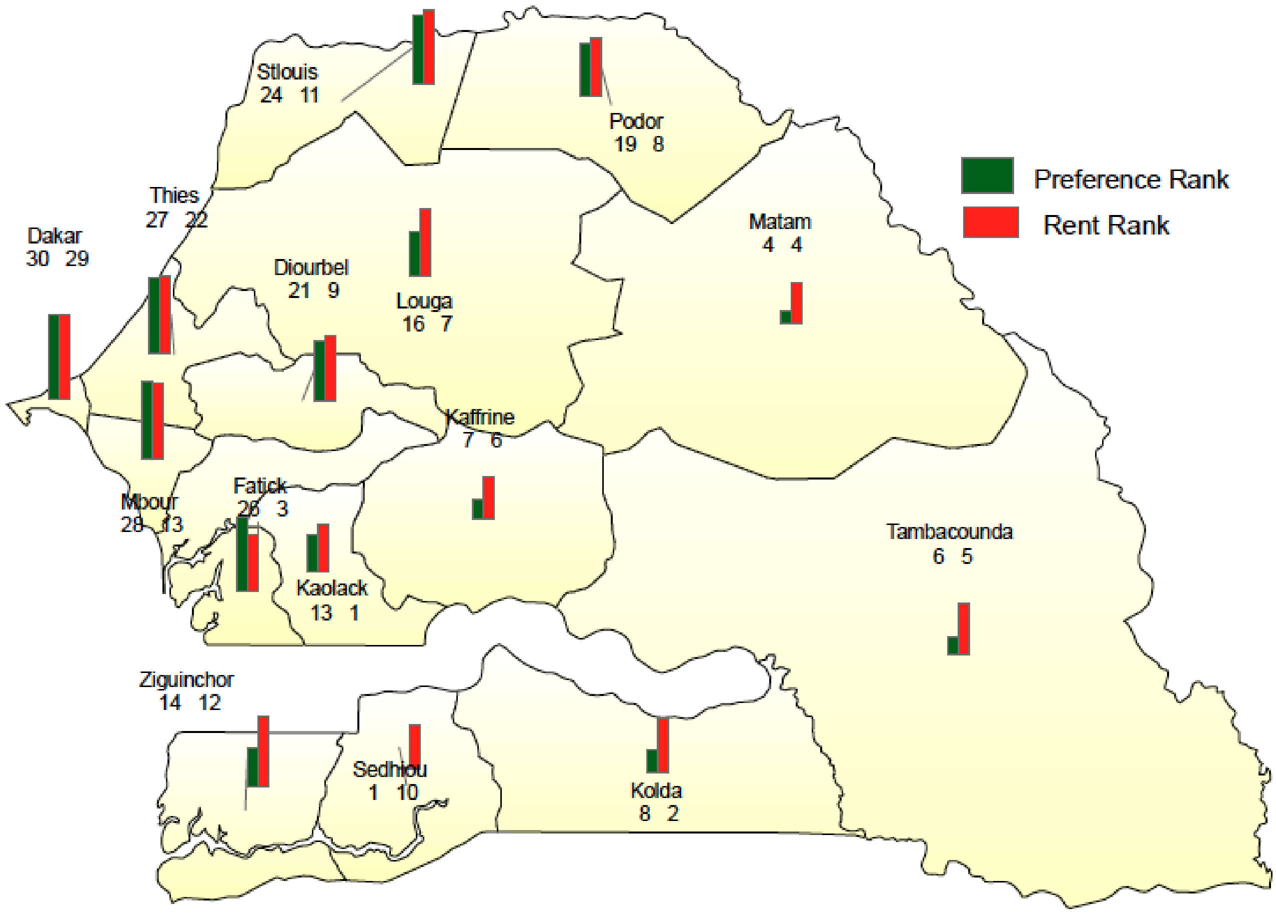
Notes: Limiting choices to only places where the teacher was **not** born, this figure shows urban location rankings given location fixed effects $\hat{\theta}_l = \hat{\alpha}_l + \bar{X}\hat{\beta}_l$ for different groups (average teacher, married teacher, old teacher, and young teacher) depending on the group personal characteristics. Old has average age of 40 where young has average age of 25. Number 30 means ranked first while number 1 means ranked last.

Figure A.4: No Birth Place Location Rankings by Different Types of Teachers: Rural



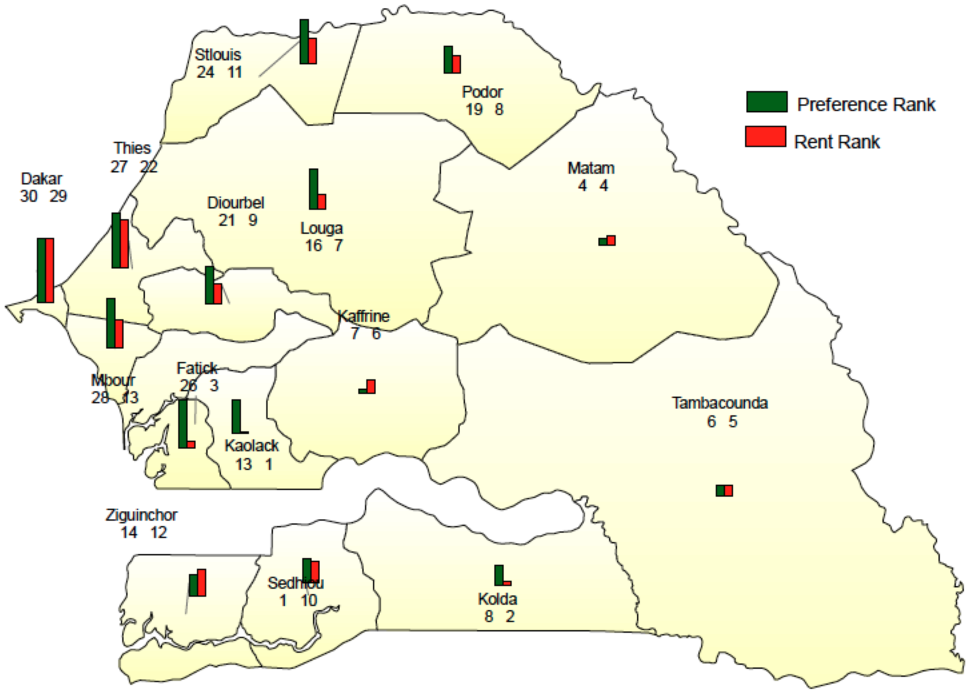
Notes: Limiting choices to only places where the teacher was **not** born, this figure shows rural location rankings given location fixed effects $\hat{\theta}_l = \hat{\alpha}_l + \bar{X}\hat{\beta}_l$ for different groups (average teacher, married teacher, old teacher, and young teacher) depending on the group personal characteristics. Old has average age of 40 where young has average age of 25. Number 30 means ranked first while number 1 means ranked last.

