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How is income distributed between districts by age in Lima Peru? A multilevel analysis

Abstract

Objectives: The aim of this article is to assess the effect of inequalities in salary between districts in Lima while controlling for age. *Design:* Cross sectional multilevel design. *Setting:* People (level 1) and districts (level 2) were evaluated in their homes all over Lima, Peru. *Participants:* 1456 people from 44 districts from the national study of homes of Peru, which used a random sampling procedure. The sample of the study, completed high school, worked more than 20 hours a week and from ages between 18-85 years old.
Main outcomes measures: Income and age were analyzed. These variables were measured by single item. Income was measured by asking the persons what was their salary the previous month and age was taken as a demographic variable. *Results:* A random intercepts, random slopes model with quadratics on level 1 and 2 had the best model of fit $p < 0.0001$ for the sample. Income was different between districts while controlling for age. *Conclusions:* Older people differ more in general than younger people and districts matter more for older people than younger people for their level of income. In richer districts, the oldest the person the higher the level of income he or she can have. In poorer districts, an extra year did not have the same effect in better income like the other districts. Overall, there was income inequality between districts while accounting for age where the raise in income was higher in richer than poorer districts.

Introduction

In recent years, there has been a strong economic growth in Peru in comparison to other countries in Latin America. It is projected that Peru will increase its gross domestic product (GDP) 5.5 % in 2014 and 5.8% in 2015. This represents the biggest

increase between the countries of the region[1]. In spite of this, there have been strong inequalities on this country. A researcher has argued that equalizing the level of education in years in people would not reduce the degree of income inequality[2]. Recent studies have shown a reduction of inequality in just middle class but that cannot be said for the other social classes[3]. In spite of this, job informality and the failure to fullfill the minimum salary by employeers has maintained inequality in certain areas of Peru[4]. Morevoer, Lima accounts for 72.8% of the (GDP) of the country and is a place where inequalities are present[5].

Therefore, to better understand the income inequalities of the whole country it is better to first study the capital city were a strong amount of the economic power is focused. Having a more profound understanding of what variables besides educational level are related to inequalities and where these inequalities are stronger, could be helpful to better comprehend the environmental causes of income inequalities in Lima and propose more effective policies for its reduction.

Overall, more focus has been given to other topics such as income inequalities and health and these has been done in European and Asian countries using a multilevel approach[6, 7, 8]. Moreover, when measuring only income inequalities in Latin American countries, a single level analyses[9, 10] has tend to be used and in Peru there is not much information in income using using multilevel analyses.

It is known that variables such as age has a relationship with income in Peru[11]. In spite of all these knowledge, income threw out different contexts acompained with these variables has not been profoundly measured especially in a big city such as Lima[12]. Therefore, the current body research lacks information about the variability of income and other variables threw out Lima on people that do not have a high educational level.

In that case, a multilevel analysis could be a helpful tool to further understand the heterogeneity of Lima and could give more information in order to further study the difference in income between the different parts of Peru.

The aim of this article is to assess the effect of inequalities in salary between districts in Lima while controlling for age.

Data and method

Study Design

The context of this study was Lima, the capital city of Peru. The setting was participant's homes that answered the national survey of homes[13]. The research used a cross sectional multilevel design and the main variables reported were salary by the participants, by asking, "in your principal occupation, How much did you earn in the last month?" and age. The data collection was done from December 2012 to December 2013. For this study the main focus was on participants of Lima, that had just high school education, had part or full time jobs and were old enough to be doing adulthood labor (and not teenage labor). This sample as the whole research used a randomized sampling which clustered threw houses (Level 1), districts (level 2) and the urban and rural center areas (level 3) all around the country. The information of houses and districts was taken from the 2007 national census[14].

Data

The level 1 sample was composed of 1456 adults from ages between 18-85 years old from all Lima Metropolitana, Peru. 63.18% were men and 36.82% were women. There average age was 35.72, SD = 12.90 and the median age was 34 yeas old. These people had part time and full time jobs and worked an average of 50.76, SD = 13.32 per week. All of them had high school education and worked in three different types of

jobs: Company employees (45.88%), household staff (6.18%) and construction workers (47.94%). The amount of salary was between 15 – 7000 “Nuevos soles” in the last month (1 pound = 4.52 Nuevos Soles). The level 2 was comprised of 44 districts, which covered all Lima Metropolitana and Callao.