Figure A.5: Comparing Prices and Teacher Preference: Urban Locations



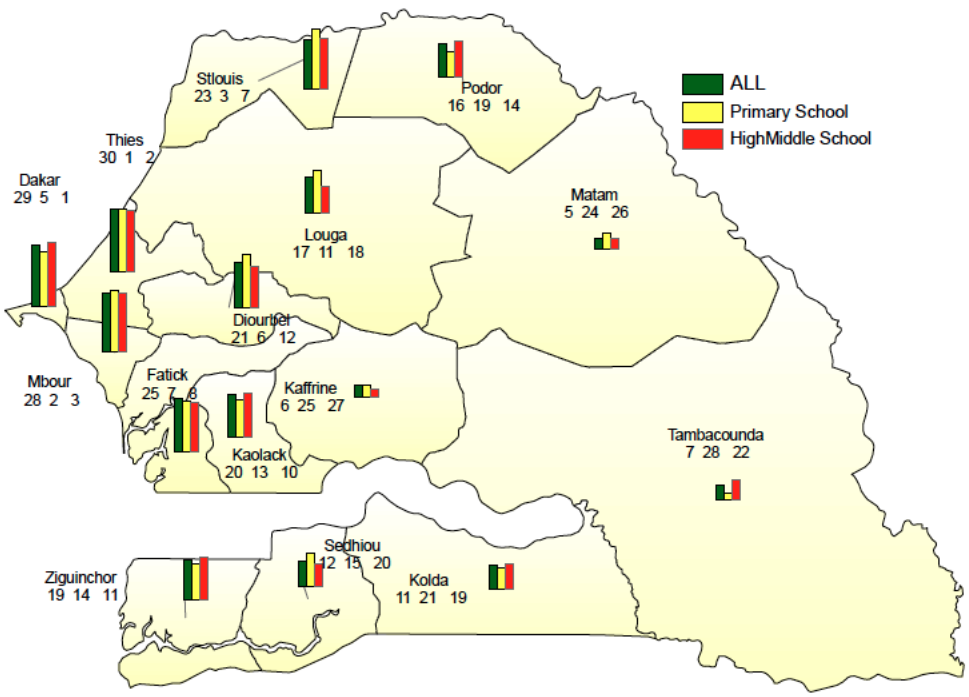
Notes: This figure shows urban location rankings given location fixed effects $\hat{\theta}_l = \hat{\alpha}_l + \bar{X}\hat{\beta}_l$ for different groups (average teacher, married teacher, old teacher, and young teacher) depending on the group personal characteristics and location rankings by rent differentials (how expensive is a location relative to the average location. Top ranked placed are the most expensive. Note old has average age of 40 where young has average age of 25. Number 30 means ranked first while number 1 means ranked last.

Figure A.6: Comparing Prices and Teacher Preference: Rural Locations



Notes: This figure shows rural location rankings given location fixed effects $\hat{\theta}_l = \hat{\alpha}_l + \bar{X}\hat{\beta}_l$ for different groups (average teacher, married teacher, old teacher, and young teacher) depending on the group personal characteristics and location rankings by rent differentials (how expensive is a location relative to the average location. Top ranked placed are the most expensive. Note old has average age of 40 where young has average age of 25. Number 30 means ranked first while number 1 means ranked last.

Figure A.7: Urban Location Rankings by Groups Teaching at Different Levels



Notes: This figure shows urban location rankings for all teachers, those teaching primary school only, and those teaching middle or high school only, respectively. Number 30 means ranked first while number 1 means ranked last.

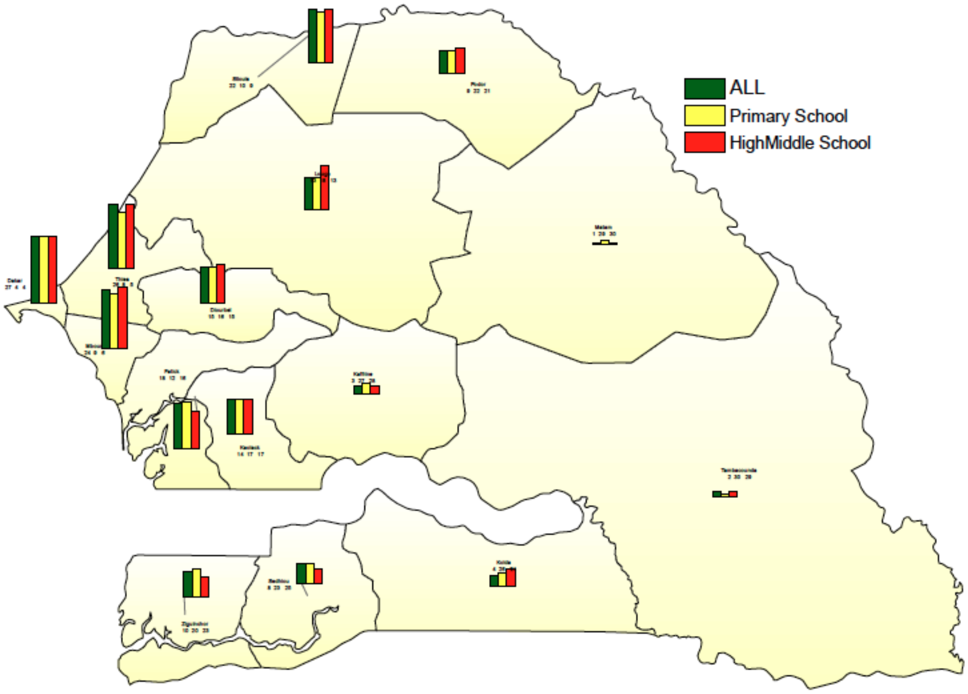
Table A.1: Controlling for Level of Teaching

Dependent Variable: Rank	ALL	Primary School	High and Middle School
Dakar Suburb	4.508***	5.816***	3.614***
	(0.185)	(0.335)	(0.237)
Dakar Urban	4.627***	5.678***	3.882***
	(0.209)	(0.381)	(0.262)
Diourbel Rural	3.205***	4.157***	2.750***
	(0.205)	(0.347)	(0.277)
Diourbel Urban	3.898***	5.650***	2.916***
	(0.214)	(0.434)	(0.264)
Podor Rural	2.292***	2.983***	1.743***
	(0.217)	(0.376)	(0.285)
Podor Urban	3.408***	3.955***	2.785***
	(0.279)	(0.503)	(0.338)
Sedhiou Rural	1.626***	2.874***	0.531*
	(0.194)	(0.320)	(0.307)
Sedhiou Urban	2.984***	4.608***	1.887***
	(0.400)	(0.668)	(0.545)
Stlouis Rural	3.965***	5.135***	3.283***
	(0.217)	(0.393)	(0.273)
Stlouis Urban	4.168***	5.898***	3.343***
	(0.208)	(0.426)	(0.253)
tamba Urban	1.521***	1.170***	1.570***
	(0.159)	(0.210)	(0.227)
Thies Rural	4.261***	5.297***	3.521***
	(0.178)	(0.333)	(0.224)
Thies Urban	4.674***	6.232***	3.823***
	(0.181)	(0.356)	(0.226)
Ziguinchor Rural	2.479***	3.757***	1.387***
	(0.180)	(0.312)	(0.247)
Ziguinchor Urban	3.663***	4.682***	2.999***
	(0.204)	(0.349)	(0.270)
BirthPlace	0.477***	0.448***	0.468***
	(0.0621)	(0.0897)	(0.0915)
Observations	9,946	5,628	4,338