Analysis Method

For analyzing the data a second level random intercepts model was done to compare against more complex ones. This was called model 1 or the Null model because it did not have any extra variables. After that, a second model was analyzed this time controlling for age. This was a two level random intercepts model. A model controlling age was performed (model three) and this time measuring not only random intercepts but also random slopes. Finally a fourth model was evaluated of random intercepts and slopes and fitting a level 2 and 1 quadratic function while controlling for age. Before performing theses analyses, three people were eliminated from the sample study because they had very high income compared to everybody else in the sample. The analysis were done using ML wiN version 2.2[15]

Results

Basic statistics without accounting levels showed that people had a mean salary of 793.49 with a standard deviation (SD) equal to 667.75 threw out Lima. The mean age was u = 35.72 with a SD = 12.90. Correlation between salary and age showed a significant relationship between the variables ($r = 0.1983$, $p < 0.00001$). Overall, in the normal null model the confidence bounds showed that the districts with less salary have an average income of 538.88 meanwhile the people from the highest paid districts have an average income of 1071.1.

Table 1: Comparison of models, null model against different complexity models controlling by age

	Model 1	S.E.	r	Model 2	S.E.	r	Model 3	S.E.	r	Model 4	S.E.	r
Fixed Part												
Grand mean salary	**806.21**	30.02		**782.36**	27.44		779.19	27.21		**780.32**	25.23	
(AGE)				**9.71**	1.27		**10.32**	1.93		**10.16**	1.43	
Random Part												
Level 2: (Districts)												
Random intercepts	18436.29	7493.56	1	13584.55	6072.65	1	15971.45	6303.56	1	11148.47	5178.31	1
Quadratic variance							1086.97	367.98	0.997	268.52	215.84	0.964

Random slopes					74.36	31.52	1	6.96	14.06	1
Level 1: (People)										
Random Intercepts	388108.13	14575.53	374403.19	14053.53	364903.00	13814.57		318310.31	17669.65	
Quadratic variance								5734.59	609.17	
Random slopes								211.43	97.77	
-2*log likelihood	22855.54		22798.10		22781.67			22645.69		
Level 2 (Districts)	44		44		44			44		
Level 1 (People)	1453		1453		1453			1453		

Model 1 = 2 level random intercepts model
Model 2 = 2 level random intercepts controlling age model
Model 3 = 2 level random intercepts and slopes controlling age model
Model 4 = 2 level random intercepts and slopes and quadratic variance function at both levels controlling age model

Table 1 shows that when controlling for age (model 2), the average mean in every district in Lima is reduced in 23.85 Nuevos soles in comparison to the null model (model 1). Furthermore, the models were age was controlled had a better fit than the null model. In every case the deviance (-2*log likelihood) shown by the models is smaller than the previous stated. Model 2 has a statistically significant better fit than model 1 ($p < 0.0001$), the same when comparing model 2 against model 3, where the latest has a significant better model of fit ($p < 0.0001$). Finally, Model 4 has a significant better model of fit than Model 3 ($p < 0.0001$). Therefore, for this

sample, a model random intercepts and slopes with a quadratic in both levels function that has been accounted for age has the best model of fit for this sample.

In that case, in the best model of fit (model 4) the average income salary while controlling age in all districts of Lima is 25.89 Nuevos soles less than without accounting for age. Moreover, if models 2 and 4 are compared it is possible to see that for the last model; the raise of income for each extra year lived is 0.45 Nuevos soles higher, in comparison to model 2. While comparing models 3 and 4 it is possible to see that the income for being one year older decreases in 0.16 Nuevos soles in the model with intercepts, slopes and quadratic level 2 and 1 (model 4) in comparison to a random intercepts and slopes model (model 3). Finally, the best-fit model has the smallest unexplained variance from all the models, which reinforces the idea that is the best model of fit for this sample. In spite of having non significant random slopes in level 2 of model 4 it is possible that this are due to imbalance in sample size between districts.

So in that regard, age does have an important effect on income. When controlling age, it is possible to have a better model of fit to predict the difference of income between districts.