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

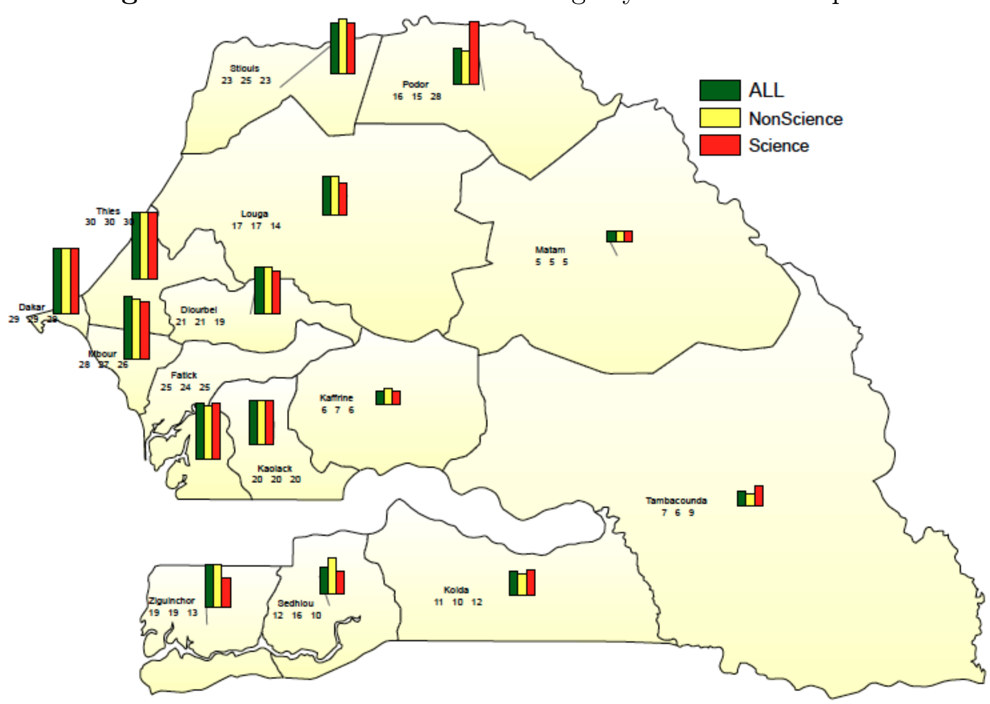
Notes: Base location is Tambacounda Rural (at 0). The coefficients shown here are $\hat{\alpha}_l$ used in the estimation of the location fixed effect that take into account personal characteristics: $\hat{\theta}_l = \hat{\alpha}_l + \bar{X}\hat{\beta}_l$ in order to compute location rankings. Here the preferences estimation are respectively for all teachers, those teaching primary school only, and those teaching middle or high school only.

Figure A.8: Rural Location Rankings by Groups Teaching at Different Levels



Notes: This figure shows rural location rankings for all teachers, those teaching primary school only, and those teaching middle or high school only, respectively. Number 30 means ranked first while number 1 means ranked last.

Figure A.9: Urban Location Rankings by Different Groups: Teachers by Subject Taught



Notes: This figure shows urban location rankings for all teachers, those teaching non-science subjects only, and those teaching science or math only, respectively. Number 30 means ranked first while number 1 means ranked last.

Table A.2: Controlling for Subject Taught

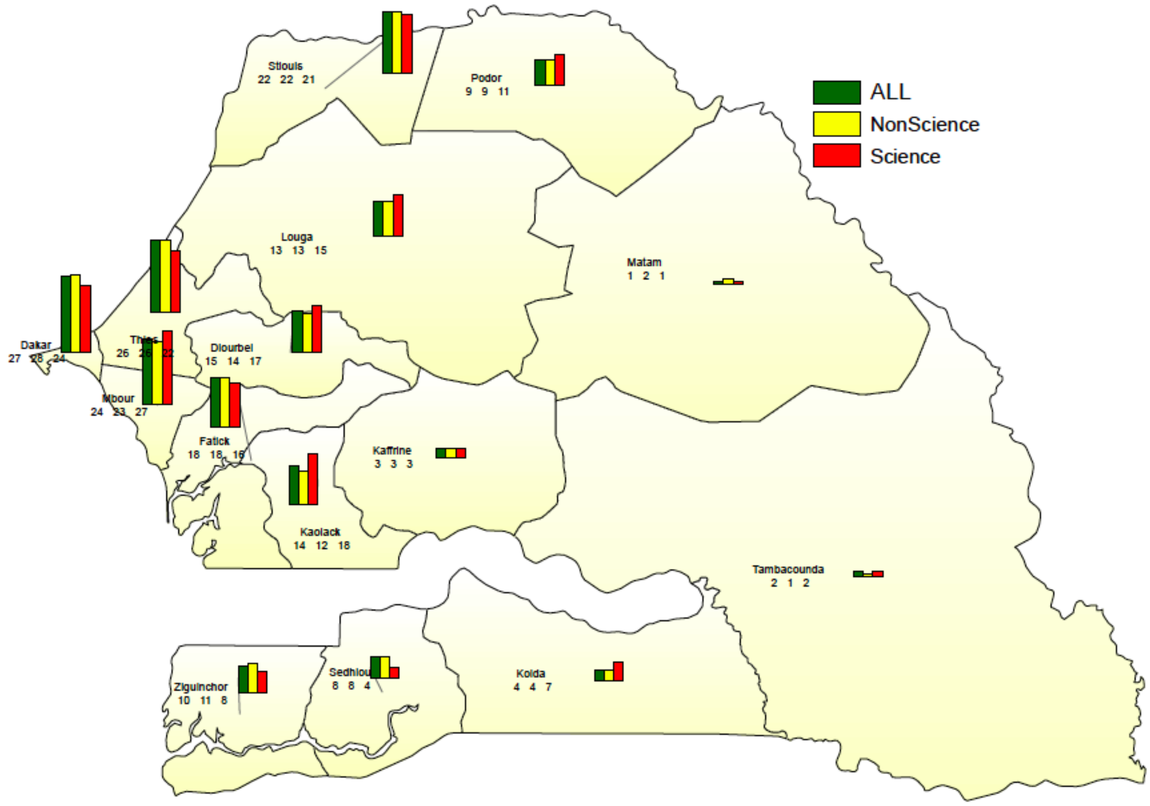
Dependent Variable: Rank	(ALL)	Non-Science	Science/Math
Dakar Suburb	4.508***	4.851***	3.417***
	(0.185)	(0.218)	(0.364)
Dakar Urban	4.627***	4.869***	3.836***
	(0.209)	(0.245)	(0.416)
Diourbel Rural	3.205***	3.338***	2.866***
	(0.205)	(0.239)	(0.411)
Diourbel Urban	3.898***	4.176***	3.007***
	(0.214)	(0.251)	(0.424)
Podor Rural	2.292***	2.465***	1.609***
	(0.217)	(0.247)	(0.502)
Podor Urban	3.408***	3.355***	3.645***
	(0.279)	(0.320)	(0.568)
Sedhiou Rural	1.626***	1.883***	0.641
	(0.194)	(0.219)	(0.530)
Sedhiou Urban	2.984***	3.496***	1.233
	(0.400)	(0.457)	(1.123)
Stlouis Rural	3.965***	4.185***	3.321***
	(0.217)	(0.250)	(0.457)
Stlouis Urban	4.168***	4.454***	3.353***
	(0.208)	(0.250)	(0.387)
tamba Urban	1.521***	1.624***	1.134***
	(0.159)	(0.179)	(0.360)
Thies Rural	4.261***	4.559***	3.351***
	(0.178)	(0.208)	(0.352)
Thies Urban	4.674***	4.954***	3.867***
	(0.181)	(0.210)	(0.366)
Ziguinchor Rural	2.479***	2.802***	1.066***
	(0.180)	(0.208)	(0.401)
Ziguinchor Urban	3.663***	3.976***	2.376***
	(0.204)	(0.234)	(0.464)
BirthPlace	0.477***	0.480***	0.441***
	(0.0621)	(0.0686)	(0.157)
Observations	9,946	8,524	1,422