Figure 1: Residual comparison between the null model and model accounting for age

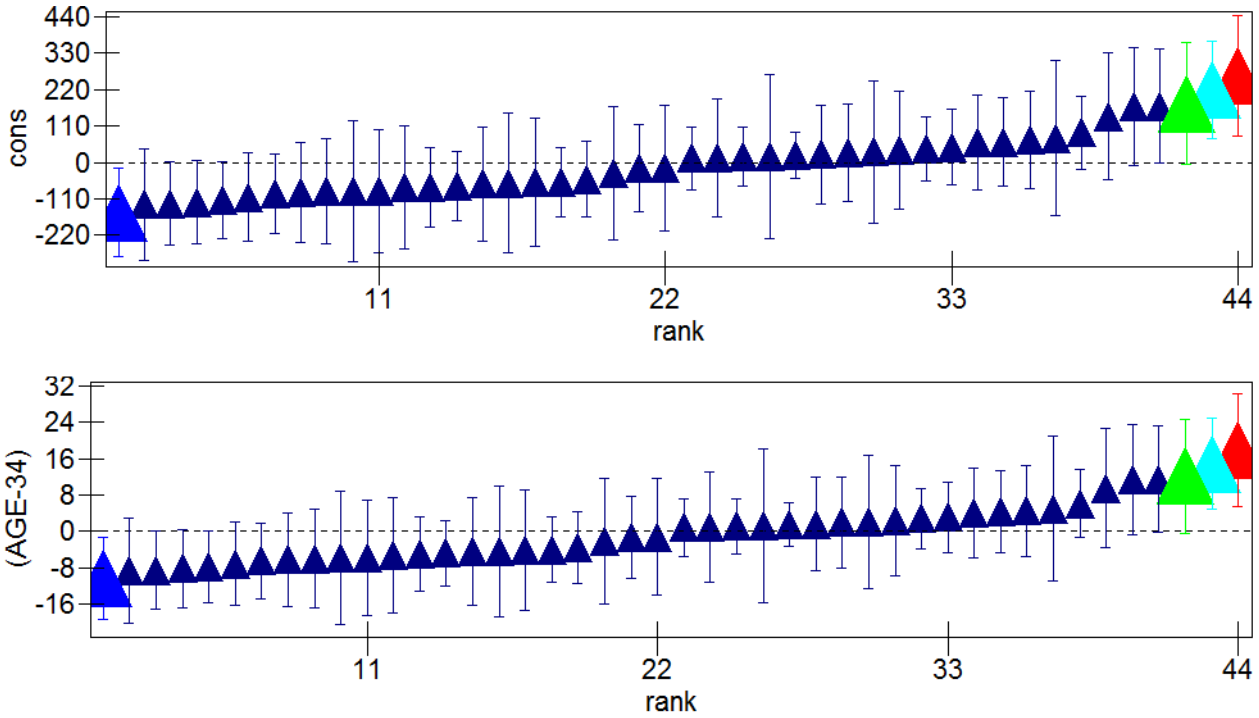

Figure 1 shows that "La Perla" district is the one that has the people with the highest income salary and the further away from the grand mean. In second place is "Bellavista" district, which has the people with the second income salary and is also above the grand mean accounting for age (the 0 spot in this case). It is important to take notice that both of these districts are part of "El Callao" which is a district that has a harbor and is a bit further apart from Lima Metropolitana. These two districts have minimum average

salaries, which are higher than the grand mean of all the districts in Lima in the null model and while controlling age. Moreover, the third district that has people with the highest income is “San Isidro”, in this case the people that has the lowest income from this district, their salary is around the grand mean of all the districts in Lima.

The district that has the people with the lowest income is “El Agustino”, the people that live in this district has salaries which are under the average income of every district in Lima. In this case, even the people that have the highest income has a lower salary the average of all the districts in Lima. Moreover, in “Pachacamac” lives the people has on average the less income salary in all district in Lima. In spite of that, the people that have the highest income in this district have salaries above the average of all the districts in Lima, meanwhile the people that has the lowest income and live their have the lowest salary of the city. These results are taking into account age and for people that have complete high school education.

Figure 2: Predictions and varying relationships between salary and age between districts

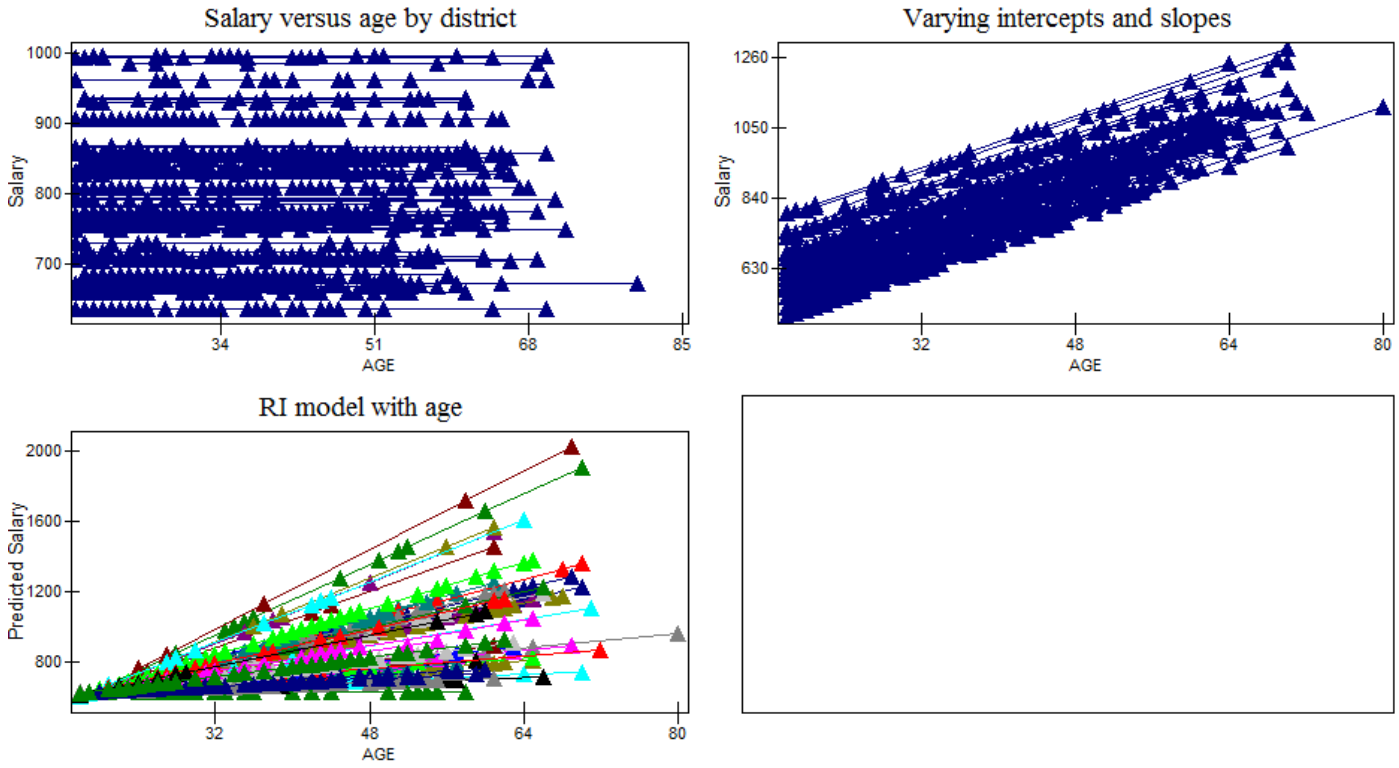

Figure 2 shows the relationship there is between age and salary between different districts. The first figure shows that there are people from different districts that has different ages and earn diverse amount of money. The second figure shows a relationship

between age and income between the different districts. The third figure shows that the relationship between salary and age is fanning out which means that in the districts that live the people that have a higher income, age will give them better salary. In the case of districts were people that have lower income live; having more age will not represent a better income. Therefore, age and context does matter in the amount of income the person perceives. This type of behavior gives the idea that an extra year can be more important in districts were people that have a better income live.