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: Base location is Tambacounda Rural (at 0). The coefficients shown here are $\hat{\alpha}_l$ used in the estimation of the location fixed effect that take into account personal characteristics: $\hat{\theta}_l = \hat{\alpha}_l + \bar{X}\hat{\beta}_l$ in order to compute location rankings. Here the preferences estimation are respectively for all teachers, those teaching non-science subjects only, and those teaching science or math only.

Figure A.10: Rural Location Rankings by Different Groups: Teachers by Subject Taught



Notes: This figure shows rural location rankings for all teachers, those teaching non-science subjects only, and those teaching science or math only, respectively. Number 30 means ranked first while number 1 means ranked last.

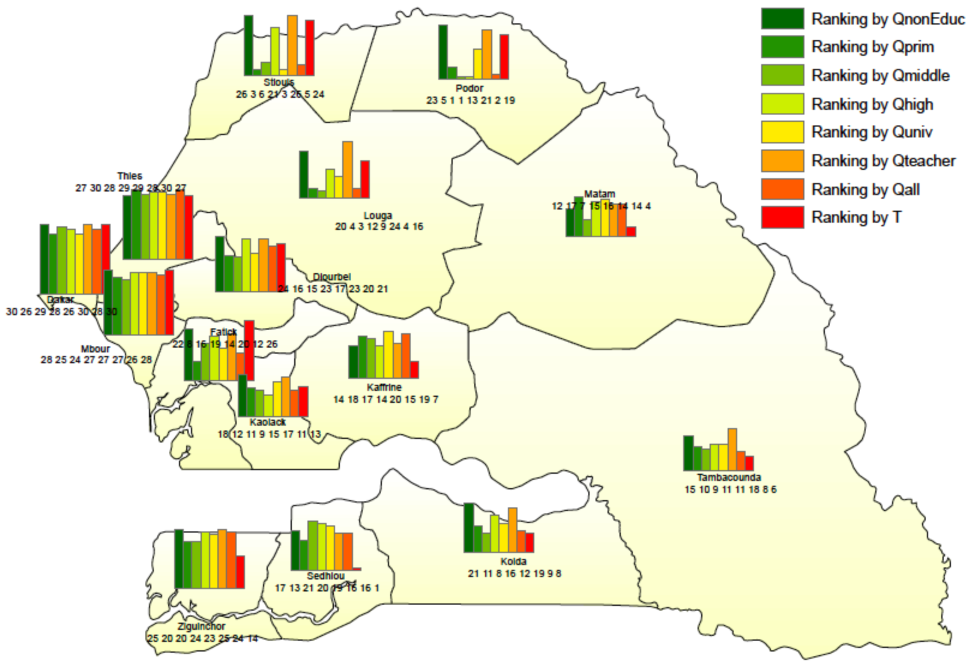
Table A.3: Fixed Effects Controlling for Student "quality": Primary School Score

Dependent Variable: Rank	(1)	(2)
Dakar Suburb	4.198***	22.85***
	(1.373)	(3.715)
Dakar Urban	3.845**	19.04***
	(1.532)	(3.299)
Diourbel Rural	7.422***	11.94***
	(1.519)	(1.894)
Diourbel Urban	3.875**	16.10***
	(1.661)	(2.936)
Age*Dakar Suburb	0.00669	0.00669
	(0.0370)	(0.0370)
Age*Dakar Urban	0.0217	0.0217
	(0.0406)	(0.0406)
Age*Diourbel Rural	-0.113***	-0.113***
	(0.0423)	(0.0423)
Age*Diourbel Urban	-0.00896	-0.00896
	(0.0450)	(0.0450)
Married*Dakar Suburb	-0.580	-0.580
	(0.492)	(0.492)
Married*Dakar Urban	-0.821	-0.821
	(0.540)	(0.540)
Married*Diourbel Rural	-0.532	-0.532
	(0.556)	(0.556)
Married*Diourbel Urban	0.207	0.207
	(0.555)	(0.555)
Child*Dakar Suburb	0.467	0.467
	(0.543)	(0.543)
Child*Dakar Urban	0.664	0.664
	(0.575)	(0.575)
Child*Diourbel Rural	0.351	0.351
	(0.600)	(0.600)
Child*Diourbel Urban	0.0673	0.0673
	(0.604)	(0.604)
Birthplace	0.477***	0.477***
	(0.0652)	(0.0652)
PrimarySchoolScore		-1.484***
		(0.233)
Observations	9,594	9,594

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

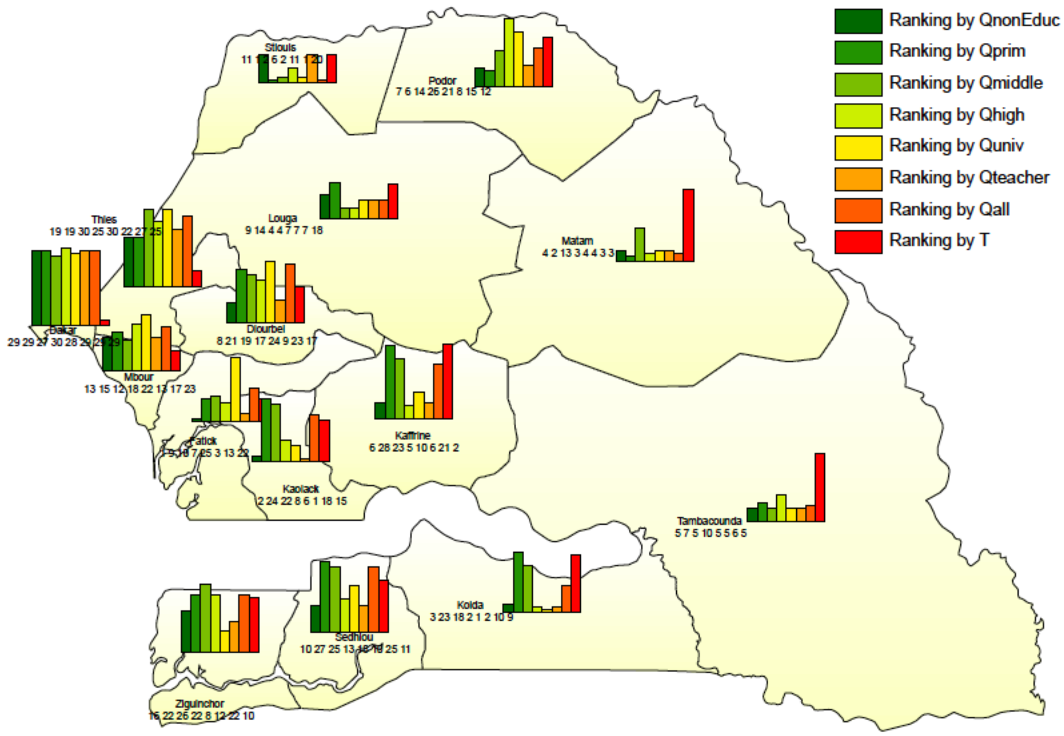
Notes: Base location is Tambacounda Rural (at 0). This table contains the partial output of the location fixed effects as the full table would not fit a page. The table is used as illustration. The coefficients here $(\hat{\alpha}_l, \hat{\beta}_l)$ are used in the estimation of the location fixed effect that take into account personal characteristics: $\hat{\theta}_l = \hat{\alpha}_l + \bar{X}\hat{\beta}_l$. The coefficient on primary school test score is actually negative.