Figure 3: Model 4 variance function per level, 95% confidence for districts and for people within districts and variance portioning coefficient

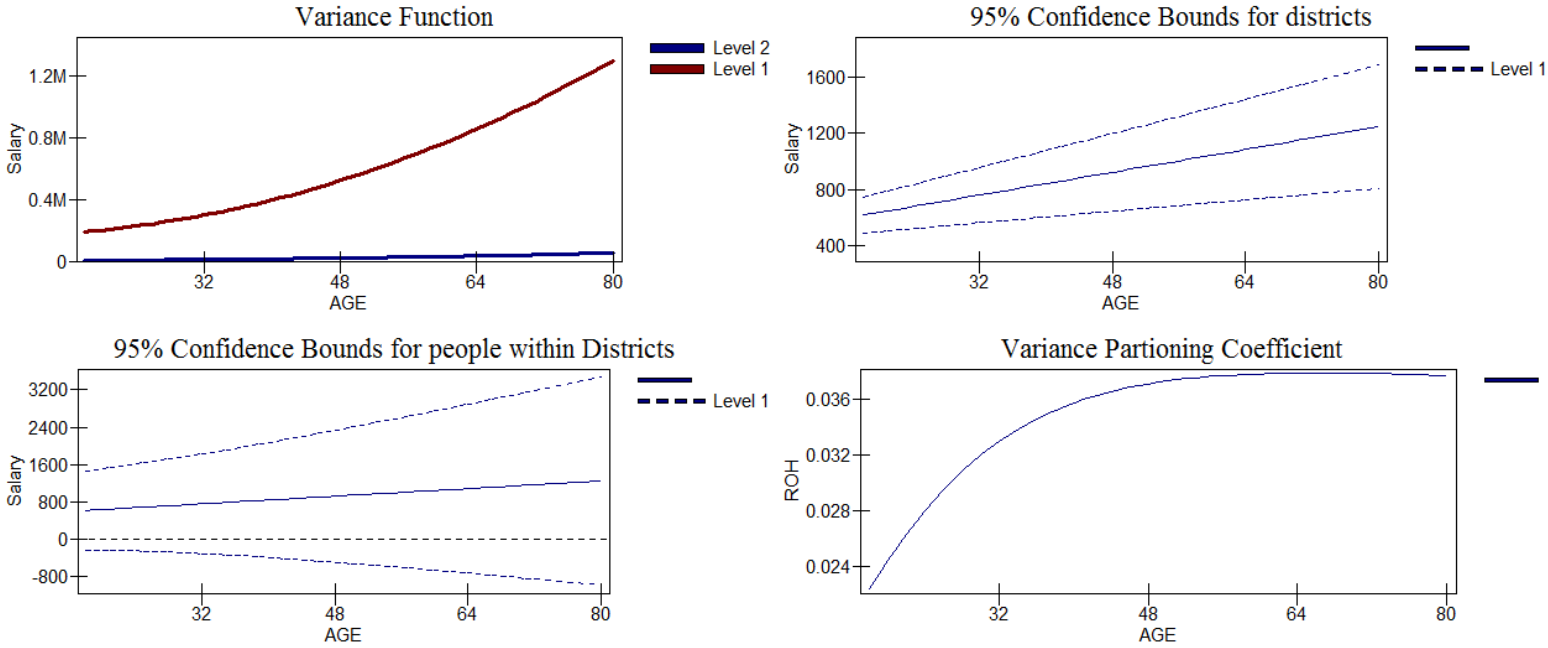

Figure 4 shows that the variance function for level 1 (salary of people within districts) has an exponential relationship with age. Meanwhile, the relationship in salary accounting for age between districts seems to have more of a constant shape. Furthermore, the 95% confidence bounds for districts reinforces this idea which shows that the confidence bounds of the salary while controlling age remain almost parallel to the grand mean income of people between districts. In spite of that, the people that live in districts, which have people that have a higher income will have a better income while becoming older. This same pattern happens in people that live in districts that people earn less than the gran mean. In spite of that, the slope of the confidence bounds of the less income districts is smaller than the one of the highest income districts.

In the case of confidence bounds for people within districts, while the grand mean of income remains almost constant while the age of people increase, this line has a slight slope that shows an increase of the grand mean threw a higher age. Interestingly, the confidence bounds for income become bigger while controlling age. There is a clear fanning out. Therefore, there is a difference in the salary of people inside the districts by accounting for age. In higher income districts the older persons earn more than the youngest ones. In the case of lower income districts, the youngest persons tend to earn more than the older ones.