Figure A.11: QOL Rankings of Urban Locations Under the Standard Method: Different Groups



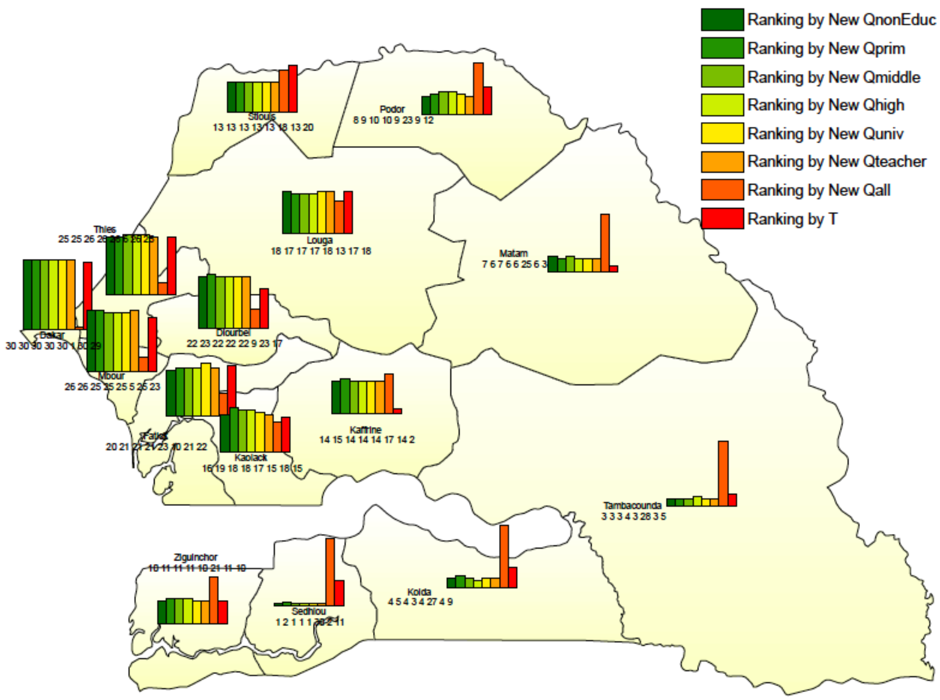
Notes: The figure shows urban location rankings given.$\hat{Q}_{noneduc}$, $\hat{Q}_{primary}$, $\hat{Q}_{middle}$, $\hat{Q}_{high}$, $\hat{Q}_{univ}$, $\hat{Q}_{teacher}$, $\hat{Q}_{all}$, $\hat{T}$ which are the standard QOL measures of teachers, the non-educated, the primary school educated, the middle school educated, the high school educated, the university educated, all groups, and the QOL of teachers using teachers' data, respectively. Number 30 means ranked first while number 1 means ranked last.

Figure A.12: QOL Rankings of Rural Locations Under the Standard Method: Different Groups



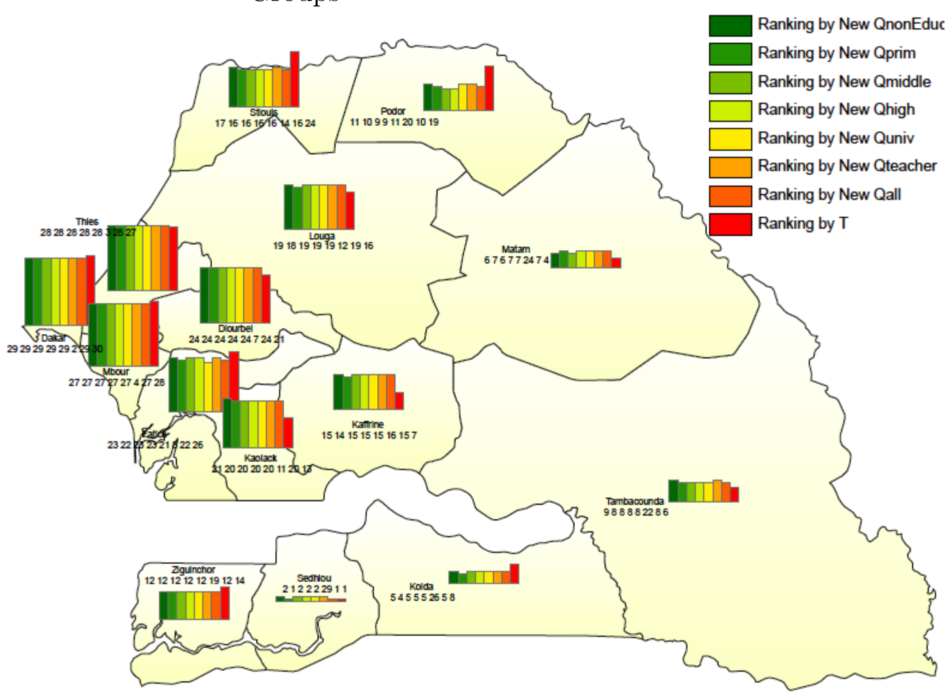
Notes: The figure shows rural location rankings given. $\hat{Q}_{noneduc}$, $\hat{Q}_{primary}$, $\hat{Q}_{middle}$, $\hat{Q}_{high}$, $\hat{Q}_{univ}$, $\hat{Q}_{teacher}$, $\hat{Q}_{all}$, $\hat{T}$ which are the standard QOL measures of teachers, the non-educated, the primary school educated, the middle school educated, the high school educated, the university educated, all groups, and the QOL of teachers using teachers' data, respectively. Number 30 means ranked first while number 1 means ranked last.

Figure A.13: QOL Rankings of Urban Locations Under the New Method: Different Groups



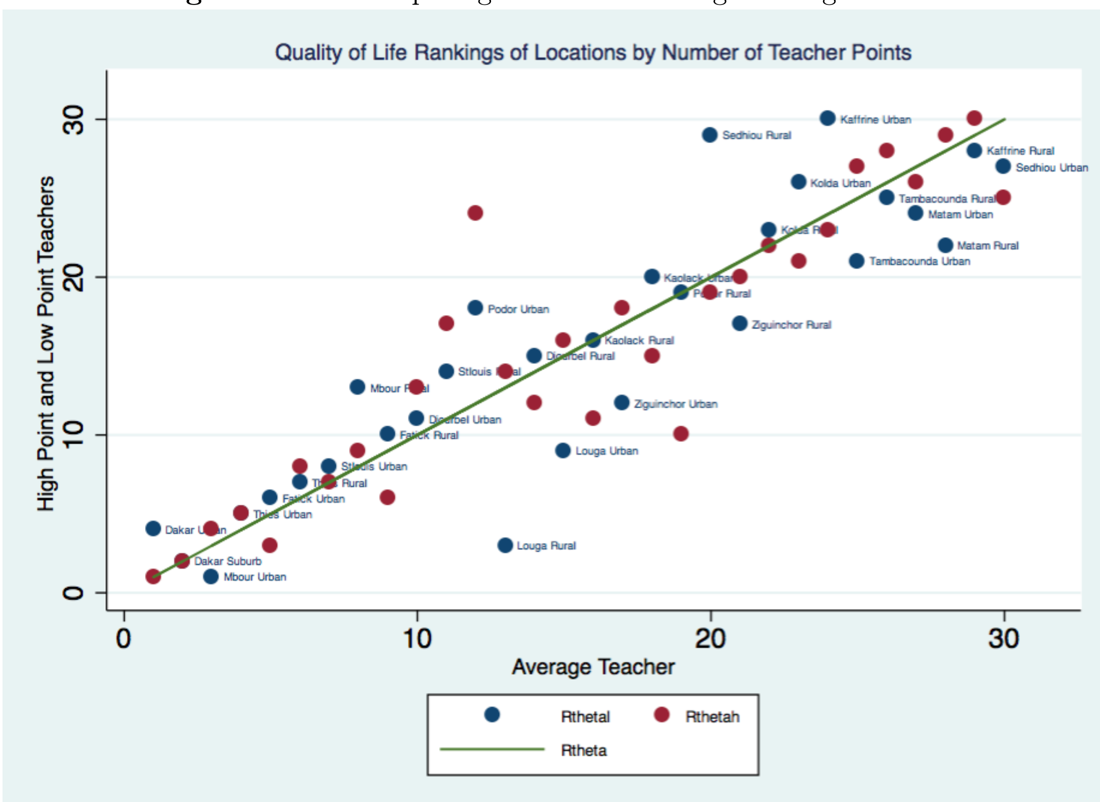
Notes: The figure shows urban location rankings given.$\hat{Q}^{New}_{noneduc}$, $\hat{Q}^{New}_{primary}$, $\hat{Q}^{New}_{middle}$, $\hat{Q}^{New}_{high}$, $\hat{Q}^{New}_{univ}$, $\hat{Q}^{New}_{teacher}$, $\hat{Q}^{New}_{all}$, $\hat{T}$ which are the **new** QOL measures of teachers, the non-educated, the primary school educated, the middle school educated, the high school educated, the university educated, all groups, and the QOL of teachers using teachers' data, respectively. Number 30 means ranked first while number 1 means ranked last.

Figure A.14: QOL Rankings of Rural Urban Locations Under the New Method: Different Groups



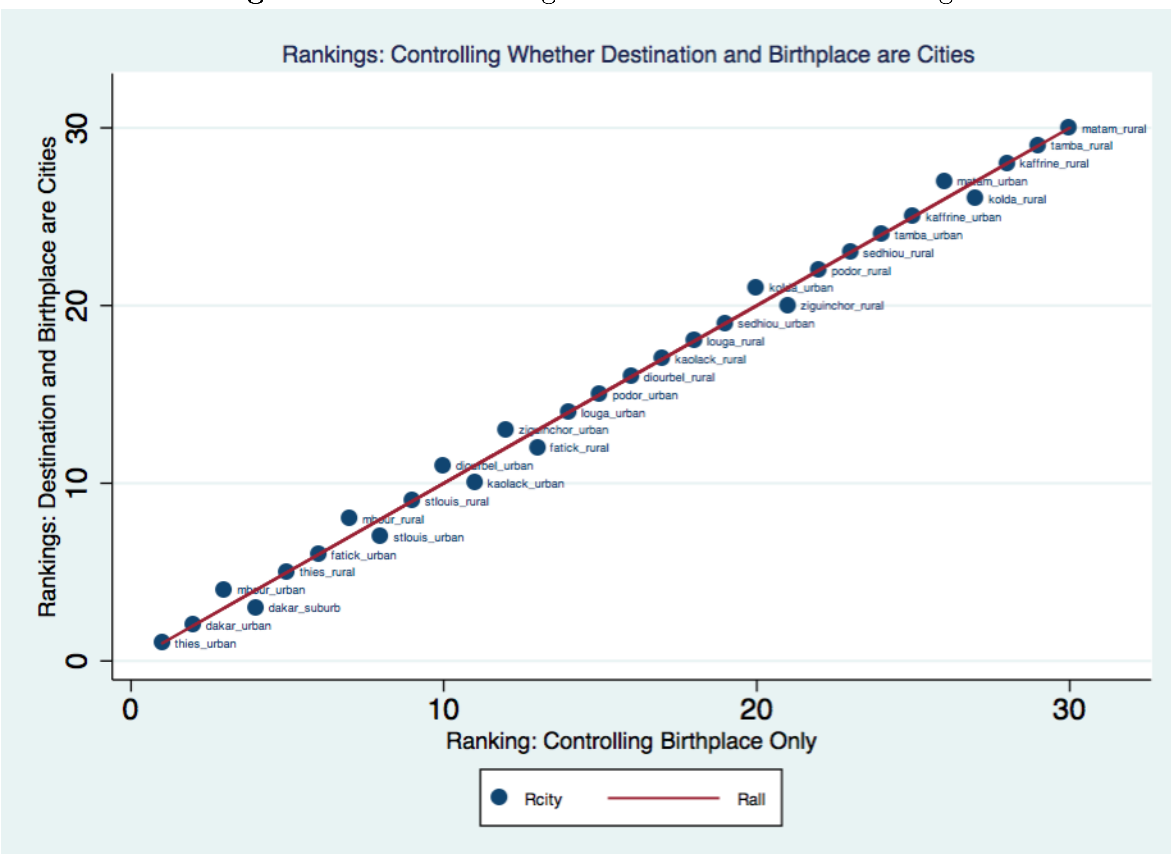
Notes: The figure shows rural location rankings given.$\hat{Q}^{New}_{noneduc}$, $\hat{Q}^{New}_{primary}$, $\hat{Q}^{New}_{middle}$, $\hat{Q}^{New}_{high}$, $\hat{Q}^{New}_{univ}$, $\hat{Q}^{New}_{teacher}$, $\hat{Q}^{New}_{all}$, $\hat{T}$ which are the **new** QOL measures of teachers, the non-educated, the primary school educated, the middle school educated, the high school educated, the university educated, all groups, and the QOL of teachers using teachers' data, respectively. Number 30 means ranked first while number 1 means ranked last.