The last graph shows the variance partitioning coefficient which shows there is a clear logarithmic function on the relationship between age and the proportion of covariance from the total variance (ROH). In that case, older people differ more in general than younger people and districts matter more for older people than younger people. Finally, If the variance partitioning function is calculated it is possible to say that 3.4% of the variation in the model accounting for age lies at the higher district level.

Discussion

The principal findings of this study show that there is a sign of inequality for income between districts while controlling age. Therefore, age does account for inequalities in income between districts. In richer districts a person can earn more money if the person is older. Meanwhile, within poorer districts the person can even start to earn less money while he or she becomes older. Overall there is a bigger difference in income in older people than in younger people and this difference becomes much higher when comparing for districts. A Peruvian study also had similar results while comparing the whole country, where older high school educated people proved to have wage loss while becoming older and younger people have experienced more earnings[11]. This study findings complement the previous mentioned results and give the idea that the loss of wages for older people are being more in poorer districts

than in richer ones. These results are similar to an African and Vietnamese studies that showed similar results to this one, that inequality is present in people that do labor and not from people that own lands[16,17], or in the case of this study people that owe companies or lands. In spite of that, these results differ from a study about land distribution in Africa were inequalities were not due to geographical factors[18].

Furthermore, in richer districts having an extra year can mean that the person can even have a better income. But in the poorest districts age is not that impactful for an increase in income. These results reinforce the idea of inequalities in income between richer and poorer districts in Lima. One possible explanation can be economical polarization were people get clustered in different groups or in this case districts. In that case, people with higher incomes and opportunities will go to richer places where experience and knowledge of skills is well valued[19], meanwhile people with less opportunities is forced to leave in vulnerable and poorer districts as a way of being segregated[20, 21]. In the case of poorer districts, as a result of less income in the district and less demand of older employess, experience does not have a strong effect on higher salaries[22].

The richer districts in Lima are “La Perla” “Bellavista” and “San Isidro” meanwhile, the poorest ones are “El Agustino” and second poorest “Pachacamac” accounting by age. This could be explained by the geographical citing of every district. First of all, the richest districts named before all are very near the sea, meanwhile the poorest ones are more further apart[23]. This can give working opportunities for people to work on companies near the harbor and do not need a lot of extremely educated employees.

Morevoer, “San Isidro” is one of the richest districts in Lima, where there is the highest production of all the city. Meanwhile, “El Agustino” is one of the districts with the least production of all the districts in the city[5]. Therefore, it is possible that a lack of money around the district also affects the income of people and that in the case of “El Agustino” older people are the ones that are

having a more trouble of finding or keeping a job. Moreover, due to climate and soil erosion it is possible that people with less income moved to poorer and more vulnerable districts to earth erosion and climate change as mean of having a place to live. Therefore, the immigration of poorer people, the fact that some districts are vulnerable to climatic changes (like “El Agustino”) could also enhance a decrease in income[24].

The strength of this study was that by using a multilevel analysis it is possible to see how income varies by controlling age for each district in Lima. Therefore, it is possible to compare districts around the grand mean of income of all the city because the income of every district is being aloud to vary threw the grand mean income of the city. Therefore, it is more precise than single level studies that separate lines for every district independently for one another. A randomized sample of people gives also the option to try to extrapolate these findings for people that had a similar description as the sample analyzed in this paper.

Some limitations of the study is regarding the dependent variable. It is always difficult to measure income especially if it is asked the last month. There could be people that do not remember specifically how much they earned the previous month. Moreover, some people in Peru are paid with food and should valorize that in Nuevos Soles, which can be biased. Another difficulty is that this study cannot generalize to the people in all Lima or all Peru, it can only draw conclusions from people that has high school studies, a part time job or more and that is 18 years or older for age. Moreover, as a result of sample invariance in some districts the random slopes were not significant in the last model. Besides, type of Job was not controlled in this study, it is possible that controlling for this variable would give further results of difference in variance in income between districts by accounting for age. Also, it is important to take into account that it is very difficult to study income inequality with summary measures of income[25].

Future studies could focus on answering some questions that this paper leaves. It would be interesting to study the variance difference between types of job in income and age in all districts in Lima. Moreover, it would also be noteworthy to widen up the spectrum and incorporate people that have higher educational studies in order to see the difference in income between people with better educational studies and how they vary between each district of Lima.

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