Figure A.15: Comparing Location Rankings for High and Low Points Teachers



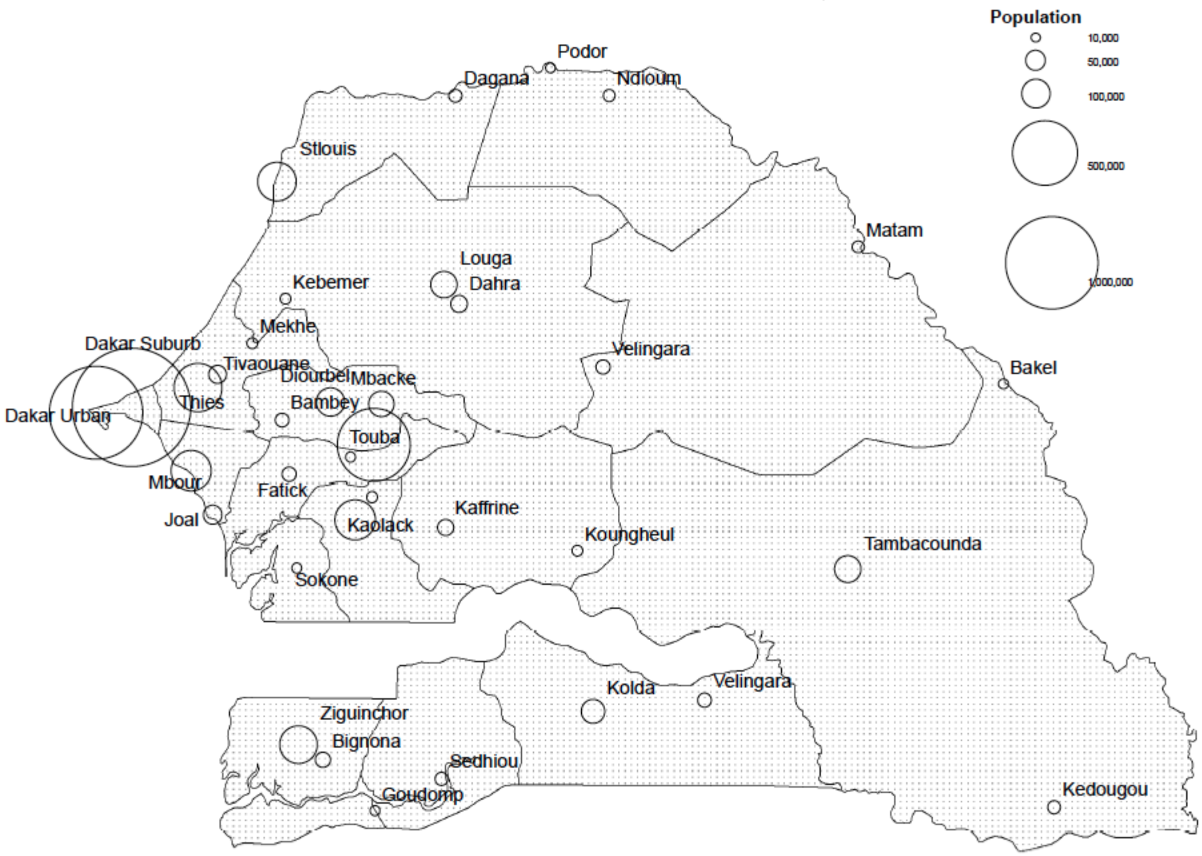
Notes: This table shows location rankings for all teachers, those with a low number of points, and those with a high number of points, respectively. The line has a slope of 1.

Figure A.16: Controlling Whether Destination and Origin Are Cities



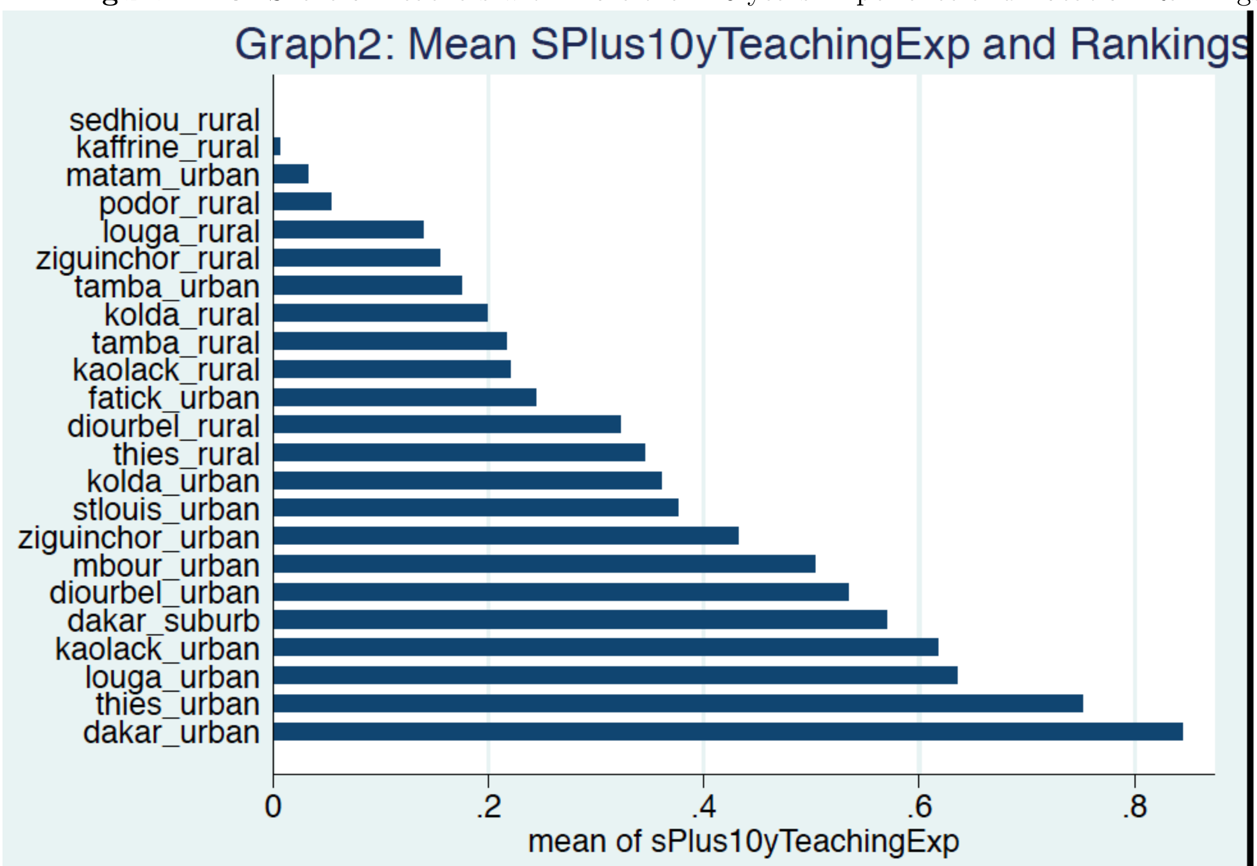
Notes: This table shows location rankings controlling for whether destination and origin are cities. The line is drawn from the variable ranking controlling for birthplace on itself.

Figure A.17: Map of Senegal



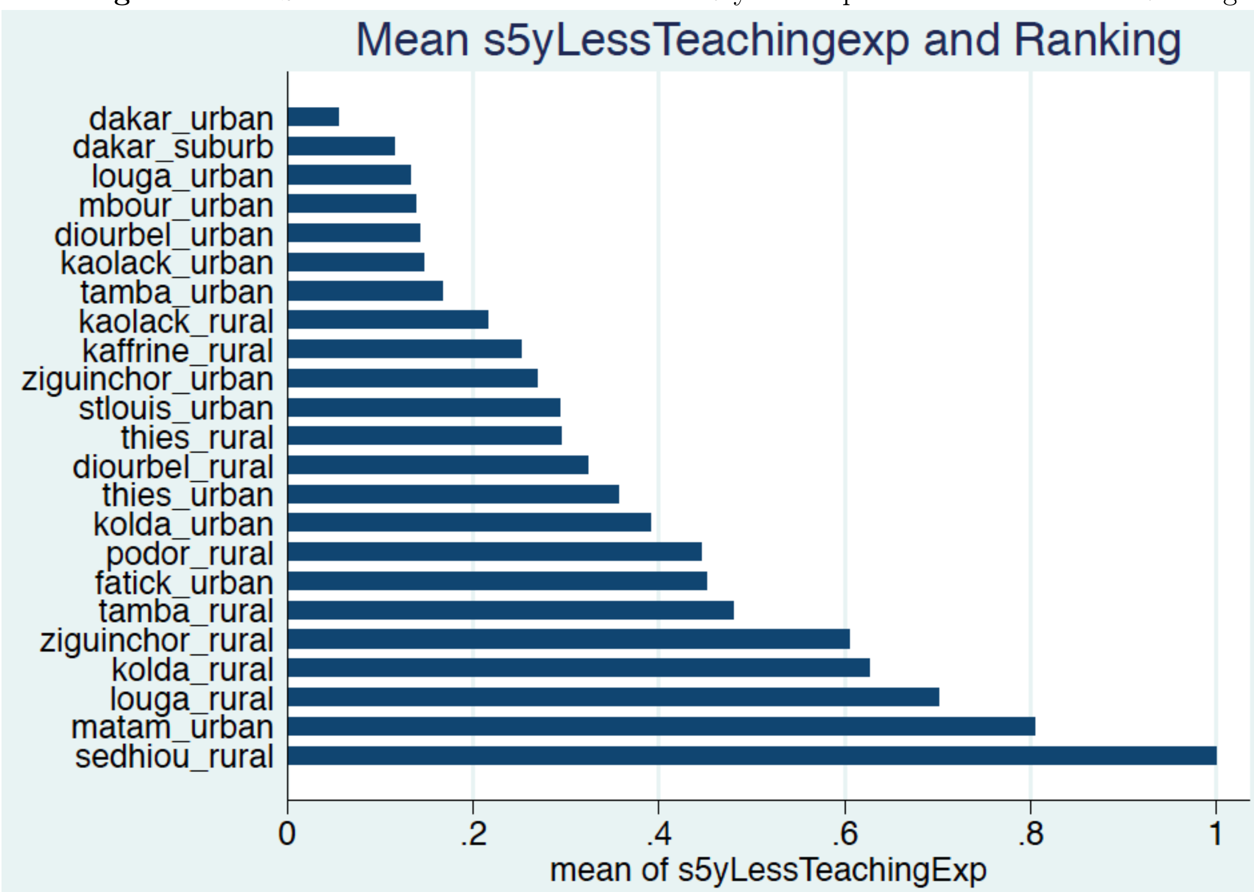
Notes: The figure shows map of Senegal by population. Technically, Touba is the second biggest city but it has a special religious status and has no public schools: so it is not available in the choice set of teachers.

Figure A.18: Share of Teachers with More than 10 years Experience and Location Rankings



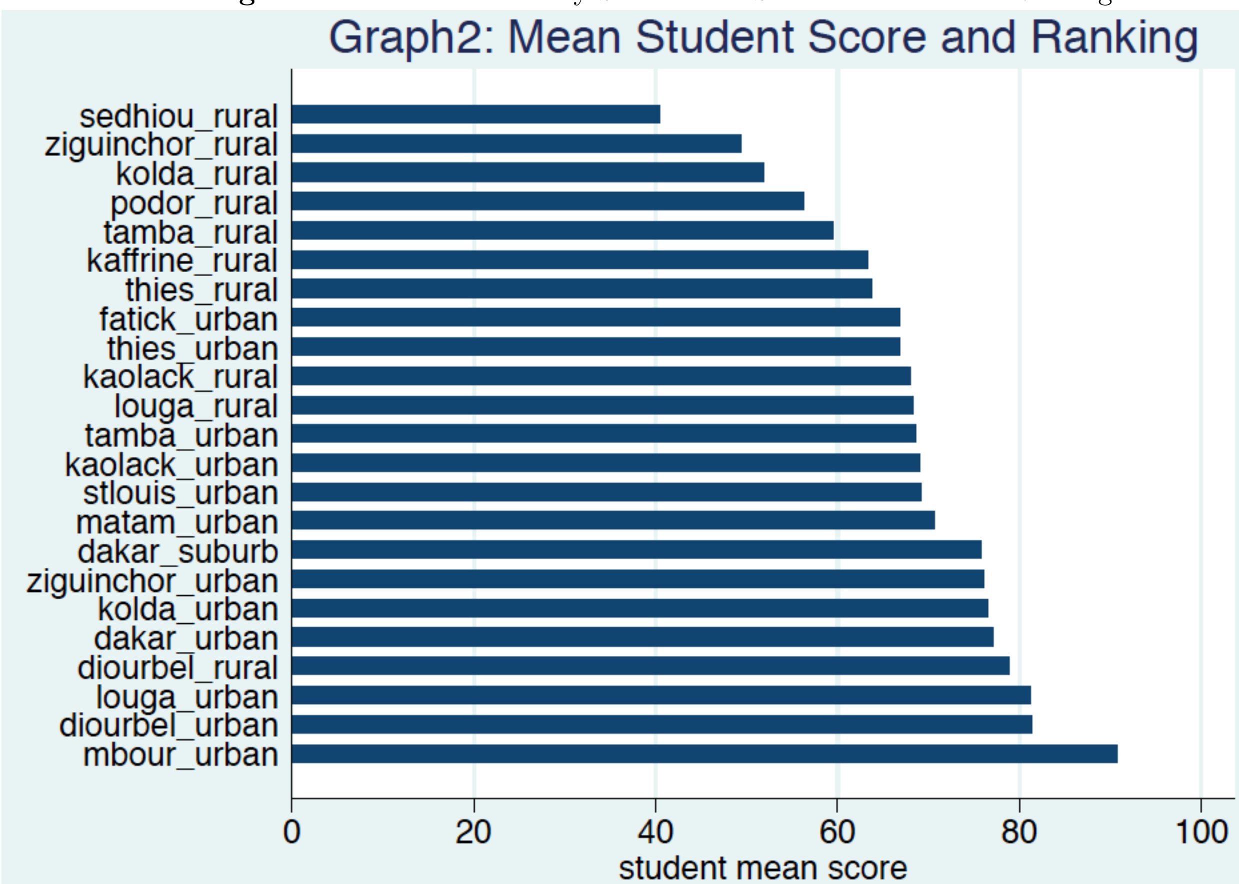
Notes: sPlus10yTeachingExp is the share of teachers with more than 10 years of teaching experience.

Figure A.19: Share of Teachers with Less than 5 years Experience and Location Rankings



Notes: s5yLessTeachingExp is the share of teachers with less than 5 years of teaching experience.

Figure A.20: Mean Primary School Test Score and Location Rankings



Notes: Mean student score is mean test scores of second and fifth graders.